Pushed to the limit: Evidence of climate change-related loss and damage when people face constraints and limits to adaptation

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Pushed to the limit: Evidence of climate change-related loss and damage when people face constraints and limits to adaptation

Volume 2

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Abbreviations and acronyms

ACPC	*African Climate Policy Centre*
AR5	*IPCC Fifth Assessment Report*
BS	*Bikram Samwat (year in Nepalese calendar)*
CDKN	*Climate and Development Knowledge Network*
CEO	*Chief Executive Officer*
CIESIN	*Center for International Earth Science Information Network*
COP	*Conference of the Parties*
CPN-UML	*Communist Party of Nepal (Unified Marxist–Leninist)*
FAO	*Food and Agriculture Organization (UN)*
FCFA	*Franc de la Communauté Financière d'Afrique*
GHG	*Greenhouse gas*
IDS-Nepal	*Integrated Development Society Nepal*
IPCC	*Intergovernmental Panel on Climate Change*
LDCs	*Least Developed Countries*
NAPA	*National Adaptation Programme of Action*
NGO	*Non-governmental organization*
PRA	*Participatory Research Approach*
RCP	*Representative Concentration Pathways*
SPM	*Summary for Policy Makers*
SREX	*Special Report on Managing Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*
UN	*United Nations*
UNDP	*United Nations Development Programme*
UNECA	*United Nations Economic Commission for Africa*
UNFCCC	*United Nations Framework Convention on Climate Change*
UNU	*United Nations University*
UNU-EHS	*United Nations University Institute for Environment and Human Security*
UNU-ViE	*United Nations University Vice Rectorate in Europe*
VDC	*Village Development Committee*
WCED	*World Commission on Environment and Development*

Executive summary

At the climate negotiations in Warsaw, Poland (Conference of the Parties (COP) 19th session – COP19) in December 2013, there is a mandate to establish institutional arrangements to address loss and damage associated with the impacts of climate change[1] (UNFCCC, 2012), including functions and modalities (ibid, paras 7 and 10). It is envisaged that the work on loss and damage under the UN Framework on Climate Change Convention (UNFCCC) will contribute to the formulation of the anticipated *international climate agreement at COP21* (Paris, December 2015). This report provides evidence that will help underpin policy and operational discussions.

What is loss and damage?

'Loss and damage' is a concept that has gained renewed interest in climate policy since the establishment of a work programme on the topic at the 16th UNFCCC Conference of the Parties in Cancun, Mexico in December 2010. The topic has gained further interest from 2012 onwards, as a mandate was given to establish institutional arrangements to address loss and damage at COP19 in Warsaw (2013). Definitions of the term vary. For this report, the research team used the following working definition of loss and damage, which includes the inability to respond adequately to climate stressors and the costs and adverse effects associated with the adaptation and coping measures themselves:

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.

Why is understanding loss and damage important now?

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. Loss and damage undermines adaptation, and can impede progress in improving human well-being. Yet there is currently a lack of empirical evidence of the circumstances under which households manage climatic stressors, the resulting societal impacts, and the loss and damage that results from not being able to adjust sufficiently. Policymakers need better information, empirical data and analysis of both the challenges and the potential solutions.

What was the key research question?

Each case study attempted to answer the same research question, while focusing on different climatic stressors and societal impacts (see Table 1). The central research question was:

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

Stressors include extreme weather events and slow-onset climatic changes. Societal impacts involve negative effects on livelihoods and physical assets and other aspects of human well-being, such as housing and health.

1 Paragraph 9 of the Doha Climate Gateway decision reads: "Decides to establish, at its nineteenth session, institutional arrangements, such as an international mechanism, including functions and modalities, elaborated in accordance with the role of the Convention as defined in paragraph 5 above, to address loss and damage associated with the impacts of climate change in developing countries that are particularly vulnerable to the adverse effects of climate change."

Which countries were surveyed and why?

Nine case studies were conducted in least developed and other developing countries. These countries were chosen after a call for proposals from research institutes in developing countries. The sites were selected to cover a wide range of ecosystems, geographic regions (drylands, mountains, a small island, a delta) and climatic stressors (droughts, floods, cyclones, sea-level rise, glacial melt, desertification, changing rainfall patterns) as well as dependence of livelihoods on climate conditions (e.g. rainfed agriculture, fishing, herding). Other important considerations included exploring cross-cutting issues related to climate stressors, such as food production, human and livelihood security, social justice and cohesion, and human mobility.

What was the methodology?

Research was undertaken using a combination of of scientific methods, combining qualitative and quantitative research tools. In addition, meteorological data and other relevant data sources were compared to local perceptions of climatic threats. The research gathered a large volume of data (n=3,269 household surveys, and an additional 100 focus group discussions and expert interviews) on climatic stressors, societal impacts, current adaptation and coping measures, and residual loss and damage affecting households. The research approach developed for the Loss and Damage in Vulnerable Countries Initiative is a *model for community-based assessments of loss and damage.*

Country	District/Region	Climate-related stressor	Societal impact focus*	Sample size
Bangladesh	Sathkira	Salinity intrusion	Rice + drinking water	360
Bhutan	Punakha	Changing monsoon	Rice production	273
Burkina Faso	Sahel	Drought	Livestock + crops	465
Ethiopia	Gambella	Flooding	Habitability + livelihood	431
Gambia	North Bank	Drought	Millet production	373
Kenya	Budalangi	Flooding	Crops, livestock + fish	400
Micronesia	Kosrae	Coastal erosion	Housing, livelihood	363
Mozambique	South & Central	Drought and flood	Staple crops	304
Nepal	Udayapur	Flooding	Agricultural livelihood	300

* Each case study focused on one or more particular impact sectors, but also registered impacts in other sectors.

Table 1: Overview of the case studies: Research area, climate threat, societal impact and sample size. Source: Authors.

What are the limitations of the research?

- Attribution of local climatic changes and extreme events to global warming is beyond the scope of this research;
- No attempt was made to estimate total monetary loss and damage at local, national or global scales;
- The local case studies are not necessarily representative of entire countries;
- Findings do not support or negate any particular position on loss and damage in the UNFCCC climate negotiations, but rather offer evidence that will support policymakers in their discussions about underlying needs that might inform a host of solutions;
- The study and its methods should be treated as points of departure for further research on loss and damage in vulnerable communities.

Instead, this 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 Fifth 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 address them. It relied on 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. They focus on the impacts of climate threats on people in vulnerable areas and their responses to such threats.

What is new about the findings on loss and damage at community level?

For the first time, the research presented in Volumes 1 and 2 of the UNU study offers empirical *evidence of loss and damage from the perspective of affected people in nine vulnerable countries.* The research reveals how climatic stressors affect communities, what measures households take to prevent loss and damage, and what the consequences are when they are unable to adjust sufficiently.

The first set of case studies (Volume 1) reported on findings about loss and damage in Bangladesh, Bhutan, the Gambia, Kenya and Micronesia and was presented at COP18 in Doha (Warner et al., 2012b). This second set of case studies (Volume 2) presents four additional case studies (Burkina Faso, Ethiopia, Mozambique and Nepal), further insights on loss and damage, and a focus on adaptation limits and non-economic losses (e.g. cultural losses). Together, the nine cases examine a broad range of extreme weather events as well as slow-onset climatic changes.

What are the most important findings of the study?

New empirical evidence from nine research sites presented in Volume 1 (Warner et al., 2012b) and Volume 2 (this publication) shows that loss and damage occurs when there are barriers that impede planning and implementation of adaptation, and when physical and social limits to adaptation are reached or exceeded.

Across the nine research sites, households struggle to manage climatic stressors on their household economy and their livelihoods. Despite their efforts to cope with the impacts of extreme weather events and to adapt to slow-onset climatic changes, many incurred residual impacts that they could not adequately manage. Some of the most notable impacts were on household 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 which impede sustainable development.

Residual impacts include deepening poverty and the erosion of household living standards and health. Residual impacts related to climate stressors happen when:

- existing coping/adaptation to the climatic, biophysical impact is *not enough* to avoid loss and damage;
- measures to adjust to climatic stressors 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 that undermine sustainable development – health, education, resilience);
- *no measures* are adopted – or possible – at all.

The case studies provide new evidence supporting the validity of these pathways and illustrate how people are affected when the limits to coping and adaptive capacity are surpassed. The new research links 'loss and damage' explicitly to the literature about adaptation limits and non-economic losses. Findings indicate that people are caught in the first two loss and damage pathways when they face constraints and limits to their ability to adjust to climatic stressors. The types of loss and damage that result from the third and fourth pathway often go beyond material losses, and touch upon people's food and livelihood security, social cohesion, culture and identity – values that contribute to the functioning of society, but which elude monetary valuation.

This evidence suggests that loss and damage happens concurrently with adaptation. If adaptation is insufficient to manage climatic stressors, loss and damage can undermine human well-being and adaptive capacity. In addition, loss and damage when there are physical and social limits to adaptation is likely to push society towards intolerable risks, and at some scales this is already happening. If ambitious mitigation and adaptation are insufficient to manage climate stressors, loss and damage can render society unable to achieve development objectives. Addressing loss and damage around limits will involve accepting escalating loss and damage, require shifting societal objectives, and could involve disruptive shocks. Transformative approaches are essential to soften these transitions.

The 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 households that adopted measures reported that they were still experiencing adverse effects of changing monsoon patterns despite the adaptation measures. Similar results were found, albeit with a variety of different coping and adaptation measures, for all the other case studies. Of the households that adopted such measures, in Micronesia 92 per cent said they were still experiencing adverse effects of the climatic stressor and resulting impacts on household development; in Bangladesh the figure was 70 per cent, in Kenya 72 per cent and in Gambia 66 per cent.

Country	Climate-related stressor	(a) Experienced stressor (%)	(b) Impact on household economy (%)	(c) Adopted measures (%)	(d) Impact despite measures (%)	(e) Experienced loss and damage (%)
		(a)	(b)	(c)	(d)	(e)
Bangladesh	Salinity intrusion	99	99	81	70	74
Bhutan	Changing monsoon	91	89	88	87	72
Burkina Faso	Drought	98	99	79	72	76
Ethiopia	Flood	100	100	98	96	96
Gambia	Drought	100	97	93	66	66
Kenya	Flood	100	98	93	72	72
Micronesia	Coastal erosion	87	80	60	92	66
Mozambique	Drought/flood	100	99	93	69	70
Nepal	Flood	97	74	72	78	60
Median		99	98	88	72	72

Table 2: Stressors, impact, responses and loss and damage (% of households). Source: Loss and Damage case studies fieldwork (2012).

Notes: Column (b) is a proportion of the households in column (a); column (c) is a proportion of those in column (b); and column (d) is a proportion of those in column (c). 'Loss and damage' in column (e) is calculated as: e = (a*b*c*d) + (1-a*b*c), where the letters stand for the percentages in the corresponding columns. In words, it is the proportion of the whole survey population that experienced adverse effects despite adopting measures to cope or adapt plus those who were affected but who did not adopt any measures in response.

The evidence presented here illustrates the kinds of signals that are already being registered (through empirical evidence, modelling, and other scientific tools) – growing food insecurity, difficulties with stable water supplies, deteriorating conditions of human welfare and increasing manifestation of erosive coping measures (such as eating less, investing less in assets needed for development, reducing the years of schooling for children, etc.). The case studies provide evidence that some 'soft' and 'hard' *limits to adaptation are being approached*. This publication sheds light on what the consequences of these limits to adaptation mean for vulnerable communities today, and what the consequences could be at different scales in the future. These insights point the way towards options for managing loss and damage now and in the future.

What does loss and damage mean for sustainable development?

Climate change poses a moderate threat today to current sustainable development. Already, research documents the fact that many countries and communities worldwide are unable to adapt to changes in climate patterns and because of this they experience loss and damage. This includes an inability to respond to climate stressors (i.e. the costs of inaction), the insufficiency of responses and the costs associated with existing coping and adaptive strategies (e.g. erosive coping strategies and maladaptation). 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. Climate change poses a severe threat to future sustainable development. Emerging science suggests that dangerous climate change is becoming a greater possibility, and fossil fuel consumption and trends point towards a +4° world, spawning discussions of *how to manage this loss and damage*, which may become increasingly challenging to adjust to (Warner et al., 2012b; Dow et al., 2013; Oliver-Smith et al.,). Loss and damage related to climate change impacts is – and will increasingly be – the outcome of unsustainable economic activity and carbon-intensive development models.

Policy reflections: loss and damage discussions can drive transitions and transformation

The IPCC´s Working Group 1 Summary for Policy Makers (IPCC 5AR WG1 SPM) indicates that climate change impacts are accelerating, and most aspects of climate change will "persist for many centuries even if emissions of CO2 are stopped. This represents a substantial multi-century climate change commitment created by past, present, and future emissions of CO2." From the findings of the IPCC Special Report on Extreme Events (SREX) and the emerging results of the IPCC Fifth Assessment Report, it becomes evident that managing the risks associated with climate change-related loss and damage is crucial because of the irreversible threats these losses pose to sustainable development.

Current loss and damage patterns – illustrated by the evidence featured in this research from Least Developed Countries, Small Island Developing States, and African countries – strike at the very purpose of climate policy: to avoid dangerous climate change and ensure the possibility of timely adaption so as not to impede food production and sustainable development. Loss and damage patterns revealed in the case studies in this report illustrate that people in vulnerable countries already appear to be approaching the biophysical and social boundaries of adaptation, beyond which climate change compromises sustainable development.

Managing the risks associated with climate change-related loss and damage is crucial because of the irreversible threats these losses pose to sustainable development. Failure to address loss and damage in ways that provide smooth transitions could leave society unprepared to manage and adjust to these negative climate change impacts. Addressing loss and damage is about capturing opportunities to ameliorate negative climate impacts on our most important goal: improving human well-being. The work on loss and damage is a major opportunity to provide guidance on transformation.

This should also be reflected in the November 2013 discussions to institutionalise the response to loss and damage at COP19 in Warsaw.

- As part of loss and damage discussions, the UNFCCC process itself will have to install a reflection point that will help to transform the objectives and functions of climate policy. This should include consistent feedback on the state of necessary adaptation vis-à-vis existing mitigation pathways. It should also be used for discussions on the wider implications of a failure to adequately address mitigation and adaptation.

- International and regional policy must facilitate a broader transformation discourse among actors shaping the risk response and management as well as among further development actors. This could take shape through providing understanding, cooperation and coordination and the facilitation of support for developing counties – the identified roles of the UNFCCC in addressing loss and damage.

- Discussions on loss and damage must facilitate a transformation impact of international support. This should strengthen transformative uses of climate, development, humanitarian, and other financial resources and soften the distributional aspects of increasing climate change risks. Finally, the magnitude and volatility of climate-related risks is likely to overwhelm national, and in some cases regional, capacities. Such risks and their impacts on development priorities cannot be addressed through national adaptation processes alone. The functions of managing volatility and shocks, and developing tools for smooth transitions, require further elaboration. One such concrete approach that could be championed through a Warsaw decision would be international leadership and guidance in the operationalisation of climate risk management. Regional climate risk management platforms with international guidance would bring together assessment of the risk landscape and provide a role for tools such as risk transfer (insurance-related approaches). Regional operationalization of approaches to address loss and damage can facilitate the political buy-in necessary to undertake further measures to address economic and non-economic loss and damage in transformative ways.


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1. Framing loss and damage: human well-being, constraints, and limits to adaptation

At the climate negotiations in Warsaw, Poland (Conference of the Parties (COP) 19th session – COP19) in December 2013, a mandate has been given to establish institutional arrangements to address loss and damage associated with the impacts of climate change[1] (UNFCCC, 2012), including functions and modalities (ibid, paras 5, 6, 7, 9 and 10). It is envisaged that the work on loss and damage under the UNFCCC will contribute to the formulation of the anticipated *international climate agreement at COP21* (Paris, December 2015). This report provides evidence that will help underpin policy and operational discussions.

The research findings presented in this report illustrate that communities in different geographic areas already face constraints and limits that prevent them from fully adjusting to current and expected negative impacts of climate change. A key question – and the focus of this report – is what happens to key development goals when efforts to adjust are insufficient or not possible? What patterns of loss and damage emerge in human systems around these barriers and constraints to adaptation?

2 Paragraph 9 of the Doha Climate Gateway decision reads: "Decides to establish, at its nineteenth session, institutional arrangements, such as an international mechanism, including functions and modalities, elaborated in accordance with the role of the Convention as defined in paragraph 5 above, to address loss and damage associated with the impacts of climate change in developing countries that are particularly vulnerable to the adverse effects of climate change."

This report contributes to discussions that critically examine the needs that will have to be addressed in the future, the perspectives that shape how loss and damage will be addressed, and the repercussions in policy and practice.

The case studies on local loss and damage in nine countries, presented in Volume 1 and Volume 2 (here), contribute to this understanding, in the spirit of paragraph 7a (iii and v) from the Doha Climate Gateway Decision, which underscores the importance of understanding:

(iii) How loss and damage associated with the adverse effects of climate change affects those segments of the population that are already vulnerable owing to geography, gender, age, indigenous or minority status, or disability, and how the implementation of approaches to address loss and damage can benefit those segments of the population;

… and …

(v) How approaches to address loss and damage associated with the impacts of climate change may be integrated into climate-resilient development processes;

1.1 Climate science and sustainable development

Safe operating space for humanity

Science points to widespread current and future biophysical impacts of anthropogenic climate change (Intergovernmental Panel on Climate Change (IPCC) 2007a, 2007b, 2012; Fung et al., 2010; Thornton et al., 2011).

Article 2 of the UNFCCC outlines its ultimate objective as the, *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system… in order 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"*. One way to think about Article 2 is of maintaining a "safe operating space" (Röckstrom et al., 2009) for humanity.

Most decision makers today recognise the importance of assessing and managing the negative impacts of climate change. It is increasingly acknowledged that current measures to adjust to climate changes are not enough to avoid negative consequences for societies and the natural systems upon which day depend. In the UNFCCC context, this is being referred to by some as "residual impacts of climate change", or "loss and damage". In the future, increasing impacts from combinations of extreme weather and slow-onset climatic processes are expected to induce even more loss and damage. The body of scientific evidence from climate science establishes that there are already detectable climate impacts at different scales. Modelling and analysis suggest the possibility that earth systems may be moving towards a '4 degree world', rather than one that stabilises around 450ppm or 1.5 to 2 degrees (the current political goal internationally). This possibility has dire implications for food production and sustainable development (poverty, livelihoods, health) – all development goals that are climate sensitive. Box 1 outlines some of the anticipated consequences of these impacts for human society and the natural systems upon which they depend for survival.

Framing loss and damage in terms of the overarching policy goal: improving human well-being

To be able to adequately design policies and practice to address loss and damage that are nuanced and fit-for-purpose, it is necessary to get more conceptual clarity on how to frame loss and damage. Consideration of climate change-related loss and damage becomes more meaningful when embedded in a discussion about socially defined objectives and values. This is because how loss and damage is understood, as well as how it is measuered,

depends on how the things that will be lost or damaged are valued. Thus, a place to begin discussion on loss and damage is what has been articulated as the major objectives and goals of international and national policy today – arguably maintaining and improving human welfare.

Different actors use the concept of 'sustainable development' to pursue a variety of objectives in policy and practice worldwide, with the common denominator of delivering improved human welfare. 'Sustainable development' is rooted in concerns about balance in the relationships between society and nature, as noted in The Brundtland Report (WCED, 1987, p. 43): "development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts of 'needs', in particular the essential needs of the world's most vulnerable, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

How constraints and limits to adaptation affect human well-being

While systems will continually change and adjust to stressors (Adger et al., 2003), 'adaptation deficits' (Burton, 2009), barriers, and limits to adaptation exist and can impede sustainable development (Preston et al., 2013; Kates et al., 2012; Schipper, 2007; McGray et al., 2007). To explore the state of knowledge on these concepts, the IPCC Fifth Assessment Report (AR5) (Working Group II) is assessing the state of knowledge about adaptation for issues like human security, poverty, urban and rural areas, food production systems, etc. One of the new themes in AR5 is "constraints and limits to adaptation"– where "adaptation constraints" are factors that make it harder to plan and implement adaptation actions, and "adaptation limits" are the point at which actors are unable to secure objectives from *intolerable risks* through adaptive action (Dow et al., 2013).

New insights (Dow et al., 2013) show that there are constraints and limits to the kinds of adjustments that can be made to avoid the negative effects of climate stressors. This applies to people as well as companies and governments. *Adaptation constraints* are the kinds of things that make it harder to plan for and implement adaptation. That may be a lack of resources, lack of information or lack of appropriate governance and coordination structures. Existing institutions and processes that address adaptation – within the UNFCCC, and in the 'real world' – can significantly reduce constraints to adaptation. By contrast, *adaptation limits* are much harder to address. Adaptation limits are the boundaries of what households, companies, communities or countries ('actors') are able to adjust to without intolerable risks to key objectives such as food security and other fundamental human rights. Such limits occur when the magnitude, frequency and scale of climate stressors is beyond actors' capacity to adress them adequately. Whereas adaptation limits are often thought of as something hypothetical, many people in vulnerable situations are already encountering and crossing their adaptation limits.

Definitions

Constraints to adaptation (Dow et al., 2013): factors that make it harder to plan and implement adaptation actions.

Limits to adaptation (Dow et al., 2013): the point at which an actor is unable to secure objectives from intolerable risks through adaptive action. At a limit there are three options: 1) accept escalating losses; 2) shift objectives; or 3) discontinue/transform responses

Loss and damage (Warner and van der Geest, 2013): negative effects of climate variability and climate change that people have not been able to cope with or adapt to.

When a household, community or country is not able to adjust sufficiently to climate stressors, it faces adaptation limits or constraints that result in loss and damage. Loss and damage is what happens to people when they cannot avoid negative impacts from climate change, when they cannot adjust enough or when adjustment comes with substantial costs – whether monetary or non-monetary, immediate or longer term. Added to this, are the opportunity costs of adaptation measures at higher levels of scale – that is, money spent on adaptation is unavailable for spending on other development objectives.

1.2 Loss and damage when there are barriers to planning and implementation of adaptation

As the evidence in these case studies (Volumes 1 and 2) illustrates, *loss and damage happens concurrently with adaptation.* Some negative climate-related impacts on development are already being observed (e.g. changes in agriculture, increases in coastal vulnerability), even though adaptation efforts are underway. Negotiating these boundaries is, in part, a task of adaptation, the success of which may lie in the ability to keep systems from exceeding these boundaries (Moser, 2009; Patt and Schröter, 2009; Adger et al., 2009). These *negative impacts in turn affect the ability to plan and implement adaptation at community*, provincial, country and even regional levels.

If adaptation is insufficient to manage climatic stressors, loss and damage can undermine human well-being and adaptive capacity. Loss and damage can undermine the ability to plan and implement adaptation, which can lead to more loss and damage, which in turn can further undermine the ability to plan and implement adaptation. There are at least three ways that loss and damage interacts with and undermines adaptation (which may require a policy response that goes beyond current adaptation efforts):

- In many places around the world today, *autonomous and planned adaptations to climatic stressors are not enough to avoid loss and damage.*
- Measures adopted to cope with impacts of extreme weather events and to adapt to slow-onset climatic changes *often have costs themselves and adaptation efforts become increasingly costly and difficult to undertake.* These costs can be both monetary and non-monetary.
- While adaptation measures in many places have short-term merits, insufficient adaptation *because of constraints/barriers and limits can mean there are adverse long-term effects* that contribute to loss and damage.

1.3 Loss and damage when there are physical and social limits to adaptation

When there are physical and social limits to adaptation, society is pushed towards intolerable risks; at some scales this is already happening. There are physical and social boundaries that broadly define a 'safe operating space' for humanity. Institutions today are designed to operate within these boundaries, but gaps already appear with increasing climatic and other stressors. If these boundaries are passed, new gaps will emerge that require policy responses. Loss and damage patterns appear when affected people, institutions and different administrative levels (such as communities, state governments, regions) are unable to secure their objectives (e.g. poverty reduction, health, or livelihood and food security) through adaptive action. Loss and damage in scenarios where there are physical and social limits to adaptation are likely to push society towards intolerable risks.

If ambitious mitigation and adaptation are insufficient to manage climate stressors, *loss and damage can render society unable to achieve development objectives.*

There are already factors that severely limit the possibilities of adjusting to climate change without accepting some loss and damage, changing societal objectives, or undertaking transformation. Social and political factors as well as the sheer scale of climatic stressors (ocean acidification, sea-level rise, widespread climatic shifts, temperature thresholds for plants and animals, etc.), mean that some actors will be unable to secure development objectives without significant disruptions. They will face *escalating losses* and might need to *shift their objectives*. Changing societal objectives often involves a deteriorating standard of living, the loss of cultural values, and the disintegration of commonly held values and practices in the community. Accepting loss and damage often means falling incomes, assets, education levels and social status, along with greater poverty, lower food consumption and diminished future prospects. For example, undertaking more significant transformation can involve more permanent migration out of one's home area, leading to other significant changes in livelihood and social systems. The consequences of loss and damage associated with inability to adapt to intolerable risks are expected to be both short and long term, and increasingly larger scale no longer limited to local, national or regional loss and damage. Some consequences may be reversible, but many large-scale consequences may be irreversible (e.g. loss of livelihood and food production systems, deepening and widening poverty, health, water, etc.).

Addressing loss and damage in scenarios where physical and social limits to adaptation are approached or exceeded will involve accepting escalating loss and damage, will require societies to shift their objectives, and could involve disruptive changes and responses (e.g. Dow et al., 2012; Preston et al., 2013). The most effective way to avoid these three associated issues around limits to adaptation is to adopt ambitious and timely mitigation. Additionally, transformative actions (Kates et al., 2012) are needed to soften and manage transitions (as opposed to accepting more disruptive, complete loss).

1.4 Additional framing elements for discussions of managing loss and damage

Loss and damage continuum

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 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 floods. 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.[3]

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.

3 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 clearly defined . The climate stimuli above interact in complex ways, and also interact with human systems in ways that drive loss and damage.

Human and natural systems

Loss and damage refers to impacts on human systems – impacts that 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 (such as 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 loss and damage, which occurs through natural system shifts and their effects on human systems.

2. Methods of generating empirical evidence

The Doha Climate Gateway Decision on loss and damage noted the need to enhance understanding of the issue with the purpose of informing further work to address the gaps and challenges. In particular, paragraph 6(f) notes the importance of "involving vulnerable communities and populations, and civil society, the private sector and other relevant stakeholders, in the assessment of and response to loss and damage". The research approach developed for the Loss and Damage in Vulnerable Countries Initiative is a *model for community-based assessment of loss and damage*. The research presented here generated original data from the perspective of people who experience loss and damage today, using a systematic assessment approach that employs a variety of methods, including a household survey, focus group discussions, in-depth interviews with people who had experienced loss and damage, and expert interviews. In addition, local meteorological and other relevant data was gathered and compared to local perceptions of changes in climatic stressors.

The case studies collected primary data during fieldwork. Case study evidence from the nine diverse research sites – five of which were presented in Volume 1 in December 2012 (Warner et al., 2012b) and four of which are presented in this second volume – generated answers to the question *'How does the impact of climate variability and change lead to loss and damage among households in vulnerable countries such as Least Developed Countries and Small Island Developing States?'*

The national research teams gathered a large volume of quantitative and qualitative data from household surveys (n=3,269) and more than 100 focus group discussions and open interviews on climatic stressors, societal impacts, current adaptation and coping measures, and residual loss and damage affecting households in the communities studied.

2.1 Objectives of the local loss and damage assessment

The nine case studies on loss and damage at local level had three research goals:

1. To understand how the interaction of climatic variability and climate change with livelihoods (and other aspects of human well-being, such as 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 begin to understand 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 which 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' that are particularly vulnerable to climatic stressors.

'Loss and damage' is a relatively new term in climate change research, and different research communities are likely to define the term in different ways as the literature develops and matures on the topic. Thus, 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 the inability to respond to climate stresses (i.e. the costs of inaction) and the costs associated with existing coping and adaptive strategies (cf. erosive coping strategies and maladaptation). 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. Loss and damage is an undesirable phenomenon of climate change impacts and does not include the impacts of managing climate change itself, which is discussed under the policy forum of response measures.

The case study research looked 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 households 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, supporting coping and adaptive capacity, and providing social security for people in situations where loss and damage is not avoidable through mitigation or adaptation – in other words, when adaptation limits have been surpassed.

2.2 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 Climate and Development Knowledge Network (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. Besides coping and adaptation, a third type of response involves preventive measures,[4] which received particular attention in the Ethiopia and Nepal case studies, both of which focused on flood impacts.

- (Residual) loss and damage: What are the limits to coping with sudden events? What are the limits to adaptation to more gradual changes? What happens to a household when it cannot cope or adapt further (i.e. the limits of coping and adaptation are exceeded)? What are the effects of climate variability/change that people have not (yet) been able to avoid? These are consequences or 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.

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 and 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 stressor] on [societal impact] lead to loss and damage among households in [location]?

4 The relationship between preventive strategies, coping and adaptation is described in detail in van der Geest, 2004: 20–29.

Country	District/Region	Climate threat	Impact focus	Volume
Ethiopia	Gambella	Flooding	Livelihood	2
Burkina Faso	Sahel	Drought	Livestock + crops	2
Mozambique	South/Central	Floods & drought	Crop production	2
Nepal	Udayapur	Floods	Agricultural livelihoods	2
Bhutan	Punakha	Changing monsoon	Rice production	1
Micronesia	Kosrae	Coastal erosion	Housing and livelihood	1
Bangladesh	Sathkira	Salinity intrusion	Rice + drinking water	1
The Gambia	North Bank	Drought	Crop production	1
Kenya	Budalangi	Flooding	Crops, livestock + fish	1

Table 3: Climate stressors and societal impacts in nine case studies. Source: Authors.

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

Sub-questions

1. What trends in [climatic stressor] 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 stressor] 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 stressor] on [societal impact] vary across households in the area?
    a. the impact varies according to households' vulnerability profile

4. How do households deal with the impact of [climate stressor] on [societal impact]?
    a. preventive measures, risk management
    b. short-term coping with impacts of extreme events
    c. longer-term adapting to more gradual changes

5. What kinds of losses and damages (costs?) are incurred as a result of the impact of [climate stressor] on [societal impact]?
    a. inability to deal with this impact effectively
    b. costs associated with adopted preventive/coping/adaptation measures ?

6. What kinds of losses and damages can be expected as a result of the impact of [climate stressor] on [societal impact] in the next two to three decades?

7. What can be done to reduce loss and damage from [climate stressor]?

2.3 A mixed-method 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 *household 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., 2012a; 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* and *www.lossanddamage.net*.

The loss and damage case studies used a mixed-method approach, combining qualitative research tools (focus group discussions 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, which served as an input to final decisions about

research design and the 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 at generating reliable estimates of the numbers of people in the research areas experiencing different climate change impacts and their strategies to address climate pressures and shocks. The aim of the focus group discussions was to gather information that allowed for a better interpretation of patterns of loss and damage reported by households in the questionnaire data.

Below, the following methods will be described: desk study; household survey; focus group discussions; 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 the research work presented here built on this knowledge. The research also goes 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 465 households was conducted for each case study. A template questionnaire was designed by the project's science coordinator, and national research teams later adapted the template for each case study to suit its thematic focus and the characteristics of local livelihood systems and environments. The questionnaires had approximately ten 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 household and their sources of food and income. The information gathered in this section could be used to create vulnerability profiles, comparing households either 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 optimise the balance between listening to the voices of vulnerable people and being able to quantify how widespread different impacts and responses are. Section 4 contained open questions about differences in vulnerability between men and women, and children and adults. In this section, respondents were also asked to share their ideas about ways to address loss and damage.

Focus group discussions

Focus group discussions 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.

Focus group discussions yielded qualitative information about how climate variability and climate change can lead to loss and damage among local populations. Keywords here are process and pathways of loss and damage. Another advantage of conducting focus group discussions 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 Participatory Research Approach (PRA) sessions and the questionnaire survey, for example about the activities of government agencies and non-governmental organizations (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 of weather-related extreme events and slow-onset changes. These stories form part of the case studies in Chapter 3 of this report.

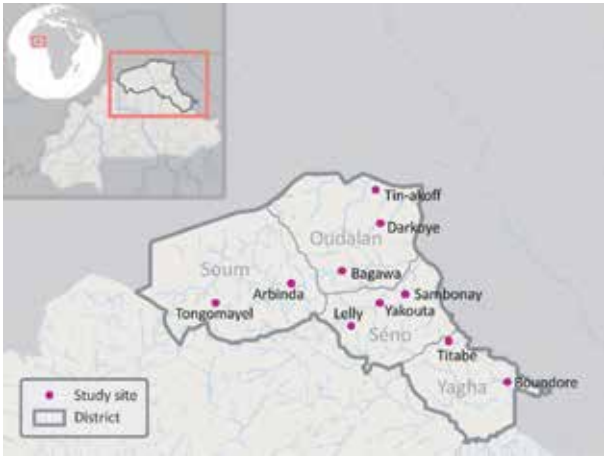
2.4 Fieldwork: team composition and division of labour

Each research team consisted of a principal investigator, a note taker and five to ten questionnaire enumerators. The principal researcher was usually a citizen of the country where the work was done. In the case of Bhutan, Micronesia and Nepal, 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 someone 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

This section summarizes findings from the Loss and Damage in Vulnerable Countries Initiative case studies in Burkina Faso, Ethiopia, Mozambique and Nepal. The findings in this Volume 2 are based on field research conducted in the second half of 2012. Findings from five earlier case studies – in Bangladesh, Bhutan, The Gambia, Kenya and Micronesia – were reported in Volume 1 (Warner et al., 2012b), and are summarized in the last section of this chapter.

Findings from the four case studies are structured as follows: 1) a short summary of the findings; 2) descriptions of the climate-related stressors, impacts, household responses and residual loss and damage; and 3) discussion of policy options in the 'What's Next?' section. Each case study also contains a diagram summarizing findings, boxes with personal stories of loss and damage and thematic maps created for the case studies by CIESIN.



Map 1: The research area in Burkina Faso: Sahel Region. Map created by CIESIN. See technical annex for details.

3.1 Burkina Faso: Loss of pastoral livelihood[5]

The Sahel region of Burkina Faso has a semi-arid climate that is especially prone to drought. In the past, people were primarily pastoralists who dealt with periodic droughts by migrating with their livestock to graze in less affected areas, a practice known as transhumance. However, a study conducted in ten villages found that as a result of intense droughts and population growth, competition over natural resources and loss of pastoral grounds to urbanisation, pastoralists are practising less transhumance, reducing herd sizes and taking up crop cultivation.[6] The adoption of crop cultivation in combination with livestock keeping was expected to diversify the risk that farmers experienced. However, in dry years livestock rely primarily on crops and crop residues for feed in lieu of grazing. Therefore, this livelihood modification does not make households less vulnerable. Instead, it locks them into a fragile system where crop failure, due to drought, results in a cascade of negative impacts. These impacts, including eating fewer meals and the death and sale of livestock, ultimately make households more vulnerable by eroding their capacity to cope with future droughts.

What is the greatest climatic stressor?

Extreme droughts in the north of Burkina Faso have been severely disrupting the livelihoods of those who depend on the land for livestock keeping and crop cultivation. Meteorological data reveals that since the 1970s this region has seen extreme fluctuations in rainfall trends, where the amount of rain has decreased overall but the intensity has increased; for instance, more than 300mm of the average 400mm annual rainfall may occur in less than a month. This concentration of rain in a few short-time periods greatly increases the risk and severity of drought.

What is the impact?

The majority (96 per cent) of respondents reported severe negative impacts on crops and 87 per cent reported severe impacts on livestock following recent droughts, particularly those in 2004 and 2010. The destruction of crops leads to cascading impacts that affect both livestock and household food security. Low or lost harvests decimate livestock, as livestock depend on crops for feed because they cannot graze. This then directly threatens the income and food security of households that depend on their crops and livestock products to meet food and financial needs.

5 More detailed findings from the Burkina Faso case study can be found in Traore et al., 2013.

6 Similar developments were reported in neighbouring Niger (Snorek et al, under review).

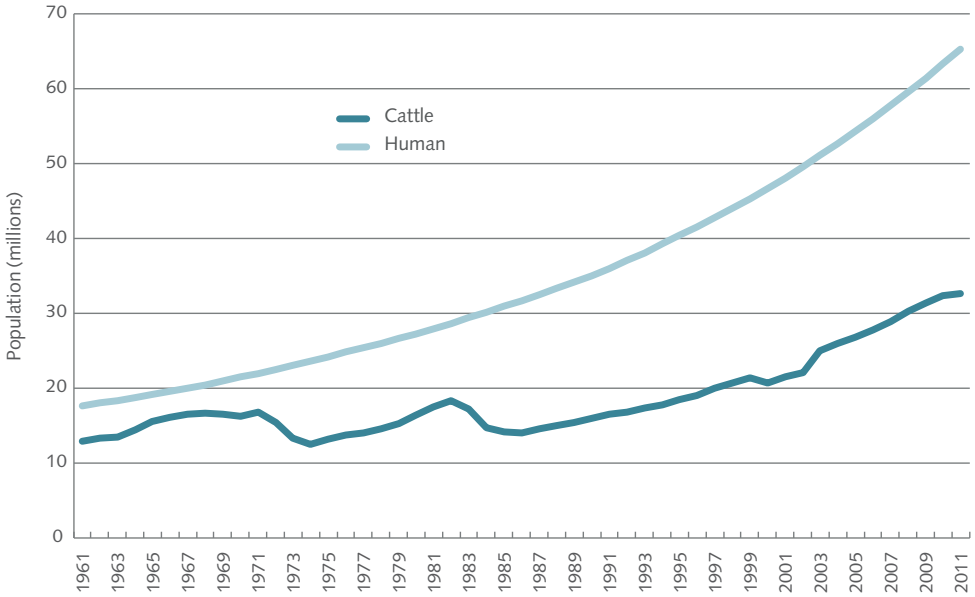


Figure 1: Human and cattle population in five Sahelian countries. Source: Figure by authors with data from FAO-STAT, http://faostat.fao.org/.

Though the focus of the Burkina Faso case study was on more recent droughts, many respondents recalled the extreme droughts and cattle losses of the early 1970s and 1980s. These were drought years, not only in Burkina, but across the Sahel. This figure, based on FAO data for five Sahelian countries – Burkina Faso, Mali, Senegal, Niger and Mauritania – illustrates that these losses are well documented beyond the individual stories that interviewees narrated (see boxes below).

How do affected people deal with drought?

The majority of respondents (79 per cent) attempted to cope with drought impacts by selling property to pay for food for the household. Most of them (62 per cent) reported selling livestock. In the aftermath of drought, livestock is often sold at drastically reduced prices (e.g. one cattle for a single bag of millet), which makes it difficult if not impossible for households to recuperate their losses later. Other households (51per cent) reported receiving food aid from government agencies and NGOs, which was often inadequate and difficult to access from rural areas. Some households also resorted to migration (41 per cent), whereby young people and heads of households migrate to urban centres to earn a meagre income in the informal sector. Some migrate to other countries (e.g. Ivory Coast) to work on cocoa and coffee plantations to sustain their families back home. Despite these attempts to cope with drought impacts, 87 per cent of the households had to severely restrict their food consumption. This is a clear sign that existing coping strategies were not enough to address the impact of these droughts.

What is the loss and damage?

While the sale of livestock to cope with drought provides short-term relief and enables households to buy food, it ultimately erodes their coping capacity in the long-term. As droughts continue to occur regularly and with increased intensity, households become more vulnerable and less able to cope as their limited livestock are continually depleted and not replenished. In addition, the migration of young people and heads of households to work in factories and on plantations carries social costs by separating families and weakening social networks. Last, but not least, the depletion of herds to cope with drought impacts constitutes a severe loss of cultural identity and lifestyle, as illustrated in the boxes below. Most people in the area are Fulani, for whom pastoralism is much more than just a source of food and income: it is a way of life. When a Fulani family loses its herd, it is felt as a disgrace.

What's next?

Households are using a variety of coping strategies; however, these strategies are often inadequate for addressing recurrent drought, especially as household coping capacity is eroded. As a result, there is a need for effective preventive measures to build the coping capacity of rural communities. These measures could include large-scale government programmes to educate farmers on different techniques for feeding livestock during drought, provision of special feed supplements and investment in irrigation infrastructure. Widespread veterinary assistance for livestock is also important, as drought leads to weakened livestock that are vulnerable to disease. Without effective preventive measures, households will continue to erode their coping capacity by resorting to desperate measures such as selling their livestock and migrating to other countries for employment. In addition, government food aid needs to be adjusted to better reach rural agropastoralist farmers, who are the most vulnerable. Often respondents reported that food aid was insufficient or they had to travel long distances to collect it.

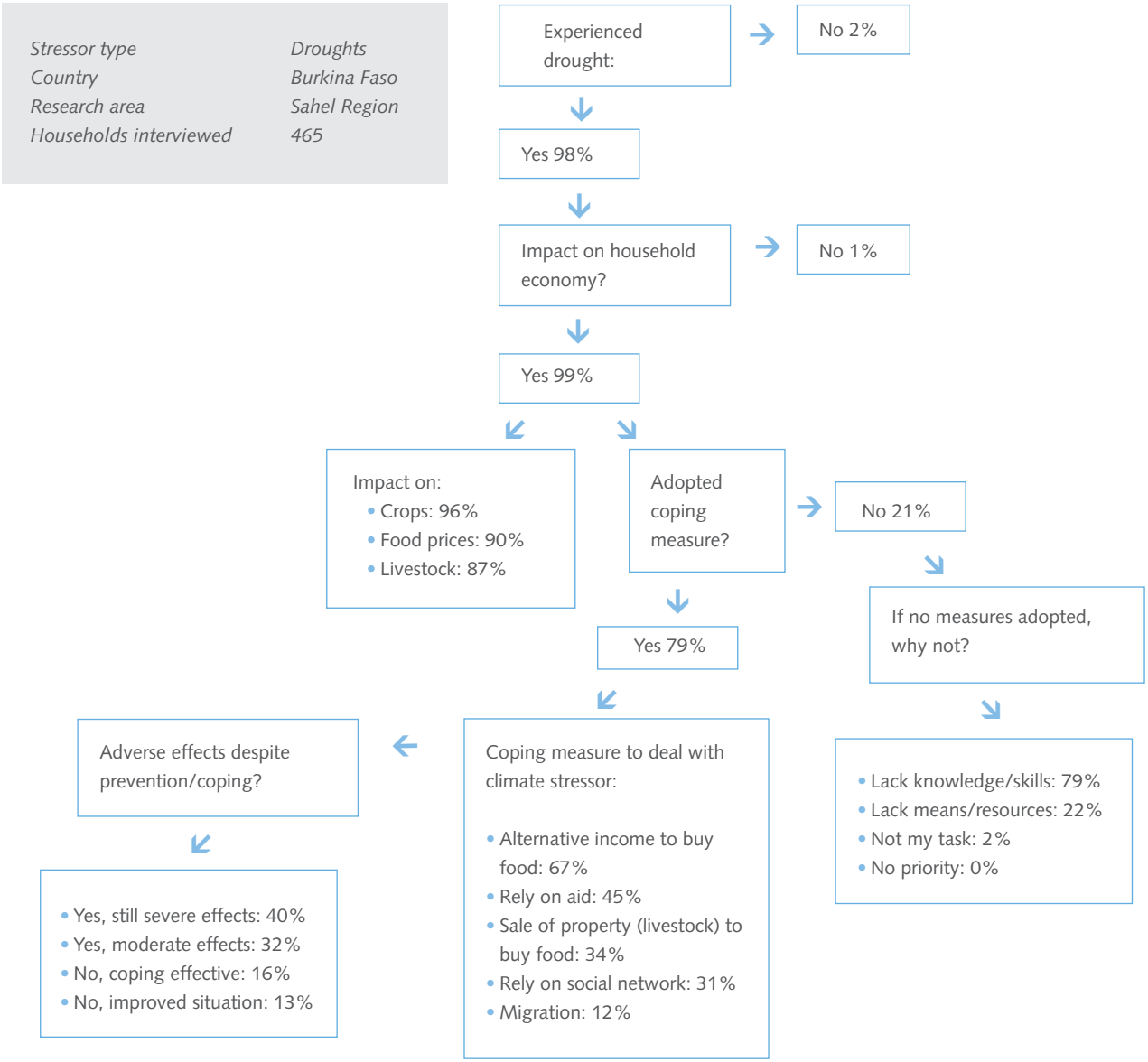
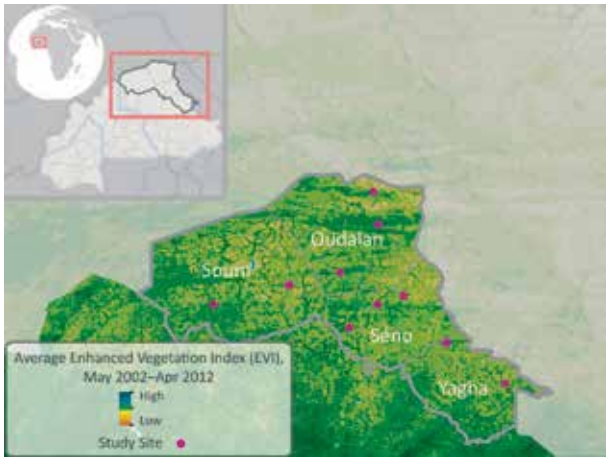


Figure 2: Summary of findings in Burkina Faso.
Source: Fieldwork; questionnaire survey (2012).

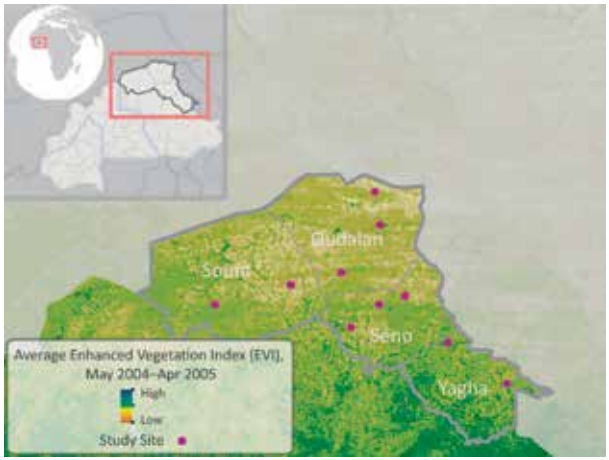
Loss and damage example: traditional livelihood no longer viable in Sahel

"I am Harouna Diallo Hamadou Mamoudou and am 81 years old. I see many changes in the climate here. Rainfall is decreasing, the sun becomes stronger and certain plants and animal are disappearing. My troubles began with the 1984 drought. At that time, I had 117 cattle and 160 small ruminants. I had only six people to take care of. That year, there were only two rains, and because of the drought there was no good pasture for our animals. We were forced to move our cattle to the province of Gourma in the southeast of the country, where the rains had been a bit better. However, there was also lack of pasture due to the arrival of so many herders coming from different regions and countries. Almost all of my cattle died. I returned to the village with only six heads. Of the small ruminants that I left with my first wife and children, only 20 remained. The others died due to lack of fodder and water. It was a situation of extreme distress and dismay that I had never experienced before. Today, I only have one cow and a dozen small ruminants. I have turned to crop cultivation instead of being a pure pastoralist as Fulani tradition prescribes. My needs are increasing day by day, meanwhile my income sources dry up. Until a few years ago, my children used to migrate to Ivory Coast, Niger and Togo. This brought a little support, but they no longer go because of political tensions in these countries. My wives used to cover some household needs by selling milk, but since the loss of my cattle, they only take care of the housework. Nowadays, the things we used to do to make a living are no longer a guarantee of putting food in the bowls. I think that irrigation agriculture in the dry season, animal fattening and trade could liberate the region from its precarious state of food insecurity, but unfortunately most of us do not have the means to take up these activities and become less dependent on rain. The future for our next generation is dark and full of uncertainties with the shrinking of pastures, erratic and declining rainfall, malnutrition, and multiple human and animal diseases. I'd like to end with a local proverb that might give you something to think about. We say: *"If you tell a hungry man to wait for the meal to cool down, he will die before his first bite."*

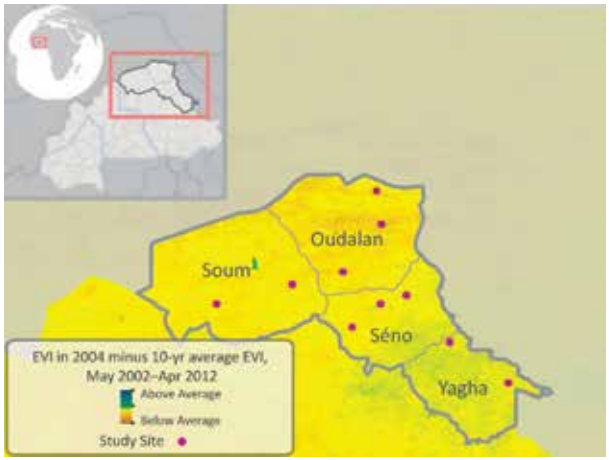
Harouna Diallo Hamadou Mamoudou (born 1931), Village of Titabé, rural commune of Titabé, Yagha Province, Burkina Faso (13.10.2012)



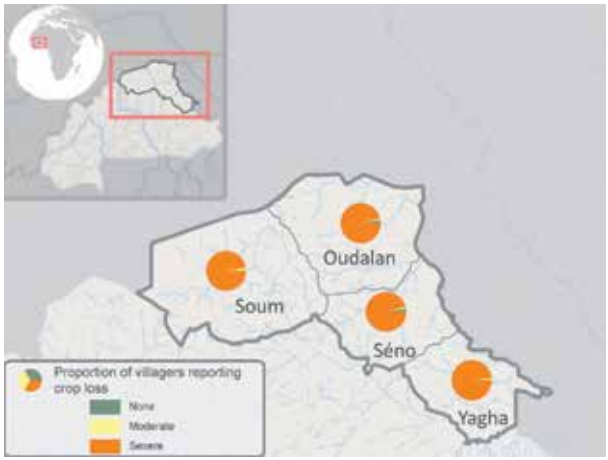
Map 2: Average Enhanced Vegetation Index in the past ten years. Map created by CIESIN. See technical annex for details.



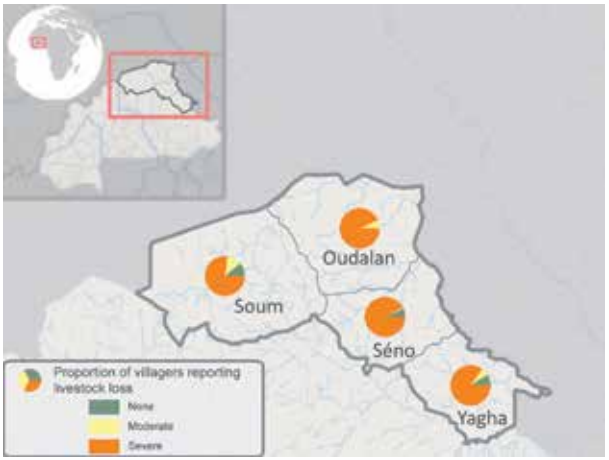
Map 3: Enhanced Vegetation Index in the period May 2004 to April 2005. Map created by CIESIN. See technical annex for details.



Map 4: Enhanced Vegetation Index (EVI), 2004/5 deviation from the 10-year average. Map created by CIESIN. See technical annex for details.



Map 5: Proportion of households reporting crop loss by district. Map created by CIESIN. See technical annex for details.



Map 6: Proportion of households reporting livestock loss by district. Map created by CIESIN. See technical annex for details.

Loss and damage example: From cattle owner to beggar

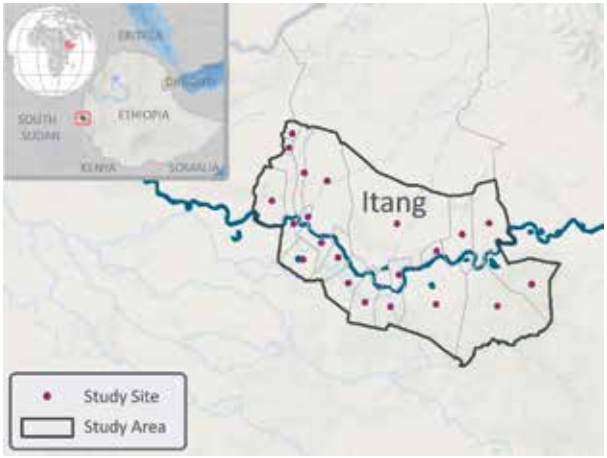
"I am Sambo Dramane Dicko, 60 years old and a native of Gandafabou in Oudalan province. I now live in Arbinda Town with my wife and three children. There was a severe drought in the years 1973-74. All crops failed and we suffered livestock losses. This drought has affected me severely and made me a poor man. I had a herd of about 120 heads. When the drought came, we went on transhumance to the Mossi plateau region, just as many others did. The pasture was a bit better there initially, but with so many cattle from different areas flocking in one place, there was not enough for everybody. I lost all my cattle, more than a hundred heads. It is a miracle that the total loss of my herds did not lead me into madness. Having lost my own cattle, I became a livestock keeper for other people. I was paid only 5,000 FCFA (US$10) per month. It was a shame for my family. That is why I could not go back to my native village in Gandafabou; it was too shameful to return without a single cow. I went into crop cultivation to feed my family, but the rains often failed. I cultivated millet on a piece of land with my wife and two boys in order to have food, at least for some months. I became a farmer by force. Before, I had never grown a single crop. We Fulani are also not used to living in towns. We want to live in the savannah, herding our cattle without obstacles. But in my case, that can no longer be. Today, I have to beg in Aribinda, and so do my wife and my son. Begging helps us to carry on the daily life and meet some of our basic needs. The people of Aribinda have compassion. Everything God does is good. I'm sure if we were to go back to my native village at Gandafabou, we would die from lack of food and from dishonour. We cannot do begging in my home village.

Sambo Dramane Dicko (born 1952), Aribinda urban district, Soum Province, Burkina Faso (12/10/2012)

Loss and damage example:
A dream of peaceful retirement shattered by drought

My name is Ag Ayad Inanchanan. I was born in 1937, and am a veteran of the Burkina Faso army. During my military service, I invested all my earnings in livestock. I thought that would guarantee a peaceful retirement. When I left the army, I had 135 cattle, 87 sheep and 45 goats. The drought of 1973–74 changed everything. I lost 75 cattle that year because of the scarcity of fodder and drinking water. I was forced to sell some 30 heads also to save the remaining animals and maintain my household. That year, my two brothers lost all their livestock. With no property, they moved in with me and became part of my household. With my herd decimated, I decided to start vegetable cultivation. I was the first gardener in Tin-Akoff along the Beli River. I had seen how that was done when I was stationed in the south. Irrigation allows me to carry on even if the rains fail, but the small profits from gardening do not allow me to reinvest in livestock and expand my herd up to previous levels. It is only enough to maintain my family. Despite my efforts to become less dependent on rainfall, we continue to suffer from the negative effects of drought on our farm. My situation started to worsen again during the drought and locust invasion of 2004. I lost 20 of the 30 heads of cattle I had then. Then, in 2011, I lost 165 small ruminants that drowned in the Beli River when searching for fodder. A big rain that was sudden and brutal washed them away. And this year, 2012, I will not even harvest 1kg of millet from my field due to the invasion of birds in the area. Because I do not have enough animals to sell, I was forced to sell one of my handcarts to cover food needs. The situation is becoming increasingly catastrophic. I never imagined my life would look like this now when I thought I was going on to a peaceful retirement.

Ag Ayad Inanchanan (born 1937), Village of Tin-Akoff, rural commune of Tin-Akoff, Oudalan Province, Burkina Faso (11.10.2012)



Map 7: The research area in Ethiopia: Itang District. Map created by CIESIN. See technical annex for details.

3.2 Ethiopia: Preventive measures not enough to avoid loss and damage from extreme floods[7]

An increase in frequency and severity of flooding in Ethiopia is affecting the livelihoods of small-scale agropastoralists who rely on the land for subsistence. A study conducted in the Itang District of Gambella region found that despite applying a variety of preventive measures against flooding, households were still experiencing severe negative impacts (e.g. lost harvests and livestock, damage to houses and property). Furthermore, relying on social networks to cope in the aftermath of a flood was found to be unsustainable, as repeated floods erode this social capital.

What is the greatest climatic stressor?

Since 2000, households in the Itang area of Gambella region in Ethiopia have reported dealing with increasingly severe floods. From 2006 to 2012 the region suffered a major flood every year, except for 2009 when they suffered from drought. The floods were especially severe in 2007 and 2012. In both years, the flood waters that normally retreat by October were still high in mid-November. Households annually experience flooding when the Baro River, a tributary to the Nile and the widest river in Ethiopia, overflows. However, at least once per season, they also suffer from flash floods that come from excessive rainfall in the upland mountain regions. Due to their unpredictability, these flash floods can be especially disastrous as they are capable of destroying crops and livestock without warning.

What is the impact?

As the region is primarily made up of agropastoralists that rely heavily on the land, flooding negatively affected nearly all of the 431 households surveyed. Ninety-four per cent of respondents reported that their crops were severely damaged or entirely destroyed following the 2007 flood. In addition to losing crops, 51 per cent reported loss of livestock, whose dairy products and meat are heavily relied upon for sale and consumption. Furthermore, the inability of livestock to graze due to flooded grazing land reduced dairy production in 2007 by half. Large-scale destruction of crops also leads to higher food prices, which make staple foods such as maize unaffordable and force already desperate households to reduce their food consumption.

How do affected people deal with floods?

The research found that households adopt both short- and long-term preventive measures. Short-term measures are undertaken right before a flood and include moving household property and livestock to relatives in unaffected areas, selling livestock prior to a flood and harvesting premature crops. Longer-term measures include digging ditches around property and farms, raising the floors of homes and erecting boundary walls. These preventive measures are effective for minor floods, but as floods increase in severity such measures become inadequate.

7 More detailed findings from the Ethiopia case study can be found in Haile et al., 2013.

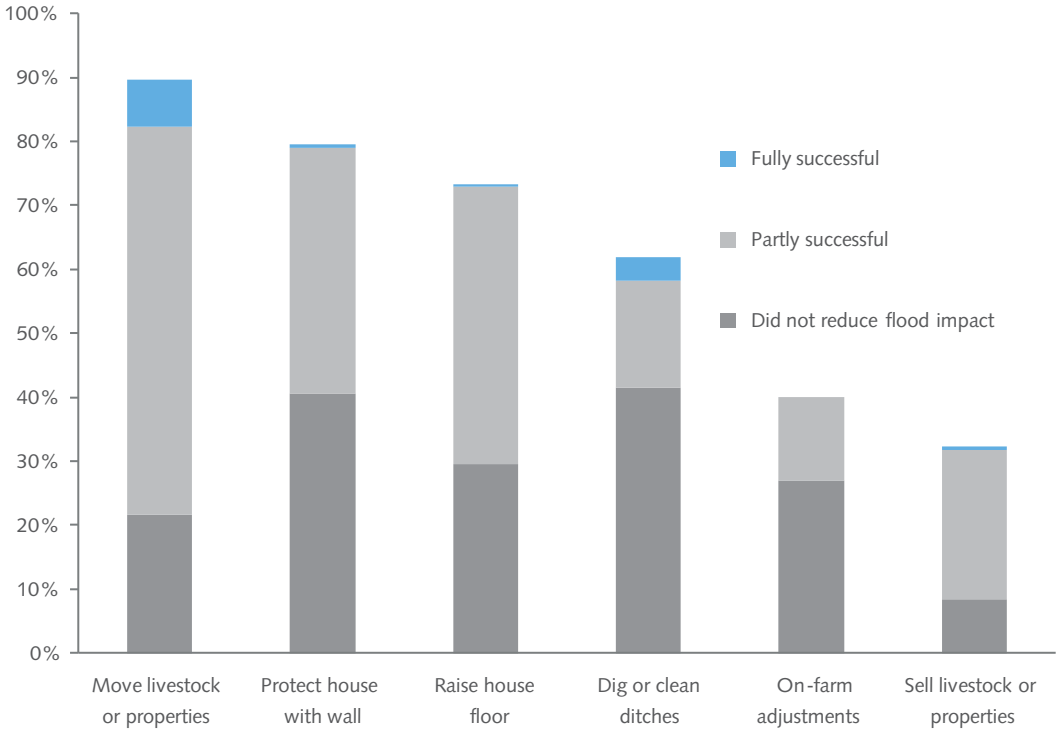


Figure 3: Effectiveness of the most common preventive measures in Itang District (Ethiopia) at the time of the 2007 floods (N=431 households). Source: Fieldwork; questionnaire survey (2012).

Figure 3 shows the prevalence of different preventive measures and their effectiveness at the time of the 2007 floods.

In the aftermath of a flood, respondents primarily cope by appealing to their social networks for support (i.e. relatives in unaffected areas), which usually comes in the form of shelter, food, financial and material assistance. The government and NGOs also provide some assistance (e.g. food and shelter); however, this is rarely sufficient and only available during or immediately after a flood. Following a flood, households also resort to selling livestock and property to pay for food and other basic necessities.

What is the loss and damage?

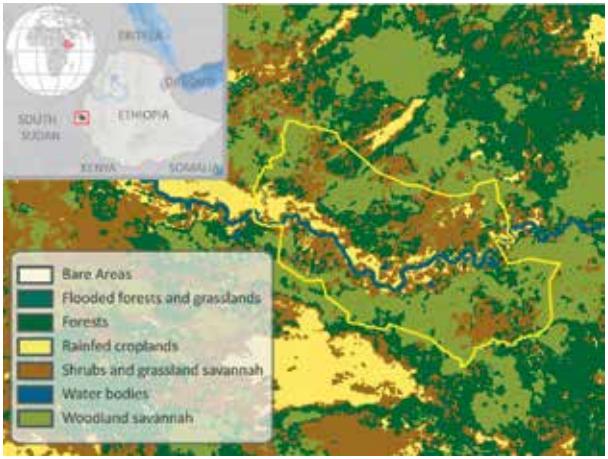
Although almost all the households surveyed had adopted some preventive strategies, they still reported experiencing severe impacts from the flood. These impacts include lost harvests, livestock and property, damage to houses and reduced food intake due to rising food prices. In addition, households lose valuable time and effort investing in strategies that are ultimately ineffective.

Following a flood, households primarily rely on their social networks; however, the research found that there are limits to this social capital. Due to the frequency of floods, residents must repeatedly get assistance from their social networks, but families do not have endless resources to support those affected by flooding. As a result, affected households must move from one family to another to avoid overburdening any one in particular. As floods continue to occur with high frequency and severity, affected households are eroding this social capital.

What's next?

Government and NGO support must involve not only immediate relief and response, but also prevention and recovery. Currently, food, material and shelter are only provided during or immediately after a flood; however, for affected households to effectively rebuild they need more substantial long-term support and investment.

The study found that households are largely left to their own devices when implementing preventive measures such as digging ditches and raising houses. Measures are often ineffective, due to the limited capacity of the households and lack of knowledge on what measures would be most effective and to what degree they must be applied (e.g. how deep to dig ditches). More support must be provided to households for adopting preventive measures and more empirical research needs to be conducted to improve the effectiveness of these measures.



Map 8: Land cover in Itang District and surroundings. Map created by CIESIN. See technical annex for details.

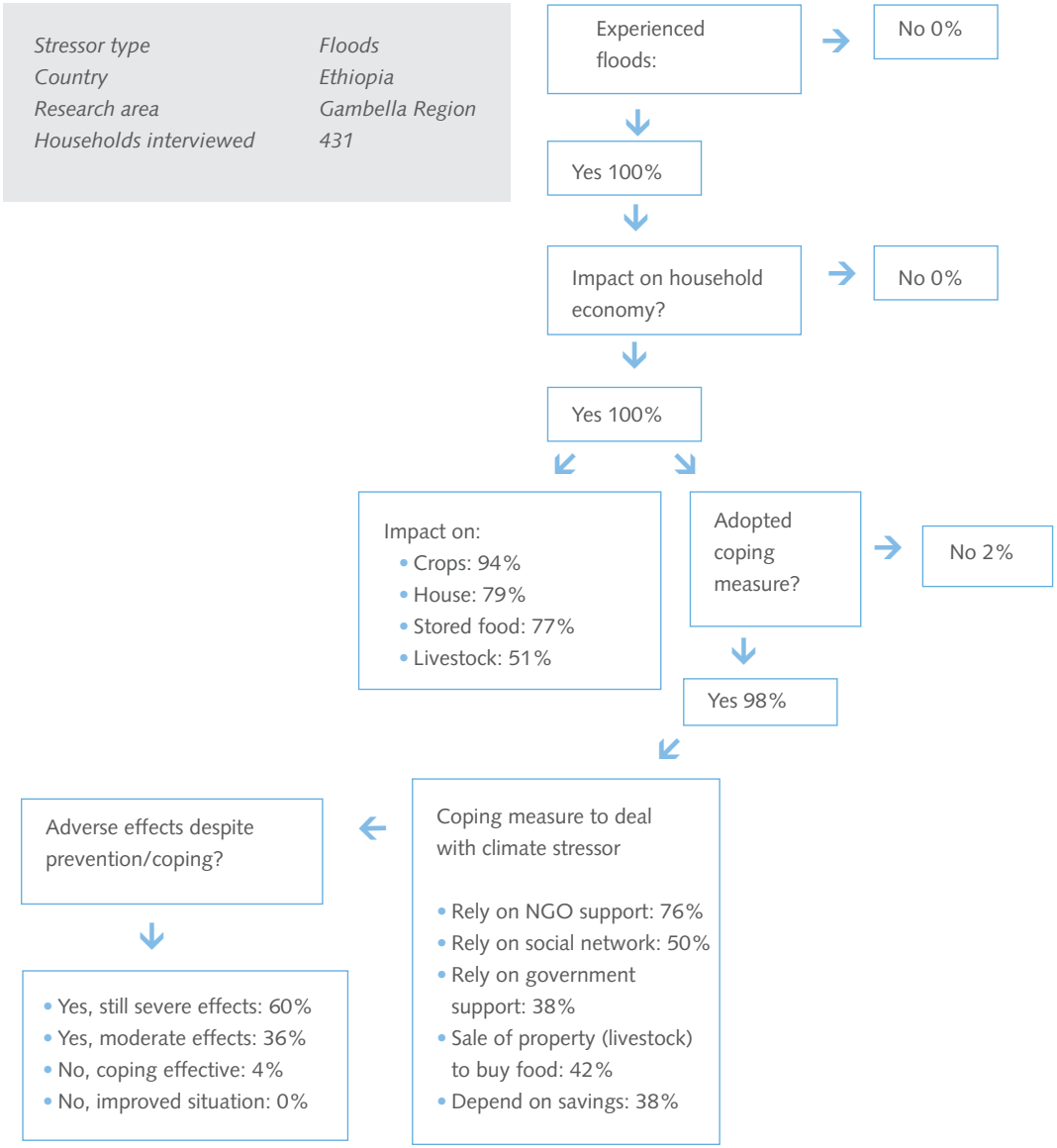


Figure 4: Summary of findings in Ethiopia.
Source: Fieldwork; questionnaire survey (2012).

Map 9: The research area in Mozambique: Caia, Mopeia, Mabote and Chibuto. Map created by CIESIN. See technical annex for details.

3.3 Mozambique: The double threat of droughts and floods

Mozambique has a long history of suffering from both droughts and floods. In response to a severe flood in 2001, the government resettled vulnerable households in southern and central Mozambique to drier upland areas, which are instead susceptible to drought and tend to have poorer soils. A study of 304 households in four districts located around the three main rivers in Mozambique (Zambezi, Limpopo, Save) investigated the impacts of and responses to droughts and floods. The study found that households are caught between the two evils of droughts and floods. As most households in the region depend on crop cultivation for livelihood and subsistence, many moved their fields back to the more fertile and less drought-prone lowland areas, while still living in upland areas. As a result, they can get better yields from their farms in normal years, although they face a high risk of losing their entire harvest if their crops are washed away in a flood. This is what happened to many households in the area when a severe flood occurred in 2007.

What is the climatic stressor?

Households in the current study are subjected to drought and flood, which both occur in the region with high frequency and severity. In 2007 and 2008 many surveyed households experienced floods, particularly in the two districts along the Zambezi River (Caia and Mopeia). In the last three years (2010-2012) drought has been the principal climatic stressor. In 2011, a particularly severe drought hit all four research sites. In the questionnaire survey, respondents were asked to answer questions about impacts, coping, adaptation and residual loss and damage for one particular climate-related extreme event. Figure 5 illustrates the frequencies of flood and drought years that people chose to focus on. About a third of the respondents focused on a flood event and two-thirds focused on a drought event. This does not necessarily mean that droughts cause more severe damage than floods in the study sites; this particular distribution was probably due to the more recent occurrence of droughts.

What is the impact?

The double threat of drought and flood severely affects the livelihoods of households in the study areas. All households were engaged in crop cultivation, particularly maize. Not surprisingly, the most severe impacts of droughts and floods were on crops and food security. In the case of floods, some people lost their entire lowland harvest when their crops were washed away. In other cases, droughts or floods reduced crop yields. Food prices also tended to rise in the aftermath of droughts and floods. Moreover, people reported adverse effects on livestock, including the death of domestic animals. These different effects, combined with low coping capacity due to high poverty levels, contributed to severe food insecurity in the study areas.

8 More detailed findings from the Mozambique case study can be found in Brida et al., 2013.

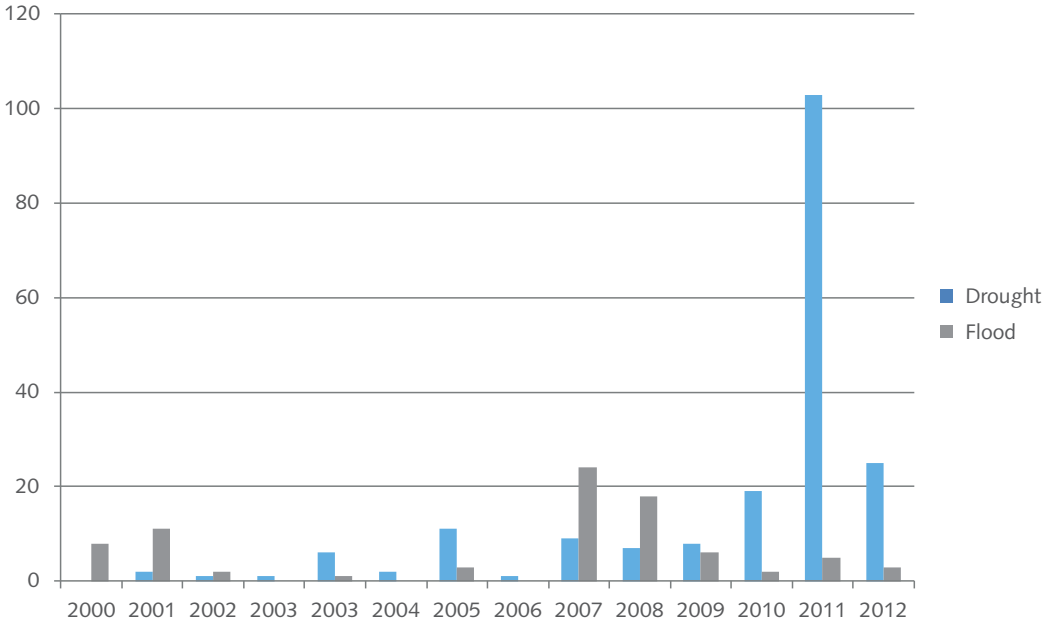


Figure 5: Drought and flood years investigated (households). Source: Fieldwork; questionnaire survey (2012).

What is the impact?

The double threat of drought and flood severely affects the livelihoods of households in the study areas. All households were engaged in crop cultivation, particularly maize. Not surprisingly, the most severe impacts of droughts and floods were on crops and food security. In the case of floods, some people lost their entire lowland harvest when their crops were washed away. In other cases, droughts or floods reduced crop yields. Food prices also tended to rise in the aftermath of droughts and floods. Moreover, people reported adverse effects on livestock, including the death of domestic animals. These different effects, combined with low coping capacity due to high poverty levels, contributed to severe food insecurity in the study areas.

How do affected people deal with drought and floods?

Households primarily adapt to the double threat of drought and flood by dividing crops between upland and lowland areas, with crops requiring less moisture (e.g. maize) sowed on upland fields and crops requiring more moisture (e.g. rice and vegetables) planted in the lowlands. Households meanwhile live in safer upland areas. Family members either commute between lowland and upland areas over the course of a day or move temporarily to lowland areas during the planting season. A majority of households also seek alternative sources of income to buy food when their crops fail. The most common income-generating activities besides farming are petty trade and collecting firewood for sale. Interestingly, households were far more likely to rely on aid from organizations when they were affected by flood than when they were affected by drought: 78 per cent and 32 per cent respectively. This stems from the tendency of governments and NGOs to be more reactive to extreme events like floods than to slower-onset events such as droughts.

What is the loss and damage?

The principal adaptation to flood risk has been to move dwellings and farms to upland areas. This is part of a resettlement project initiated by the government of Mozambique. While this measure is effective in reducing loss and damage from flooding, it makes households more vulnerable to drought and reduces agricultural production in normal years because upland soils are much less fertile. To reduce drought vulnerability and to reap the benefits of more fertile alluvial soils, many farmers have decided to move some fields back to lowland areas. By doing so, they take the risk of losing their lowland harvest if a flood washes away their crops. Farming households must also spend much more time moving between their lowland fields and their houses in the upland resettlement areas. The study population in the Mozambique case study generally had low capacity to cope with crop failures and losses. Many households faced acute food security problems in the aftermath of droughts and floods. In open interviews, many respondents further emphasized the stress of constantly having to manoeuvre between the risks of flooding and drought. They indicated that people in the study areas are getting worn down to a point that is unacceptable.

What's next?

The government must better evaluate the needs and livelihoods of households before undertaking resettlement programmes in response to extreme climate-related events such as floods. The study found that as households rely so heavily on crop cultivation, they reported being more severely affected by droughts than by floods. Due to the slow-onset nature of drought, it is often considered to be less urgent by the government. However, moving households to drier upland areas actually means taking them away from their main source of livelihood. The key to a successful adaptation to both flood risks and drought risks is to improve agricultural conditions in the uplands, e.g. introducing drought-resistant crops or supporting more effective soil and water conservation and irrigation. Furthermore, attempts should be made by both governments and NGOs to create favourable conditions for people to diversify their income sources and become less dependent on agriculture. This could be done by improving infrastructure (e.g. market access) and access to training and credit. For the most vulnerable households who lack the human and natural capital to improve their situation, such measures may not be effective. Such households may need longer-term social protection measures.

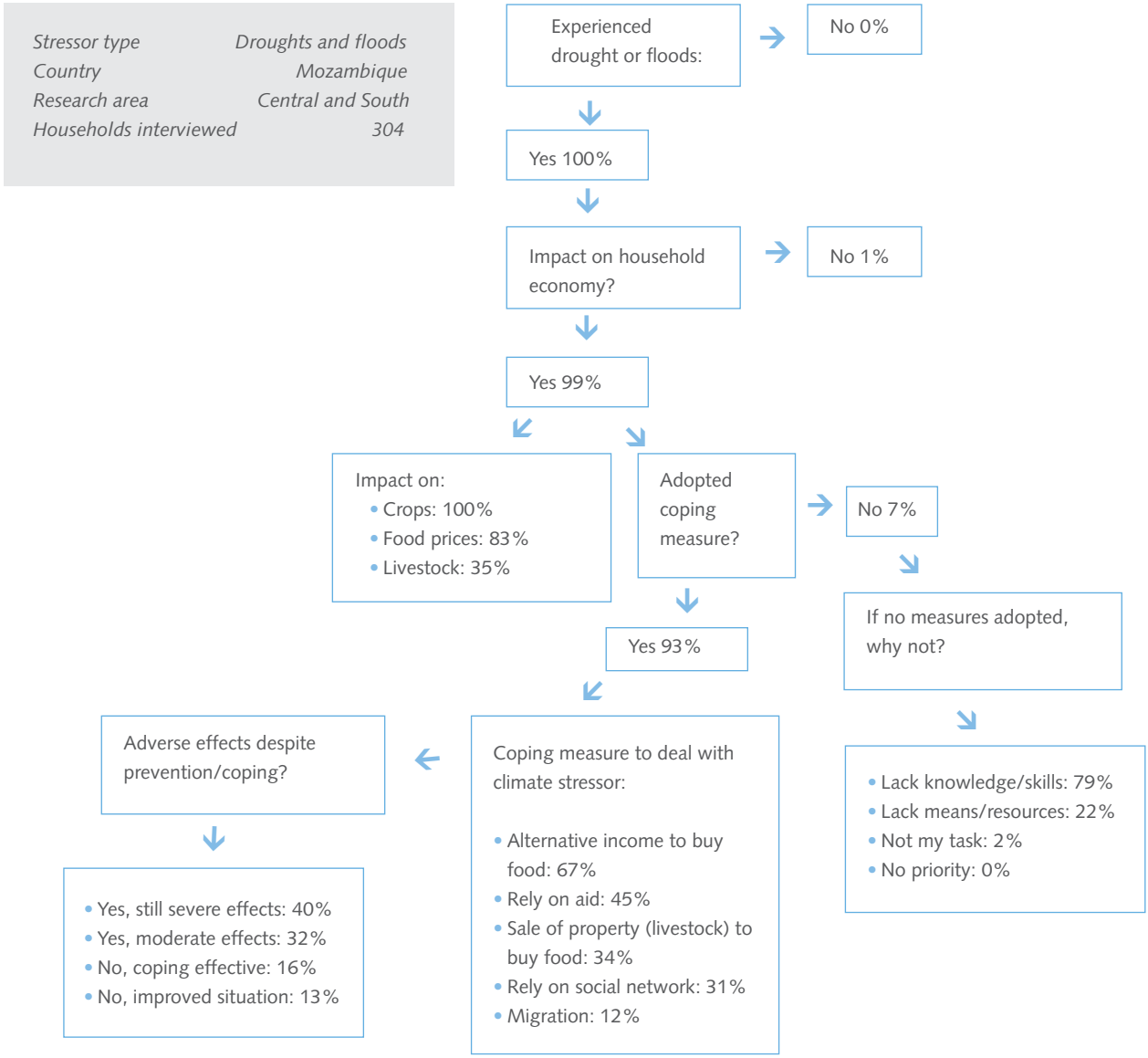
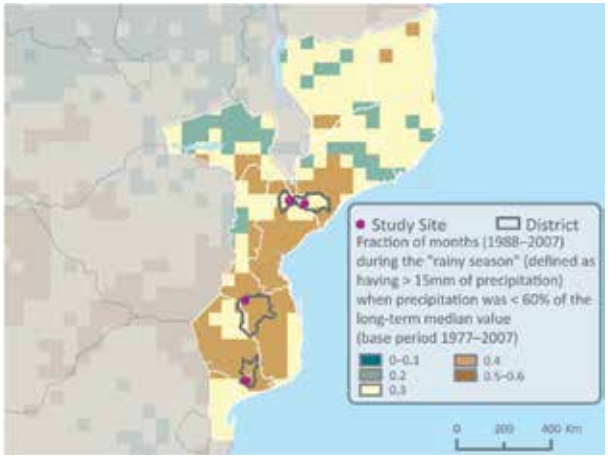


Figure 6: Summary of findings in Mozambique.
Source: Fieldwork; questionnaire survey (2012).

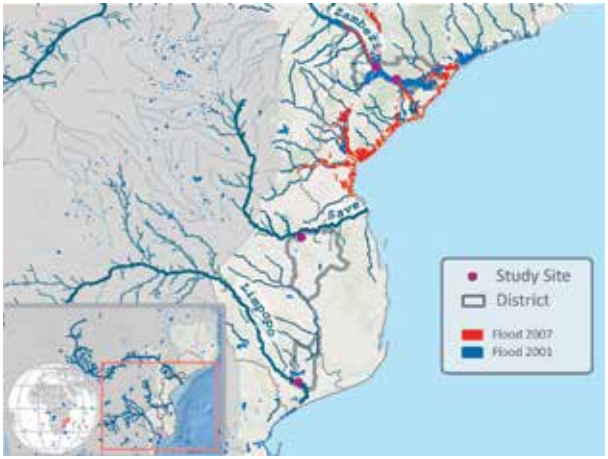
Loss and damage example:
Inability to cope with flood and drought

"I mainly engage in *ganho-ganho* (petty trade) to raise my seven kids. In the past few years it has been really hard to get something from my farm because of the droughts. I also grow vegetables closer to the river, but floods have destroyed my crops several times and there is the risk of crocodile attacks. I need to feed my kids and send five of them to school. When they get sick, it is even more difficult. Often, when I don't get enough from *ganho-ganho* I have to work on other people's farms for little pay. I don't have any livestock and I can't fish. When I leave the house to look for money I have to leave my younger children under the care of the older ones. I suffer a lot living like that and would like to have something that could make life less difficult and help me raise my kids more easily. A motor pump could help me produce more in the upland farm close to my house. That way I could still harvest even if there is a drought and I would not run the risk of losing my crops from flooding and crocodile attacks in the lowland farms. And I could be closer to my kids when I go to work on the farm. But I cannot afford to buy a pump, and even if I had one I could not pay for the gasoline to operate it. I don't know what to do."

Lucia Manuelle (born 1978), Mopeia Zona Verde resettlement center, Mopeia (16.12.2012)

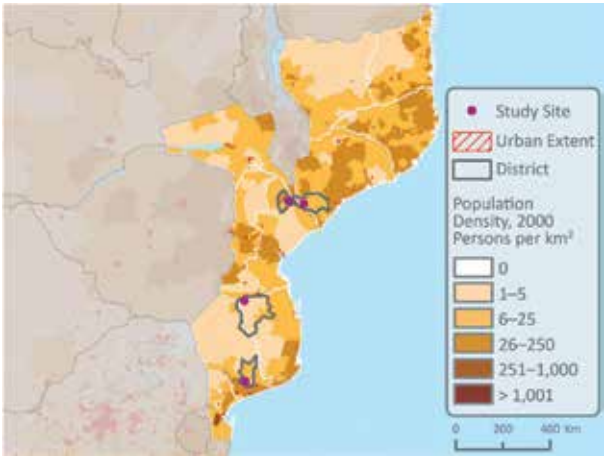


Map 10: Incidence of drought in Mozambique. Map created by CIESIN. See technical annex for details.

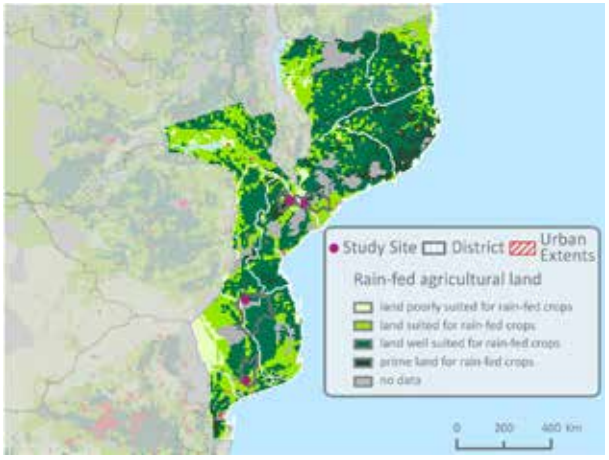


Map 11: Areas flooded in Mozambique (2001 and 2007). Map created by CIESIN. See technical annex for details.

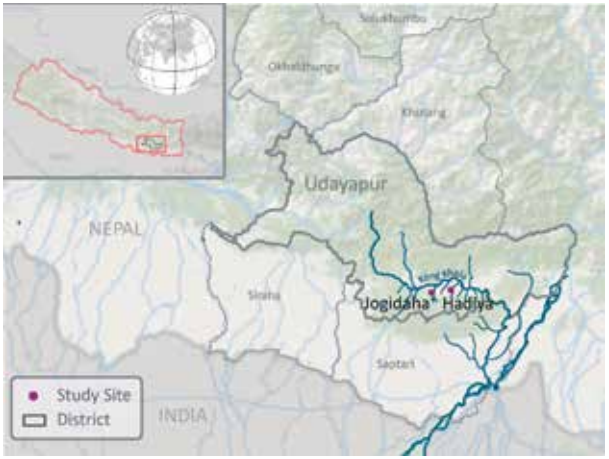
Map 12: Proportion of households reporting on drought and flood and flood events in the study sites in Mozambique. Map created by CIESIN. See technical annex for details.



Map 13: Population density in Mozambique. Map created by CIESIN. See technical annex for details.



Map 14: Suitability of land for rain fed agriculture in Mozambique. Map created by CIESIN. See technical annex for details.



Map 15: The research area in Nepal: Udayapur District. Map created by CIESIN. See technical annex for details.

3.4 Nepal: Loss and damage from flooding[9]

Nepal is particularly susceptible to climate-related disasters. It experiences frequent landslides, debris flows and floods because of its varied topography and geological characteristics, together with torrential rain during the monsoon season. The United Nations Development Programme (UNDP) estimates that since 1980, flooding in Nepal has resulted in nearly 200 mortalities, affected hundreds of thousands of lives and caused US$35 million worth of damage each year (UNDP 2009). In addition, demographic factors such as rapid population growth, unsustainable land use, economic underdevelopment, gender inequality and poverty contribute to the frequency and size of these disasters. A study of the impacts of climate-induced disaster among 300 households in two Village Development Committees (VDC) of Udayapur District found that communities in this region of eastern Nepal were especially vulnerable to floods. Moreover, patterns of development and settlements put the low-income and the vulnerable members of these communities at increased risk, since many farm on land that is prone to flooding and sedimentation.

What is the climatic stressor?

Climate change contributes to increased occurrences of natural disasters in Nepal, particularly water-related disasters such as floods. The impacts of global climate change have intensified the short-term and long-term effects of flooding as precipitation regimes change and temperatures rise at a rate that is significantly higher than the global average. Though a majority (61.2 per cent) of households in Udayapur District reported that the frequency of floods has decreased, two-thirds (65.5 per cent) noted that floods have become more severe in the past 20 years.

What is the impact?

Parts of Nepal like Udayapur District are vulnerable to seasonal flooding, which can reduce yields or destroy crops altogether. In some cases these impacts are immediate, such as when fields are washed away, but floods can also have longer-term negative impacts by increasing topsoil erosion and sedimentation, reducing soil fertility and organic matter content. Some estimates suggest a loss of 1.7mm of productive soil annually in Nepal, reducing already scarce productive agricultural land. Increased sediment loads due to deforestation and regional irrigation schemes have altered the breadth and course of rivers in Udayapur District, causing rivers to breach their banks and inundate fields during the monsoon season. This in turn aggravates endemic issues of food security in this relatively resource-poor region of Nepal. Almost half (46.6 per cent) of the interviewees reported that in

9 More detailed findings from the Nepal case study can be found in Bauer, 2013.

the past ten years the effects of flooding on their crops has been severe. In addition, almost half (45.2 per cent) of respondents reported moderate and severe effects on food prices as a result of floods and more than half (55.3 per cent) reported experiencing food shortages. Finally, more than half (55.3 per cent) of the households surveyed experienced food shortages in the past ten years as a result of flood-related disasters.

How do affected people deal with floods?

Households in Udayapur adapt to the threat of floods through both preventive and coping measures. Almost half (43.8 per cent) of the households interviewed had built physical barriers around their homes and fields to prevent flood damage. In addition, in almost a quarter of the households interviewed, some family members switched to new economic activities, particularly migration (17.4 per cent), to reduce risks from future floods. Nevertheless, three-quarters (77.1 per cent) of respondents reported that the coping strategies they had adopted were not enough and that there were still severe (44.8 per cent) or moderate (32.3 per cent) effects on the household due to flooding; money was cited as the major limiting factor in adopting more active prevention measures. In addition to these household-level measures, communities in Udayapur use traditional bioengineering methods, such as bamboo fences and sand dikes, to prevent or reduce the effects of flooding. District- and village-level government offices have also built gabion walls of stone and wire mesh to help retain earth and stabilize soils in flood-affected areas.

What is the loss and damage?

As a result of flooding, households are forced to expend much more time and effort in preventing, coping and adapting to these destructive climate events. For example, families farming along riverbanks must frequently repair the walls of their fields even as they attempt to rehabilitate soils damaged by flood events. Adaptive capacity in these vulnerable communities is limited: 50 per cent noted that despite taking preventive measures there were still "severe negative effects". Almost a quarter (22.7 per cent) of the households interviewed had sold property – including homes, livestock and heirloom possessions. Additionally, close to 40 per cent of households interviewed had reduced their expenses (e.g. school fees, health care, productive investments, etc.) and food consumption in the aftermath of floods.

What's next?

With continued population growth and limited opportunities to convert additional land (e.g. forests) to productive agricultural use, it is imperative for residents of flood-affected areas such as Udayapur District to expand and diversify their sources of income to decrease their reliance on natural resources and to cope with the vicissitudes of a climate that is shifting. For example, support for fishpond construction and large-scale bamboo and cane plantations could stimulate cottage industries and the creation of non-farm income opportunities. The government has an important role to play through agricultural extension activities that enhance the adaptive capacity of vulnerable communities and through improving infrastructure to ensure rural communities are able to reach markets for their agricultural goods and outlets for inputs such as fertilisers, improved seeds, etc. Rather than simply reacting to extreme events (e.g. disaster relief following floods), the government also needs to provide substantive long-term support to, and investment in, households suffering from slow-onset events such as soil erosion and sedimentation. Management of community forests to protect watersheds will rely on improved grazing regimes, fodder plantations and dissemination of biogas units to reduce impacts on forest resources. Community-based disaster management for facilitating climate adaptation has already been initiated by several communities in the study site, including the construction and provision of emergency shelters and rudimentary early warning systems; however, much remains to be done to prepare communities for flood disasters. While very few of the households interviewed (6.9 per cent) had made changes in agricultural production to prevent the impacts of floods, future adaptations may need to include changes in crop patterns, including varietals and species that are better suited for emerging conditions.

Stressor type	*Floods*
Country	*Nepal*
Research area	*Udayapur District*
Households interviewed	*300*

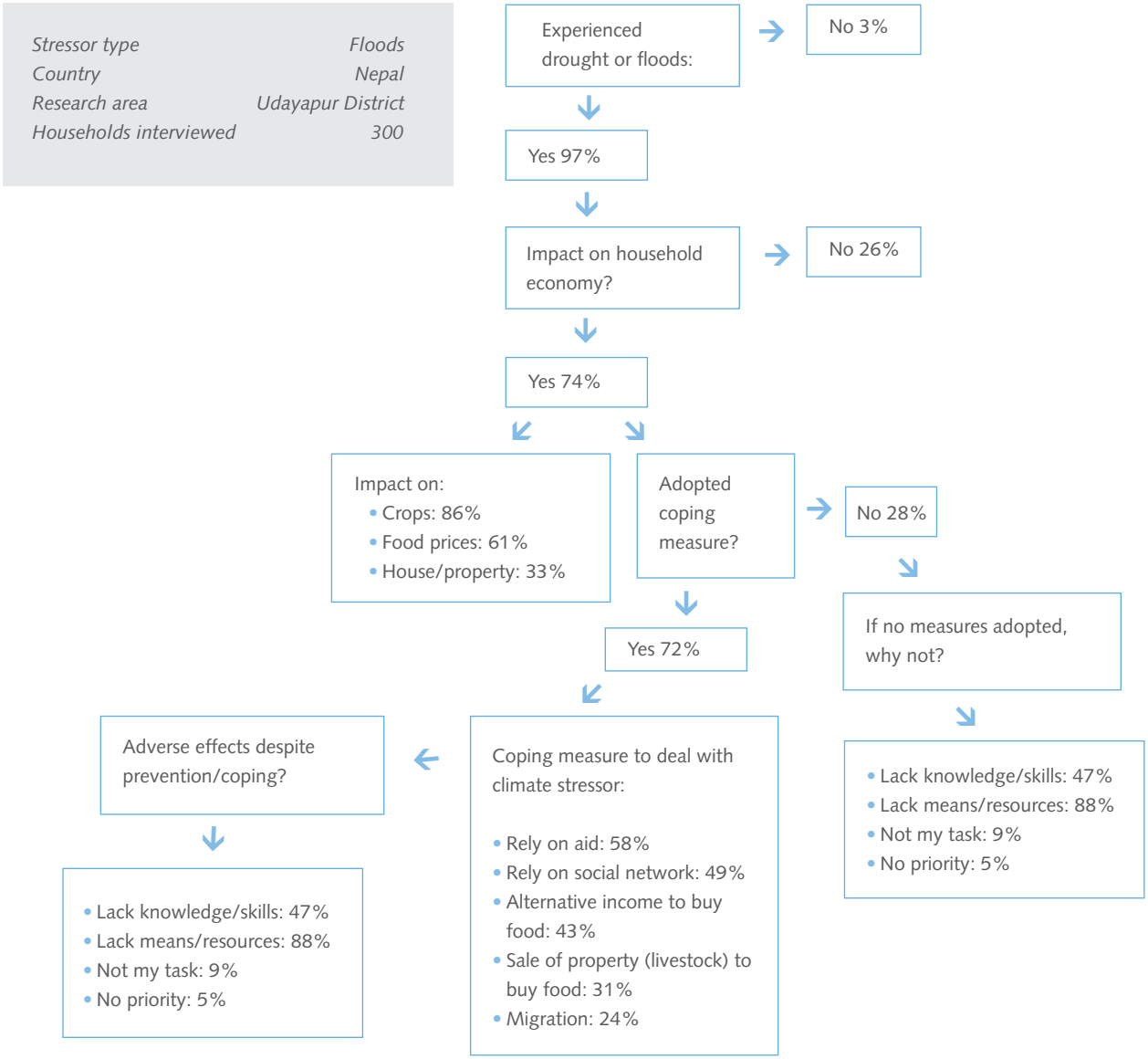


Figure 7: Summary of findings in Nepal.
Source: Fieldwork; questionnaire survey (2012).

Loss and damage example: Struggle to recover after floods

Mishri Lal Chaudhary says: "We have lived in Udayapur from the time of our fathers and forefathers. I am 59 years old and have two daughters, one son and a wife. We moved to this place, Dhanti Tol, in 2052 BS (1995 AD). A big flood had swept our family home away. I had a house and two cattle sheds before this flood. I used to make tiles and put up roofs all around Udayapur. I earned about Rs 9,000 per month. Also, I used to work my fields. My two brothers and I jointly own 2.5 *bigha*, but the flood took all that land. It was Asar. The paddy was fully grown and about to fruit. The rain had been falling continuously for six or seven days. The river started to swell and the flood came at 7 o'clock. Water entered all the houses in the village. The water reached up to waist level in my house. My wife and I gathered up all the livestock (two oxen, three cows, six goats) and then moved upstairs with our two children. We also carried our clothes and food upstairs. The river slowed down after 10 o'clock. We spent the next two nights sleeping and eating upstairs. We were then relocated to Hadiya Higher Secondary School with 12 other families. The VDC provided us with 2kg of rice, 2 litres of kerosene and a lantern. The Red Cross distributed tents, blankets, cooking utensils, cloth, cooking oil, beaten rice and lentils. We spent 15 days in the school and had to leave after the school reopened. After that, we started to construct huts of bamboo and straw in the Dhanti jungle. Six forest guards arrived and told us to stop building. They arrested us and took us to the forest office. We put all our grief and problems before them. All of our assets and houses had been swept away by the river. We had to settle somewhere. We negotiated with the Ilaka Range Post for a full day without even eating. The forest officer gave us some assurances after talking with our VDC Chairperson. He said, 'Go back to Dhanti jungle. I will visit shortly and make a decision.' When he visited, the forest officer warned us that we could live here for only one year then we had to leave. After six months, the forest office again warned us to leave the place and gave us seven days' notice to return to our own place. But we had no house; we were living in tents provided by the Red Cross. We then organized a group meeting and had intense discussions. We visited the District Administration Office with our Member of Parliament. The Chief District Officer gave us each Rs 1,000 and permitted us to live at Dhanti Tol so long as we didn't encroach on the jungle. After one year, the District Forest Officer once again tried to move us from this place. We went to Bed Prasad Pokhrel, President of CPN UML [a political party] in Udaypur and he protected us. We 12 families have lived here since that time; now it is our permanent residence."

Loss and damage example: Investing in hope

Rajendra Prasad Chaudhary (33 years old) is literate but studied only up to Class 8. He was born and raised in Jogidaha Bazaar, where he rents and runs a cycle repair and maintenance shop. Rajendra tried being a security guard in Kathmandu, only to return to his village. Recently, he moved to the banks of the Kong River, from where many families had been displaced by floods. Rajendra saw the possibilities for rehabilitating this land, so he purchased two kattha (7,200 sq ft). Few think this is a suitable place to live and he was the first to move to this degraded land, which he bought for just Rs 15,000 from a local Chaudhary family.

Rajendra had no choice but to build his new house on the margins of the village. Like many rural poor, he had taken a loan from a group of moneylenders, but couldn't return the loan of NRs 100,000 for many years. With compound interest, the amount rose to NRs 350,000. His father also got sick and became paralysed. Making a harsh decision, he sold his family's property to the moneylenders: he had no other way to repay the loan and pay for his father's treatment. The balance left was minimal and not sufficient to build even a small house in the bazaar, pay for his children's education and buy medicines for his father. Rajendra said, "I could only buy land along the riverbank." He added, "Many of my friends have also purchased land nearby and we are making efforts to raise our hopes for the future along this flood-prone bank of Kong River." Rajendra and his family have begun building a small house with walls of hollow cement block and sheet roofing, but the house is not yet complete. The roof and wall plaster are finished, but not the doors and windows.

He has raised the building plinth more than 1.5 feet above the ground. He thinks that if a flood comes, it won't be able to enter his house. "My home is waterproof and strong," he says. The roof is also heat resistant: he has chosen building materials carefully after thinking about it for a long time.

Rajendra and his family spent NRs 20,000 building a sand dyke along the river to protect their land and home. They also planted bamboo roots and other fodder trees to preserve the dyke. Rajendra has not received training in soil conservation and bioengineering techniques but is well aware of which plants grow in these conditions and which will help protect soils. Rajendra cheerfully explained his reclamation strategy: "We have many traditional practices in our community to protect against flood and soil erosion, so we use those techniques. We are also planning to lay turf on top of the dyke."

This year, Rajendra has planted potatoes and radishes on the land he is rehabilitating. He states with confidence, "The sand ultimately will turn to soil after I irrigate it and apply compost and manure. I am very hopeful." He has planned to farm paddy on a small piece of the land next year; he is also keeping goats and pigs in another corner of land. He thinks this land will definitely help improve his living standards. His three children are going to school and his wish is for them to be well educated and to enter business or serve the community as doctors. Rajendra has many responsibilities in trying to singlehandedly rehabilitate this land, but he sees hope on the banks of Kong River and has many aspirations for a better life.

3.5 Summary of findings from Bangladesh, Bhutan, the Gambia, Kenya and Micronesia

The four case studies presented in this report are part of a larger set of nine case studies (Warner and van der Geest, 2013). The first five case studies were reported earlier in more detail in Volume 1 (Warner et al., 2012b), and are summarized below.

Sathkira 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 2 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 rise in the salt content of 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 only 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 enough to avoid loss and damage when the situation is aggravated by an extreme weather event (Rabbani et al., 2013).

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 the adverse effects of reduced availability of water. Moreover, the adaptation measures involve extra costs, both monetary and non-monetary (Kusters and Wangdi, 2013).

The North Bank Region in *The Gambia* is a drought-prone area. Meteorological data since 1886 show a strong reduction 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 on their household economy, as a result of the drought. Most households tried to survive by finding alternative sources of income to buy food. This was difficult, however, because of rising food prices and 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. Despites these coping measures, 63 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 most vulnerable had to do both (Yaffa, 2013).

In December 2011, the River Nzoia in western *Kenya* broke its dykes and wreaked havoc in Budalangi Division. Crops were washed away, livestock drowned, houses were severely damaged and there was an outbreak of waterborne 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, which often came in the form of camps. However, for many households the amount of food that was distributed to

them was inadequate. The other coping strategies they adopted, including the sale of draught animals to buy food or to reconstruct their properties, were found to have severe implications for future livelihood security (Opondo, 2013).

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 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 found 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 implemented adaptation measures reported that they were not sufficient, with some measures also resulting in negative side effects. For example, large 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 reported that they lacked the resources to do so, for example most households do not have the resources to build a sea wall to protect their house and property (Monnereau and Abraham, 2013).

4. Analysis of findings

This section reflects on the findings from the four new loss and damage case studies to show current relationships between climatic stressors, societal impacts and attempts to address these climatic stressors. The aim is to better understand how the interactions of climatic variability and climate change with human systems result in loss and damage, particularly in vulnerable regions.

The four case studies presented in this volume focused exclusively on droughts and floods. Three case studies were conducted in Africa (Ethiopia, Burkina Faso and Mozambique) and one in Asia (Nepal). People in the case study areas believe that droughts and floods are occurring with increased frequency and intensity. This fits with a broader picture of increasing variability of rainfall and more extreme weather. In the case of floods, particularly in the Nepal study site, increased severity of floods is also related to human factors, such as deforestation and unsustainable land use upstream.

Table 4 shows the percentage of households in each research site experiencing droughts and floods and their impacts, adopting coping strategies and experiencing residual loss and damage. Climatic stressors are widely experienced in the research sites surveyed. For example, in Ethiopia all households surveyed reported experiencing floods that affected them. In Mozambique and Burkina Faso, similarly high proportions of the study population (close to 100 per cent) were affected by droughts or floods. In Nepal, although 97 per cent had experienced flooding, 'only' 74 per cent reported adverse effects on their households. Just as in the first series of case studies (Warner et al., 2012b), the impact of climate-related stressors was primarily on crop cultivation.

Country	Ethiopia	Burkina Faso	Mozambique
Research area	Gambella Region	Sahel Region	Central and South
Households interviewed	431	465	304
Climate-related stressor	Experienced floods: Yes: 100% No: 0%	Experienced drought: Yes: 98% No: 2%	Experienced drought or floods: Yes: 100% No: 0%
Did climatic stressor affect household economy?	Yes: 100% No: 0%	Yes: 99% No: 1%	Yes: 99% No: 1%
Adverse effect on:	Crops: 94% House: 79% Stored food: 77% Livestock: 51%	Crops: 96% Food prices: 90% Livestock: 87%	Crops: 100% Food prices: 83% Livestock: 35%
Did you use coping strategy?	Yes: 98% No: 2%	Yes: 79% No: 21%	Yes: 93% No: 7%
What did you do?	Rely on NGO support: 76% Rely on social network: 50% Rely on government support: 38% Sale of property (livestock) to buy food: 42% Depend on savings: 38%	Sale of property (livestock) to buy food: 79% Rely on aid: 51% Migration: 41% Alternative income to buy food: 33%	Alternative income to buy food: 67% Rely on aid: 45% Sale of property (livestock) to buy food: 34% Rely on social network: 31% Migration: 12%
How effective was it?	Still severe effects: 60% Still moderate effects: 36% No more negative effects: 4% Improved situation: 0%	Still severe effects: 40% Still moderate effects: 32% No more negative effects: 16% Improved situation: 13%	Still severe effects: 23% Still moderate effects: 46% No more negative effects: 28% Improved situation: 3%
If no measures adopted, why not?	Not available	Lack knowledge/skills: 79% Lack means/resources: 22% Not my task: 2% No priority: 0%	Lack knowledge/skills: 64% Lack means/resources: 40% Not my task: 0% No priority: 0%

Table 4: Proportion of households experiencing climate stressors, impacts and residual loss and damage. Source: Authors own (2013).

Nepal
Udayapur District
300
Experienced floods: Yes: 97% No: 3%
Yes: 74% No: 26%
Crops: 86% Food prices: 61% House/property: 33%
Yes: 72% No: 28%
Rely on aid: 58% Rely on social network: 49% Alternative income to buy food: 43% Sale of property (livestock) to buy food: 31% Migration: 24%
Still severe effects: 44% Still moderate effects: 34% No more negative effects: 8% Improved situation: 15%
Lack knowledge/skills: 47% Lack means/resources: 88% Not my task: 9% No priority: 5%

As the large majority of respondents practise subsistence agriculture, with few non-farm income sources, one can expect direct impacts on food security. The vast majority of the survey respondents indicated that they adopted measures to counter adverse effects of droughts and floods (median: 86 per cent). Among the people who adopted such measures, most were not fully successful in avoiding residual impacts. For example, in the Ethiopian study area, 96 per cent of households reported that they were still experiencing adverse effects of flooding despite preventive measures, aimed at avoiding impacts; and coping measures, aimed at addressing impacts that could not be avoided. For the other three case studies, the proportion of households experiencing residual loss and damage was lower (69-78 per cent), but still a majority.

4.1 Loss and damage patterns

The five loss and damage case studies presented in Volume 1 (Warner et al., 2012b) revealed four 'loss and damage pathways'. Despite attempts to manage climatic stressors and associated impacts, households incur loss and damage when:

1. Existing coping/adaptation measures to biophysical impact are not enough to avoid loss and damage;
2. Measures have costs (economic, social, cultural, health, etc.) that are not regained;
3. Despite short-term merits, measures have negative effects in longer term (erosive coping);
4. No measures were adopted – or possible – at all.

The four case studies presented here provide new evidence that people in vulnerable regions are already experiencing loss and damage along those lines. Their livelihood, food security, housing, social capital and cultural values are affected because limits to coping and adaptive capacity are already being surpassed.

For example, in the Gambella Region in Ethiopia, the preventive measures people adopted to avoid flood impacts were not enough to deal with extremely severe floods in 2007 (Haile et al., 2013). In Udayapur District in Nepal, people have to invest more and more time in maintaining physical structures that protect their houses and land against floods, and to rehabilitate farmland that has been affected by flooding despite preventive measures (Bauer, 2013). Along the Zambezi, Limpoopo and Save Rivers in Mozambique, people have had to move from lowland areas to upland areas in response to high flood risk. This adaptation is successful in reducing flood impacts, but due to poor soils and drought risk in upland areas, it severely affects their ability to grow enough food for the household (Brida et al., 2013). Lastly, in the Sahel Region in Burkina Faso, many respondents indicated that there is not much they can do to save their livestock when severe droughts hit the area (Traore et al., 2013).

While droughts and floods appear to become more severe, many people's capacity to cope and adapt is limited because of high levels of poverty and factors that make people vulnerable in the face of climate threats.

4.2 Non-economic loss and damage

When a place is hit by an extreme weather event or affected by slow-onset climatic changes, the damage is usually expressed in monetary terms, and limited to physical assets, like buildings and infrastructure. However, non-economic loss and damage – although intangible and difficult to measure – may actually be the most significant and have the most far-reaching consequences. Current discussions of non-economic loss and damage in science and policy circles highlight why it is essential to include a much broader spectrum of ways to address loss and damage (beyond compensation and liability), and why mitigation efforts must be raised significantly and at scale.

The case studies presented in this report provide local level evidence of non-economic losses. Across all research sites, a common coping strategy – or actually a sign that other coping measures were not effective enough – was to modify food intake. When crops fail because of drought, or when fields and granaries are destroyed by flooding, people need to find alternative ways to get food. Despite a wide array of coping strategies, such as reliance on social networks, non-farm income and migration, typically three out of four surveyed households across the study sites had to cut down the number of meals or reduce portion sizes (Warner and van der Geest 2013). While hard to measure, these adverse effects of climate-related stressors can have severe consequences, especially for young children and pregnant women.

Other examples of non-economic loss and damage were loss of identity among former pastoralists in the Burkina Faso case study. Having lost most of their herd in recurrent droughts, many of them had no choice but to take up crop cultivation or move to urban centres. The testimonies of people in our study area show that this has had far-reaching consequences, beyond the material loss. Losing one's herd equalled losing one's ethnic identity. Many also reported severe mental health problems among former pastoralists.

Non-economic and cultural losses often undermine people's ability to withstand future stressors. It makes them more vulnerable and less resilient in the face of climate change (Morrissey and Oliver-Smith, 2013).

4.3 Adaptation limits and constraints

Loss and damage results from inability to avoid global warming and associated climatic stressors, and inadequate capacity to adjust to these stressors. This occurs when actors face adaptation constraints and when adaptation limits are being surpassed. Adaptation *constraints* – which can be experienced by any actor, from individuals, households and communities to private

companies and governments –are factors that make it harder to plan for and implement adaptation measures. At the household level, constraints are usually lack of information, knowledge, skills, financial means or other resources. Private and public sector organizations also face such constraints; in addition, their governance and management structures may be inappropriate for guiding adaptation processes. Research on adaptation constraints would usually identify which options exist for adaptation measures in a particular setting, and try to find out why actors have not adopted these measures, or why measures have not been enough to avoid loss and damage.

Dow and colleagues (2013) defined an adaptation *limit* as the point at which an actor is unable to secure objectives from intolerable risks through adaptive action. This definition is challenging to make operational for empirical research. It is more subjective and dependent on cultural values. When are risks tolerable, acceptable or intolerable? Examples of 'objectives' are having access to safe drinking water, food security and other fundamental human rights. Adaptation limits occur when the magnitude, frequency and scale of climate stressors is beyond the actors' capacity to deal with them adequately.

When faced with such adaptation limits or constraints, households and communities have to make difficult choices: changing their objectives, accepting loss and damage or undertaking more significant transformation. Changing objectives often involves a deteriorating standard of living, the loss of cultural values and the disintegration of commonly held values and practices in the community. Accepting loss and damage often means falling incomes, assets, education levels and social status, along with greater poverty, lower food consumption and diminished future prospects. Undertaking more significant transformation can involve more permanent migration out of one's home area, leading to other significant changes in livelihood and social systems.

The vast majority of respondents in the case study areas indicated that their households adopted measures to prevent or cope with impacts of climatic stressors (median: 88 per cent). For those who did not, the survey instrument included questions about why households did not adopt any such measures. Most of these households faced constraints or limits that made it impossible for them to adjust at all. Table 5 shows reasons for not adopting coping or adaptation measures. Lack of knowledge or skills was the most common reason, followed by lack of financial means or other resources. These households did not know what to do or were not able to do anything. Very few households indicated that it was not their task to do anything or that it was not a priority.

The reasons provided for not adopting coping/adaptation measures can be related to either adaptation limits or adaptation constraints. Responding to the open question on non-adoption, many respondents answered "We don't know what to do" or "There is nothing we could do". That could be interpreted as lack of information/knowledge (a constraint) but it is also possible that the magnitude of the climate stressor is beyond adaptation limits. More community-based research is needed to develop better methods for assessing adaptation limits and constraints.

The combination of a survey instrument and qualitative research tools allowed the loss and damage case studies to go beyond quantitative findings and tell the story of each study area. This yields examples of people living on adaptation frontiers and of adaptation limits being surpassed. The pastoralists we studied in northern Burkina Faso are a case in point. They are experiencing increased frequency and severity of droughts. Existing risk management strategies within the pastoral system, which were once effective in addressing recurrent droughts, are no longer effective. For these pastoralists, a key objective is to maintain the pastoral way of life and a respectable herd size.

Country	Lack knowledge or skills	Lack means orresources	'Not my task'	No priority
Bangladesh	68	30	0	2
Bhutan	68	16	4	12
Burkina Faso	79	22	2	0
The Gambia	58	28	3	2
Kenya	40	31	10	4
Micronesia	47	74	3	0
Mozambique	64	40	0	0
Nepal	47	88	9	5
Median	61	31	3	2

Notes: Percentages calculated over households that did not adopt coping or adaptation measures. Data is missing for Ethiopia.

Table 5: Reasons for not undertaking coping or adaptation measures (% of households): Source: Authors own (2013).

In the face of increasingly frequent and severe droughts, many of them are forced to abandon this objective and move into crop cultivation, which in this community amounts to a loss of respect and cultural identity. Upon a severe reduction in herd size, many former pastoralists in the area were driven by shame to move away altogether.

Such impacts of climate stressors are very severe for the people that are affected. Whereas adaptation limits are often thought of as something hypothetical, many people in vulnerable situations are already encountering and crossing their adaptation limits.

5. Policy reflections: loss and damage is an opportunity to drive transition and transformation

Current and future loss and damage patterns strike at the very purpose of climate policy. Loss and damage patterns revealed in the case studies in this report illustrate that people in vulnerable countries already appear to be approaching the biophysical and social boundaries of adaptation, beyond which climate change compromises sustainable development. The case studies show how climate-related losses relate to the central policy objectives of many countries: economic development, poverty reduction, livelihood and food security, health, education, access to usable water and overall human welfare.

These are areas of concern highlighted in Article 2 of the UN Framework Convention on Climate Change (UNFCCC): "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 GHG 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" (UN, 1992).

5.1 Loss and damage in focus under UNFCCC climate policy

Addressing climate change-related loss and damage has been given a greater focus in the UNFCCC process in recent years:

- COP16 in Cancun – Setting the path: Cancun (2010), the birthplace of the Adaptation Framework which streamlines the international response on adaptation, launched a work programme to identify ways in which the international community could approach the issue of loss and damage in developing countries. It requested focused work on climate insurance, risk management and rehabilitation measures to address slow-onset events.

- COP17 in Durban – Clarifying the work: In order to facilitate decision-making towards COP 18 in Doha, the Durban climate meeting (2011) defined the structure of work in 2012 in the run-up to the Doha conference. As a result, UNFCCC organized five expert meetings, global and regional in scope, to prepare for the Doha decision and achieve spin-offs with national implementation debates.

- COP18 in Doha – Landmark decision: The 2012 climate summit in Doha reached a landmark decision, defining the role of UNFCCC in providing leadership on addressing loss and damage internationally, and by contextualising it with the relevant provisions of UNFCCC, including the need for a precautionary approach and the need for comprehensive risk management. The Doha decision also lays out concrete national approaches that should be strengthened and further areas where more clarity needs to be gained in the future. The Doha decision itself builds on a succession of discussions at prior climate conferences.

While Doha built the foundation, the complete path is not yet clear. A glimpse towards the future envisions:

- COP19 in Warsaw – Building an institutional home for loss and damage: The Warsaw climate summit scheduled for November 2013 is tasked to decide on the institutional set-up for addressing loss and damage in the UNFCCC process. At the same time, the Warsaw conference is expected to develop the vision for future activities of the work programme launched at the 2010 Cancun conference.

- COP21 in Paris – the 2015 climate agreement: The Paris meeting, scheduled for autumn 2015, will conclude discussions leading to a new international agreement. This entails the need for a legally binding regime applicable to all countries. While addressing loss and damage is not yet part of the 2015 negotiations, the main variables of loss and damage, mitigation ambition and adaptation implementation, are core areas of the 2015 agreement. Therefore, it is expected that addressing loss and damage will feature either formally or as a reflection discussion, in the run-up to the Paris meeting.

5.2 Why addressing loss and damage provides a window to transformation

From the findings of the IPCC Special Report on Extreme Events (SREX) and the emerging results of the IPCC Fifth Assessment Report, it is evident that climate change poses a threat to current and future sustainable development. Loss and damage is also related to the extent of mitigation, since the potential costs of future climate change depend to a large extent on the intensity of climatic disruptions, which in turn are a function of global mitigation efforts.

IPCC´s Working Group 1 Summary for Policy Makers (IPCC AR5 WG1 SPM) indicates that climate change impacts are accelerating, and most aspects of climate change will "persist for many centuries even if emissions of CO^2 are stopped. This represents a substantial multi-century climate change commitment created by past, present, and future emissions of CO^2."

Excerpts from the IPCC Fifth Assessment Report Working Group 1 Summary for Policy Makers

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.

…

The atmospheric concentrations of carbon dioxide (CO2), methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. CO^2 concentrations have increased by 40 per cent since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The ocean has absorbed about 30 per cent of the emitted anthropogenic carbon dioxide, causing ocean acidification.

…

Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system.

…

Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea-level rise, and in changes in some climate extremes. This evidence for human influence has grown since AR4 [Fourth Assessment Report]. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.

…

Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.

…

The global ocean will continue to warm during the 21st century. Heat will penetrate from the surface to the deep ocean and affect ocean circulation.

…

It is very likely that the Arctic sea ice cover will continue to shrink and thin and that Northern Hemisphere spring snow cover will decrease during the 21st century as global mean surface temperature rises. Global glacier volume will further decrease.

…

Global mean sea level will continue to rise during the 21st century. Under all RCP[10] scenarios the rate of sea-level rise will very likely exceed that observed during the 1971–2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets.

…

10 Representative Concentration Pathways

Thus, discussions on how to address loss and damage must recognise that this is not about marginal management and standard adaptation practice. It is to be anticipated that policy discussions will increasingly need to consider transformative, significant departures from business as usual. That means approaches that are adopted at a much larger scale, that are "truly new to a particular region or resource system, and that transform places and shift locations" (Kates et al., 2012).

5.3 How to address negative climate change impacts for which there may be few or no alternatives

Questions arise about how to address those negative biophysical and socioeconomic impacts of climate change for which no clear, practicable adjustments exist within the boundaries of our current values, culture and economic systems. Such impacts might be seen as climate change begins to affect the basic functionality of some low-lying island countries. Further questions arise about how to address the potentially reduced habitability of dryland areas and coastal zones – many of which host dense population concentrations, including mega-cities. The potential changes that science suggests may be felt as early as this century raise questions about the ability of environmental systems to adjust naturally. Further questions arise about whether food production, and the associated livelihoods of an estimated 2.6 billion people,[11] will be able to continue in a sustainable manner.

Loss and damage policy with constraints to adaptation

Addressing loss and damage when constraints impair planning and implementation of adaptation will involve reducing those constraints, or finding new ways to adjust to negative climate change impacts.

Policy will need to address those factors that impede planning and implementation of adaptation (otherwise loss and damage can undermine adaptation efforts). Policy will need to focus on preparatory, *transformative actions* (scale, location, doing things differently). Loss and damage happen in parallel with adaptation – so it is not a matter of 'giving adaptation a chance' and then later making efforts to assess and address loss and damage. Loss and damage undermines the ability to plan and implement adaptation – therefore, policy responses are needed that enable action to be taken that is different in scale of effort, location of adaptation (e.g. migration) and types of activities (Kates et al., 2012).

Loss and damage policy at physical and social limits to adaptation

The pre-eminent approach to loss and damage in the medium and longer-term – in terms of avoiding future loss and damage and minimising impacts in the short and medium-term – lies in today's choices about mitigation and adaptation. An implicit decision not to take ambitious mitigation action at a global scale, and/or decisions not to invest in and actively drive adaptation, is likely to lead to loss and damage that exceeds the ability to manage (at all scales).[12]

Should ambitious mitigation fall short, societies worldwide will increasingly have to accept escalating loss and damage which could involve disruptive changes and responses (e.g. Dow et al., 2013; Preston et al., 2013). Accepting loss and damage often means falling incomes, assets, education levels and social status, along with greater poverty, lower food consumption and diminished future prospects. For example, undertaking more significant transformation can involve more permanent migration out of one's home area, leading to other significant changes in livelihood and social systems. The consequences of loss and damage associated

11 According to the statistics division of the Food and Agriculture Organization of the United Nations (http://faostat.fao.org), the world's 'agricultural population' amounted to 2,621,037,000 people in 2012. FAO defines agricultural population as all persons depending for their livelihood on agriculture, hunting, fishing and forestry. It comprises all persons economically active in agriculture as well as their non-working dependants. Source: http://faostat3.fao.org/home/index.html#METADATA_GLOSSARY.

12 See, for example Stern Report 2006

with inability to adapt to intolerable risks are expected to be both short and longer term, and at increasingly larger scales (i.e. no longer limited to localised losses and damages). Some consequences may be reversible, but many large-scale consequences may be irreversible (e.g. loss of livelihood and food production systems, deepening and widening poverty, deteriorating health and water quality, etc.).

Societies will be required to evaluate and adjust their objectives. Changing objectives often involves a deteriorating standard of living and the loss and/or disintegration of commonly held cultural values and practices in the community. Forums will be needed for broad societal discourse about impacts on institutions, values, developmental objectives, laws and regulatory codes.

Policy will increasingly focus on managing and ameliorating disruptive transitions. Transformative actions (Kates et al., 2012) are needed to soften and manage transitions (as opposed to accepting more disruptive, complete loss). Transformative action may operate at different scales and different locations, and may entail entirely new activities to avoid and manage the negative impacts of climate change which cannot be adapted to (ibid). Tools that help manage volatility and uncertainty – akin to some of the risk management and risk transfer approaches used today – may help bridge and soften climate shocks to human systems in combination with other approaches. For example, risk management tools can help assess loss and damage potential around limits in ways that help decision makers identify and evaluate options for managing loss and damage. Insurance-like tools cannot erase limits, but can help distribute loss and damage around those limits so that the societal impacts are less acute. Tools such as contingency planning, early warning systems and others can help incentivise activities and investments that will help reduce acute disruptions associated with loss and damage, and smooth transitions to new ways of addressing negative climate change impacts where further adjustments may either be unacceptable or impossible. Those actors and countries with the largest financial and other capacities will need to facilitate these transitory and transformative approaches.

Focus on managing and ameliorating disruptive transitions – not stopping at the smoking gun

Some discussions on loss and damage, especially in the media, have focused on the question: to what extent can losses and damages be attributed to climate change, or to what extent is there a causal link? Associated with this view, a 'theory of change' that some groups put forward asserts that establishing evidence in a punitive system against polluters will significantly incentivise mitigation and, in the longer run, reduce loss and damage.

While not linked to specific polluters that may be required to pay, the IPCC Fifth Assessment Report Summary for Policy Makers (Working Group 1, September 2013) already establishes that: "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased… Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system."

The profound societal changes that climate change-related loss and damage will set in motion will require a discourse that is dedicated to providing smooth transitions and societal transformation.


प्रकोपको सामना, समुदायको चाहना
सुरक्षित समुदाय "डिपेको-IV" परियोजना
वडा स्तरीय प्रकोप व्यवस्थापन समि
जोगीदह- ७, उदयपुर
स्थापित-२०६४
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Transformative approaches may incorporate, but must also go significantly beyond, 'proving' the culprits of global climate change. Thus, as an alternative, this report suggests that societies must be 'positively' motivated, not solely by threats of liability – by their own interests. Climate change impacts and related loss and damage may require revisions in the statutes, legal systems and governments´ duties to their citizens. Political systems may experience increasing pressure from constituencies as a variety of key societal objectives come under pressure—such as water standards, access to livelihoods and jobs in sectors sensitive to climate stresses, food security and nutritional standards, what is considered acceptable in terms of poverty, etc. Loss and damage will drive social discourse on changing objectives, accepting and managing loss and damage and undertaking necessary transformation. New paradigms that may incorporate but go well beyond models of 'climate liability' will be needed in order to manage the magnitude of change and provide smooth transitions.

5.4 What needs to be done now to address loss and damage?

All the emerging evidence at the nexus of increasing risks, development and climate adaptation make it increasingly clear that UNFCCC and other policy discussions on climate change-related loss and damage will need a transformative approach to solutions. This should also be reflected in the November 2013 discussions to institutionalize the response to loss and damage at COP19 in Warsaw.

First, loss and damage – especially striking as a result of collective societal or natural limits – is related to the very purpose of UNFCCC: preventing dangerous climate change. As part of loss and damage discussions, the UNFCCC process itself will have to install a reflection point that will help to transform the objectives and functions of climate policy. This should include consistent feedback on the state of necessary adaptation vis-à-vis existing mitigation pathways. It should also be used for discussions on the wider implications of a failure to adequately address mitigation and adaptation.

Second, discussions on loss and damage must facilitate a transformation of international support. International and regional policy must facilitate a broader transformation discourse among actors shaping risk response and management and other development actors. This should strengthen transformative uses of climate, development, humanitarian and other financial resources and soften the distributional aspects of increasing climate change risks. This could take shape by providing understanding, cooperation, coordination and facilitation of support for developing countries – the identified roles of UNFCCC in addressing loss and damage. It will be useful to analyse how the mandates, principles and norms as well as the statutes and laws relating to existing national, regional and international institutions are affected by loss and damage. Cooperation and coordination is required in moving from silo, ex post and ad hoc approaches in crisis management, towards better integration of humanitarian and developmental objectives.

Finally, the magnitude and volatility of climate-related risks is likely to overwhelm national, and in some cases, regional capacities. Such risks and their impacts on development priorities cannot be addressed through national adaptation processes alone. The functions of managing volatility and shocks, and developing tools for smooth transitions, require further elaboration. One such concrete approach that could be championed through a Warsaw decision would be international leadership and guidance in the operationalization of climate risk management approaches. Regional climate risk management platforms with international guidance would bring together assessments of the risk landscape and provide a role for tools such as risk transfer (insurance-related approaches). Regional operationalization of approaches to address loss and damage can facilitate the political buy-in necessary to undertake further measures to address economic and non-economic loss and damage in transformative ways.

6. Concluding remarks

Vulnerable countries such as those profiled in the current report are at the frontline of loss and damage realities and policy solutions. The case studies conducted for the Loss and Damage in Vulnerable Countries Initiative represent a first generation of research systematically assessing residual impacts of changes in climate variability and climate patterns at household level. 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 what the consequences of adaptation shortfalls might be in the future.

Such households and communities face barriers that erode livelihoods, food security and asset bases and that prevent them from accessing appropriate, sufficient adaptation options to manage climatic risks. Resulting loss and damage patterns can be seen in all the case studies.

As the evidence presented in this report indicates, *loss and damage is already a significant consequence of inadequate mitigation of, and adaptation to, climatic changes* around the world. The research presented here tells a story of community efforts to adjust to the negative impacts of climatic stressors, and the consequences when communities approach barriers or limits to successful adaptation. Many of the households surveyed are 'just getting by', suggesting that at some scales and in some regions, communities are situated precariously between the borders of 'safe' and 'unsafe' operating spaces at the adaptation frontier.

Managing the risks associated with climate change-related loss and damage is crucial because of the irreversible threats these losses pose to sustainable development. Failure to address loss and damage in ways that provide smooth transitions could leave society unprepared to manage and adjust to these negative climate change impacts. *Addressing loss and damage is about capturing opportunities to ameliorate negative climate impacts, and transform in ways that help us move towards our most important goal: improving human well-being.*

7. Technical annex

This annex contains a reference list of all the data layers used for the maps accompanying the case studies. We begin with data used in all the maps (for Nepal there is only a base map), and then identify data layers specific to individual countries.

All countries

Basemap: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, et al. 2013. Ocean Basemap. Redlands CA: Esri.

Water Bodies: DeLorme Publishing Company, Inc. 2010. Hydrolines and Hydropolys: A subset of DeLorme World Base Map (DWBM). DeLorme Publishing Company, Inc., Yarmouth, Maine, USA; Esri. 2012. Data and Maps for ArcGIS. Redlands CA: Esri.

Rivers: Food and Agriculture Organization of the United Nations (FAO). 2010. Rivers of Africa (Derived from HydroSHEDS). Available at: http://www.fao.org/geonetwork/srv/en/metadata.show?id=37333 (downloaded March 2013).

Burkina Faso

The maps included results of the survey conducted by the ACPC team in Burkina Faso for crop loss and livestock loss.

Enhanced Vegetation Index: United States Geological Survey (USGS), NASA Land Processes Distributed Active Archive Center (LP DAAC). USGS LandDAAC MODIS version_005 Enhanced Vegetation Index, EVI. Available at the International Research Institute for Climate and Society (IRI) Data Library. Available at http://iridl.ldeo.columbia.edu/SOURCES/.USGS/.LandDAAC/.MODIS/.version_005/.WAF/.EVI/ (downloaded April 2013).

Ethiopia

Land cover: European Space Agency and the Université catholique de Louvain. 2010. GlobCover 2009. Available at http://due.esrin.esa.int/globcover/ (downloaded February 2013).

Mozambique

The maps included results of the survey conducted by the ACPC team in Mozambique on the relative importance of climate stressors, including floods and droughts.

Drought map: Analysis conducted by Bradfield Lyon, International Research Institute for Climate and Society (IRI)/Earth Institute, Columbia University, in 2010. Rainfall data from the Global Precipitation Climatology Center (GPCC) and IRI Data Library.

Flood map: Brackenridge, G.R. and E. Anderson. 2008. Satellite-based inundation vectors, Dartmouth Flood Observatory for Mozambique region, 2001 and 2007. Boulder, CO: Dartmouth Flood Observatory.

Population Density: Center for International Earth Science Information Network (CIESIN)/Columbia University, International Food Policy Research Institute (IFPRI), The World Bank, and Centro Internacional de Agricultura Tropical (CIAT). 2011. Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Population Density Grid. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). Available at http://sedac.ciesin.columbia.edu/data/set/grump-v1-population-density (downloaded November 2012).

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