Loss & Damage

Measuring What Matters?

A Suitability Analysis of Loss and Damage Databases for the Climate Change Convention Process

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May 2013

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MCII
UNITED NATIONS UNIVERSITY UNU-EHS

Summary

Disaster losses reveal more than damage: they gauge levels of resilience, vulnerability, and exposure and point at underlying conditions that make people and places susceptible to losses. Loss databases are the gatekeepers to this information. These databases collect, consolidate, and manage loss data in a central repository that is quickly and easily accessible by the public. Over the past decades, the number of national databases has significantly increased reflecting the need and relevance of tracking disaster impacts. At present, there are 42 disaster loss databases at the national or regional level – 75 percent of which utilize the DesInventar data management approach.

Loss databases are generally utilized for disaster risk reduction purposes. However, they have the potential to also provide essential information for climate change adaptation. To better document, quantify, and monitor loss and damage from climate change, six actionable activities are proposed that enhance the structure of existing disaster loss databases. These actions are:

1. expand loss assessments with indirect and non-monetized loss and damage information
2. add climate change-related hazard types based on hazard origin
3. add and standardize climate change-relevant loss categories.
4. establish database standards to ensure compatibility and comparability.
5. document the investments made in disaster recovery and climate change adaptation
6. Implement Periodic Reviews of Loss Estimates and Expand the Loss Estimation/Accumulation Period

Adding climate change-related hazards, including non-monetized and indirect loss and damage, standardizing hazard and loss types as well as improving database compatibility should be pursued to generate a better understanding of climate change impacts and adaptation needs. In addition, significant improvements in regard to data quality are imperative. This, however, goes beyond the scope and capabilities of disaster loss databases. In order to increase the accuracy and quality of loss and damage data, it is necessary to:

7. devote resources to improve loss data collection;
8. improve and enhance historic climate records; and
9. measure and monitor changes in vulnerability and resilience.

It seems beneficial for the climate change community to draw on existing disaster loss and damage databases to better understand the relationship between climate change, vulnerability and resilience. Modifying loss and damage databases to better assess the effects of climate change seems feasible and logical given the overlapping interests between the climate change and disaster risk management communities. Linking the multitude of loss and damage databases and merging data analytically will aid in the evaluation of adaptation actions and support fact-based decision-making. To move forward, collaborative approaches and joined efforts between the disaster risk and climate change communities are needed, to effectively utilize loss and damage databases for climate change purposes.

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Editor/Layout: Linos Xanthopoulos

1. Introduction

Disaster losses, such as property damage and crop losses, have been steadily rising over the past decades and are predicted to increase further due to the effects of climate change.[1] Thus, adapting to more frequent and more severe events and improving risk reduction strategies is a key component of climate change adaptation.[2] Disaster losses are indicative of the effectiveness of disaster risk reduction because they reveal more than damage: they gauge levels of resilience, vulnerability[3], and exposure[4] and point at underlying conditions that make people and places susceptible to losses. In past years, the documentation of disaster losses has made great strides through the expansion of disaster loss databases. However, little has been done to track loss and damage from climate change. Currently, the debate on climate change is largely framed around mitigation, the reduction of emissions, and adaptation, the development of strategies to adapt and adjust to changing climate conditions, with limited consideration of how to

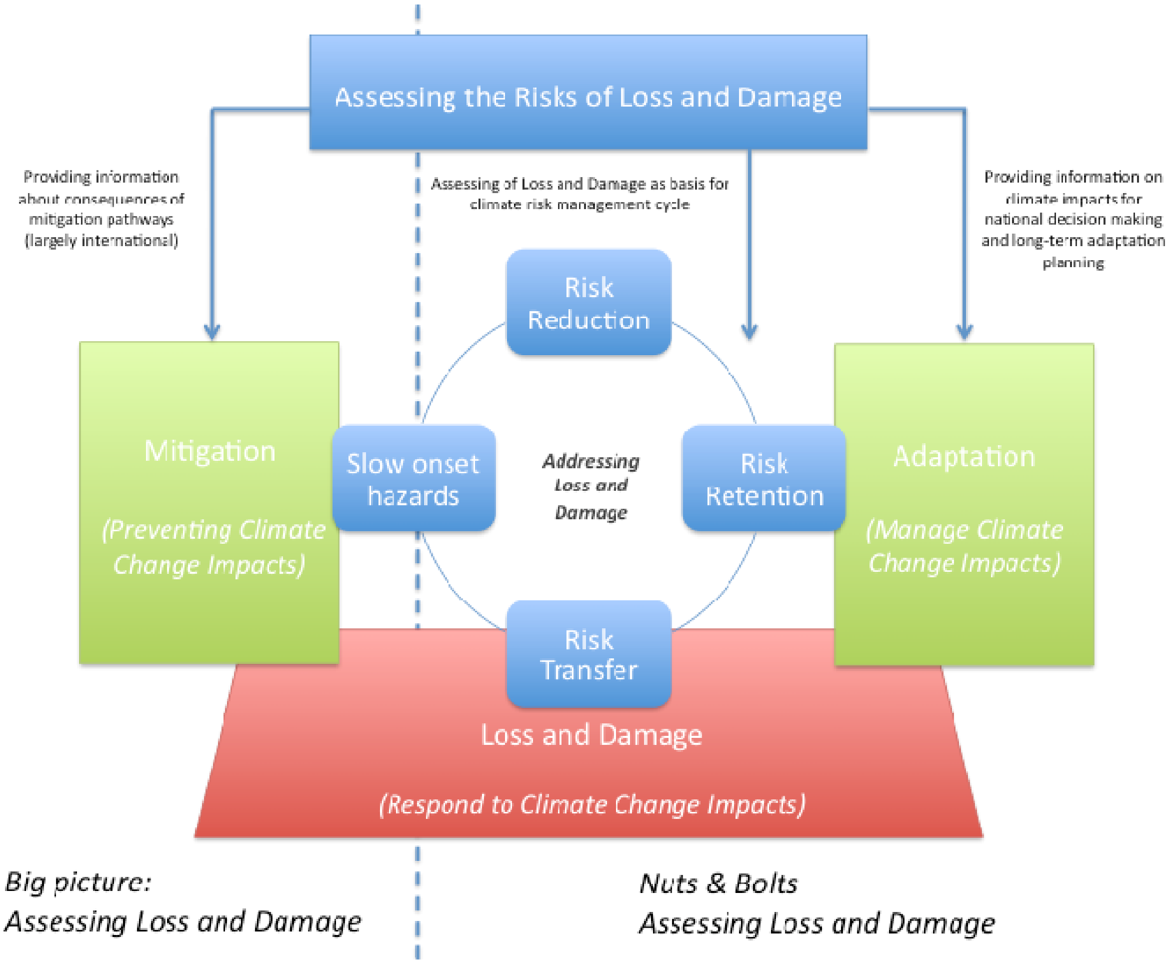

Figure 1: Framework for assessing the risks of loss and damage in the UNFCCC

[1] IPCC. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and Ii of the Intergovernmental Panel on Climate Change. edited by C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, et al. New York: Cambridge University Press, 2012.

[2] Warner, Koko, and Sumaya A. Zakieldeen. "Loss and Damage Due to Climate Change: An Overview of the UNFCCC Negotiations." Oxford, UK: European capacity Building Initiative, 2012.

[3] In this context, hazard vulnerability is broadly defined as the potential for loss. Most notably, vulnerability includes a socioeconomic component referring to the ability to prepare for, respond to, and recover from an event.

[4] Exposure refers to community assets meaning the people, property and infrastructure that are at risk of being impacted adversely.

monitor and measure adverse impacts from climate change.

At the climate conference in Cancun in 2010, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) launched a work programme on loss and damage aimed at providing recommendations to the UNFCCC by 2012's climate conference in Doha. The work programme is structured along three themes: (a) assessing the risk of loss and damage, (b) exploring options to address loss and damage, and (c) exploring the role of the UNFCCC process in regard to loss and damage. The first two themes draw heavily on existing research, technical papers, and expert discussions whereas the discussion surrounding the role of the UNFCCC process is explored through negotiations.

This paper contributes to the assessment of loss and damage through a detailed analysis of existing disaster loss databases and their suitability to measure and monitor impacts from climate change. It also aims to support the Parties in developing adaptation strategies related to risk management. Disaster loss databases play a key role in this process since they collate, maintain and publish loss and damage data.

... only documented impacts und quantified losses generate paradigm change and incentives to invest ...

The UNFCCC's major objective is to stabilize greenhouse gas levels and to prevent dangerous anthropogenic interference by adaption. Being a framework convention it works largely catalytic with implementation undertaken by national and other international processes. Sound information on climate change and its effects is the basis for decision-making – nationally, regionally and internationally. Only documented adverse impacts und quantified losses generate paradigm shifts and incentives to invest in adaptation and mitigation. Bringing the consequences of climate change into the public domain is part of the work of the convention (Figure 1).
In presentations to the work programme representatives of UNISDR as well as UNDP outlined various disaster loss databases and recommended mechanisms for up-scaling their geographical scope in the future. In response, UNFCCC delegates – from both developed and developing countries – signalled their willingness to consider the inclusion of loss and damage databases in the national communication process. The constraints of disaster loss information in capturing certain types of loss and damage related to climate change (e.g., non-economic, non-monetized, etc.) are high-priority concerns to many countries involved in the UNFCCC process. As such, a comprehensive and descriptive analysis of disaster losses and data management practices is important.

Parties of the UNFCCC are expected to submit to the UNFCCC suggestions on how to utilize and perhaps modify existing disaster loss databases to improve disaster risk management in a changed climate. In order to propose effective mechanisms, it is essential to clarify the utility, quality, and relevance of existing loss and damage databases for the climate convention process. This paper offers such a discussion. Section 2 presents background information on how disaster losses are classified and measured. It also outlines current shortcomings in assessing the full impact of disasters. Section 3 provides a snapshot of available disaster loss databases with a particular focus on DesInventar databases. Section 4 focuses on the suitability of disaster loss databases to document and monitor the effects of climate change. It concludes with suggestions on how to better leverage loss and damage data in the context of climate change and the climate change convention process.

2. Loss and Damage as Indicators of Disaster and Climate Change Risk Management

2.1 Definitions of Loss and Damage

The effects of extreme events on society are as manifold as the terminology and approaches used to quantify them. It is therefore prudent to clarify definitional differences and state the use of terms in this document.

A hazard is a threat (e.g., flood, drought, sea-level rise, etc.) whereas a disaster is an event that disrupts and overwhelms local coping capacity due to its catastrophic impacts. The term disaster tends to be applied to acute events causing devastating destruction. By definition, a hazard or disaster can have a slow speed of onset such as a drought where the impact unfolds over months and years or a quick speed of onset such as an earthquake where the damage occurs within minutes.

… the nature of loss and damage varies and can refer to direct as well as indirect effects, to physical as well as psychological harm, to economic decline and rise, to social and environmental changes …

The terms "loss", "damage", and "cost" are similar and often used interchangeably but there are nuanced differences. In many instances, the differentiation between loss and damage is vague and not always consistent. Engineers, for example, study the damage caused by extreme events on buildings whereas economist analysis economic losses and public health researchers investigate disease outbreaks, injuries and fatalities. For the purpose of this report, the terms "loss" and "damage" are treated interchangeably with both encompassing all adverse effects of an extreme event including economic and non-economic, tangible and intangible, as well as reversible and irreversible impacts such as fatalities, destruction of infrastructure, homes, and crops, contamination of drinking water, habitat loss, and more.

Loss and damage are classified based on their nature and type of impact. The nature of loss and damage spans physical as well as psychological harm, economic decline and rise, social and environmental changes, and more.[5] The impact of a disaster is generally separated into direct and indirect loss and damage. Physical harm to people, infrastructure, property, and agriculture constitutes direct loss and damage. The loss of mangroves due to a tropical cyclone or sea-level rise, for example, is a direct loss. The most widely used measures of direct loss are property and agricultural damage as well as fatalities, injuries and displaced people (Figure 2). Again, a direct loss represents an asset directly affected by the peril. Any subsequent effect triggered by the physical destruction classifies as indirect loss and damage. This includes, for example, lost remittances, lost time in school, polluted drinking water, or lost income from business closures. Indirect losses are sometimes also called intangible losses or higher-order effects.[6]

Losses are frequently expressed in quantifiable and universally accepted units such as the (replacement) value of a collapsed building, number of fatalities, or tonnage of destroyed crops.[7] Although monetary units are widely used, it is important to note that any loss expressed in monetary terms does not necessarily represent an economic loss. For example, environmental impacts can be expressed as lost environmental services and be measured in monetary units.

In recent UNFCCC discussions, the phrase "economic vis-à-vis non-economic loss and damage" has been coined recently, partially to avoid capturing losses purely in monetary terms.[8] A non-economic loss refers to those adverse effects that cannot be reasonably assessed in economic terms. Examples are abandonment of territory, destruction of cultural

[5] For a discussion of loss and damage as defined by UNFCCC see United Nations Framework Convention on Climate Change. "Current knowledge on relevant methodologies and data requirements as well as lessons learned and gaps identified at different levels, in assessing the risk of loss and damage associated with the adverse effects of climate change", FCCC/TP/2012/1,http://unfccc.int/resource/docs/2012/tp/01.pdf

[6] Rather than differentiating between direct and indirect losses, economists distinguish between "stocks" (a quantity at a single point in time) and "flows" (services and outputs of stocks over time); Rose, Adam. "Economic Principles, Issues, and Research Priorities in Hazard Loss Estimation." Chap. 2 In Modeling Spatial and Economic Impacts of Disasters, edited by Yasuhide Okuyama and Stephanie E. Chang. Advances in Spatial Science, 13-36. New York: Springer Verlag, 2004.

[7] National Research Council. The Impacts of Natural Disasters: A Framework for Loss Estimation. Washington D.C.: National Academies Press, 1999.

[8] Parties to the UNFCCC used this term during the Bonn Subsidiary Meeting in reflecting the outcomes of the Workshop on Assessing the Risk of Loss and Damage in Japan 26th-28th of March. See FCCC/SBI/2012/15.

landmarks, extinction of species, salt water intrusion, and so forth.

In the aftermath of a disaster, governments, organizations, and individuals spend tremendous amounts of resources to rebuild. These investments are generally referred to as “costs”. Some define costs as actual pay-outs and expenditures by governments, organizations, businesses, and individuals.[9]

Unlike loss and damage though, costs are rarely captured and documented in a systematic fashion that is comparable to disaster loss databases. Even less so are investments that go beyond reconstruction and aim at improving resilience [10] or climate change adaptation.

2.2 The Importance of Loss and Damage for Disaster and Climate Change Risk Management

Disaster risk management is a systematic process aimed at reducing the adverse impacts of natural hazards by means of early warning systems, building codes, land-use planning, insurance, structural measures (e.g., dams) as well as policies and ordinances. As such, disaster risk management directly influences the amount of loss and damage incurred from disasters and explains why hazards of equal magnitude create varying patterns of loss and damage. The severity of a disaster, and consequently the degree

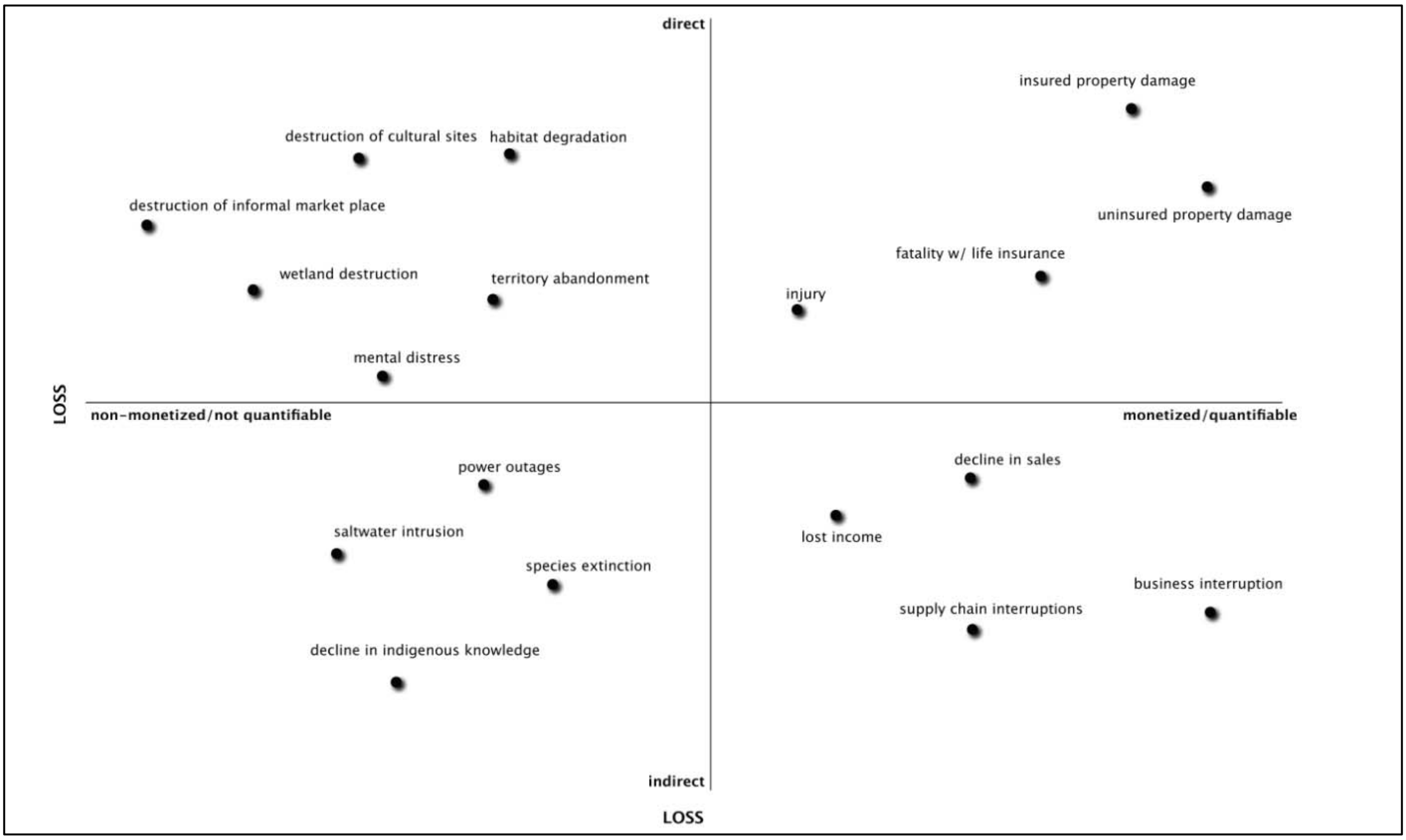

Figure 2: Current loss and damage databases focus on losses in the top-right quadrant. Non-economic and indirect losses are largely absent from disaster impact assessments.

[9] National Research Council. The Impacts of Natural Disasters: A Framework for Loss Estimation. Washington, D.C.: National Academies Press, 1999. The insurance industry generally differentiates between insured and uninsured losses only without further distinguishing between costs or damage.

[10] Resilience is defined here as a system’s ability to adapt and adjust to new conditions and a changing environment.

of loss and damage, is an immediate reflection of the effectiveness of local risk management strategies and community resilience. Loss and damage are consequently performance metrics of disaster risk management

...loss and damage can be used to assess the effectiveness of climate adaptation strategies...

Similarly, loss and damage can be used to assess the effectiveness of climate adaptation strategies. Understanding the impacts of both natural hazards and climate change provide the knowledge base for comprehensive risk management and fact-based decision-making. The quantification of loss and damage is therefore not solely an assessment of the harm done by a disaster and climate change, it is also an evaluation of risk management strategies: high amounts of loss and damage equal insufficient or inadequate risk management; low loss and damage reflect a level of risk management appropriate to current conditions.

The relationship between risk management, exposure, and vulnerability becomes apparent in the different loss patterns that developed and developing countries experience. Developing countries suffer far greater death tolls than do developed countries.[11] The absence of effective disaster risk management and resources for disaster preparedness at national and sub-national government levels, combined with limited resilience at the individual level, create highly vulnerable environments – especially in least developed countries. The 2004 Indian Ocean Tsunami, which killed more than 165,000 people in Indonesia alone, or Cyclone Nargis with more than 138,000 fatalities in Myanmar are stark reminders of these conditions.[12]

The economic impact is often equally devastating to the economies of developing countries, but pales in absolute term to that of developed countries. Although developed nations have improved their risk management, as evidenced in the much lower death toll figures, they are highly susceptible to catastrophic economic losses. While past risk management strategies significantly reduced the human toll, these strategies appear to be insufficient and inadequate in limiting the concentration of valuable assets in high risk areas.[13] As a consequence, today's disasters cause exorbitant direct losses and a multiple in indirect losses. For example, the 2011 Tohoku-Oki earthquake in Japan triggered an estimated $171-183 billion in direct losses – plus an estimated $122 billion in recovery costs.[14]

2.3 Detecting Climate Change Effects at the Local and Regional Levels Through Loss and Damage Data

The effects of a changing climate and the impacts of more extreme weather events (heavy precipitation but also increased intensity of tropical storms) will likely alter disaster losses as we know them today. Without the implementation of effective risk reduction measures, loss and damage will continue to increase due to more severe and frequent events. Climate change-induced shifts in rainfall and temperature patterns along with sea-level rise will likely worsen the impacts of some hazards (e.g., tropical cyclones, droughts). Not only will climate change likely bring more intense and severe events but it will also bring extreme events into areas unaccustomed to them.[15]

Risk information, i.e. loss and damage data, is indispensable when it comes to translating global climate change effects into local weather and disaster impacts. As stated in a recent G20 publication by the

[11] Toya, Hideki, and Mark Skidmore. "Economic Development and the Impacts of Natural Disasters." Economics Letters 94, no. 1 (2007): 20-25.

[12] CRED. "Em-Dat: The International Disaster Database." Leuven University, www.emdat.be.

[13] Government of Mexico, and The World Bank. "Improving the Assessment of Disaster Risks to Strengthen Financial Resilience." 296. Washington D.C.: International Bank for Reconstruction and Development/International Development Association of The World Bank, 2012.

[14] Norio, Okada, Tao Ye, Yoshio Kajitani, Peijun Shi, and Hirokazu Tatano. "The 2011 Eastern Japan Great Earthquake Disaster: Overview and Comments." International Journal of Disaster Risk Science 2, no. 1 (2011): 34-42.

[15] IPCC, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and Ii of the Intergovernmental Panel on Climate Change.

Government of Mexico and The World Bank: "The need for better information on adverse natural events and associated economic, fiscal and social impacts emerges as a key message."[16] The G20 report highlights the need for investing in the collection, analysis, management, and dissemination of loss and damage data to foster the understanding of vulnerability and exposure and to limit the combined effects of climate and anthropogenic change. If this is not done – the report warns – the economic burden of disasters will exacerbate governments' contingent liabilities and increase fiscal and economic instability.

1. Loss and damage are critical information for managing the risks associated with disasters and climate change. Loss and damage data offer:

2. documentation of adverse impacts from disasters and climate-sensitive hazards on local societies, economies, and environments;

3. development of a loss and damage baseline in order to monitor changes in disaster and climate change risk;

4. identification of spatial and temporal trends in loss and damage;

5. prioritization of areas susceptible to loss and damage and in need of risk reduction and adaptation strategies;

6. performance evaluation of risk management strategies, not only in terms of climate change adaptation but also in regard to advancements in resilience;

7. development of loss and damage scenarios along with calibration of probabilistic risk; and

8. attribution of disaster impacts due to climate change.

[16] Government of Mexico and The World Bank, "Improving the Assessment of Disaster Risks to Strengthen Financial Resilience."

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Thus, loss and damage information enables effective disaster climate change risk management as well as more scientific endeavours such as forecasting and attribution research. The latter is of particular importance since, at the moment, the IPCC sees no evidence for a climate change signal in globally rising losses. [17] The current, state-of-the-art knowledge attributes the rise in loss and damage to the concentration of assets and population growth in hazardous areas – not climate change. As stated in the IPCC report: "Long-term trends in economic disaster losses adjusted for wealth and population increases have not been attributed to climate change, but a role for climate change has not been excluded (high agreement, medium evidence)."[18]

Recently though, researchers began utilizing loss and damage data to investigate this linkage between rising losses and climate change. By accounting for changes in the exposure of both people and economic assets over time, researchers adjusted (normalized) loss data from past events to study the relationship between increasing disaster losses and growth in population and/or wealth. Gall et al. found hazard losses to increase even after adjusting for social and economic factors.[19] The authors speculated that the cause of the continued rise of losses could be climate change and/or a reduction in societal resilience. While Gall et al.

[17] IPCC, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and Ii of the Intergovernmental Panel on Climate Change.

[18] IPCC, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and Ii of the Intergovernmental Panel on Climate Change.

[19] Gall, Melanie, Kevin A. Borden, Christopher T. Emrich, and Susan L. Cutter. "The Unsustainable Trend of Natural Hazards Losses in the United States." *Sustainability* 3 (2011): 2157-81.

based their analysis on direct losses in the United States, Barthel and Neumayer utilized insured losses to explore the relationship between climate change and impacts. [20] Barthel and Neumayer did not find a global trend, although, they identified a positive trend for both the U.S. and Germany after normalizing the loss data. It is important to note these studies provide inconclusive evidence regarding the linkage between climate change and disaster losses.

In order to foster fact-based climate change risk management and to research the connection between climate change and climate-sensitive hazards such as floods, droughts, sea-level rise as well as rising losses, it is imperative to develop a global record on loss and damage and where needed improve existing information.

2.4 An Incomplete Picture of Loss and Damage

The most widely used measures of disaster impacts are (a) direct losses, meaning the hazard's immediate, physical damage to property, infrastructure, agriculture and human life and (b) insured losses. Direct as well as insured losses are largely reduced to monetary damage, fatalities and injuries. At present, the use of direct losses dominates all other loss measures due to the tangible nature of physical damage.

Direct losses, are by no means always accurate and reliable. In fact, their monetized values and counts of injuries and fatalties are generally estimates and can vary dramatically between different sources. For example, estimates of losses from the 2011 Japan earthquake range from over US$ 170 billion and 14,000 fatalities [21] to around US$ 309 billion and 16,000 fatalities. [22] The reason for such discrepancies lies mostly in the inclusion or exclusion of different impact types (e.g. insured losses, indirect, etc.).

[20] Barthel, Fabian, and Eric Neumayer. "A Trend Analysis of Normalized Insured Damage from Natural Disasters." *Climatic Change* 113, no. 2 (2012): 215-37
[21] Ibid.,
[22] http://earthquake.usgs.gov/earthquakes/eqinthenews/2011/usc0001xgp/#summary

Although experienced damage appraisers and estimation guidelines can increase the likelihood of reliable impact assessments,[23] the fact remains that most losses are estimates. As a result, many direct loss estimates often originate from unvented, secondary sources such as newspapers or humanitarian agencies. This creates competing estimates of unknown quality and origin[24] – often combining and merging different types of losses.

A far more challenging endeavour than providing reliable estimates of physical damage, however, is broadening loss assessments to include other types of losses. Currently, data on (a) indirect losses (e.g., reduced crop yield), (b) non-monetized losses (e.g., lost territory), and (c) costs incurred from a disaster are largely absent from assessments. The lack of this information produces incomplete and skewed risk assessments that are biased toward direct economic and direct human loss.

The inclusion of costs, indirect as well as non-monetized loss into loss estimation is of paramount importance for a sound understanding and quantification of the full impacts of disasters and climate change (Figure 2). This relates particularly to the damage of non-monetized resources such as natural, cultural and social capital and the relationship between ecosystems and society. Saltwater intrusion due to sea-level rise or drought, for example, could render existing water sources for irrigation and drinking water unusable. In this case, the environmental, non-monetized loss could have long-term economic effects on agriculture through higher costs for irrigation and well drilling and could also lead to a decline in human health and in some cases could even force farmers to entirely abandon their land. Although disasters also adversely affect the social, cultural and environmental, those effects are rarely captured in loss estimates and subsequently in loss and damage databases.

[23] NWS. "National Weather Service Policy Directive 10-16: Operations and Services Performance." Silver Spring, MD: Department of Commerce, National Oceanic & Atmospheric Administration, National Weather Service (NWS), 2009.
[24] Guha-Sapir, Debarati, and Regina Below. "Collecting Data on Disasters: Easier Said Than Done." Asian Disaster Preparedness Center, http://www.adpc.net/v2007/IKM/ASIAN%20DISASTER%20MANAGEMENT%20NEWS/2006/Apr-Jun06.pdf.

Thus, today's loss and damage information is not only incomplete but underestimates the true impacts of natural hazards and (unnatural) disasters and subsequently of climate change. Implementing so-called full-cost accounting approaches related to disaster and climate change risk management – meaning capturing the entire spectrum of the economic, social, and environmental burden suffered from disasters and climate change as well as the costs associated with recovery and adaptation – is indispensable in order to realistically reflect the true burden of disasters and climate change.

2.5 All Loss and Damage Matters – but how to measure it?

The absence of indirect, and non-monetized loss data is rooted in the methodological challenges associated with their quantification. At present, the measurement of indirect losses is rudimentary – often a mere multiplication of direct or insured losses using subjective multiplication factors.[25] An indirect loss can be economic (e.g., lost revenue, supply chain disruptions), social (e.g., destruction of culturally meaningful sites, forced relocation, erosion of trust), or environmental (e.g., pollution, destruction of wetlands and mangroves). Economic techniques for modelling indirect losses exist (e.g., lost productivity, ecosystem valuation, econometric models, general equilibrium models, etc.),[26] but have not been widely used to supplement direct loss estimates.

Estimating indirect losses for a singular hazard event or disaster is not only difficult methodically but relies on a systems-approach that various by assessment scale (e.g., household, community, province, country, region, etc.) and purpose. Capturing indirect losses for a household involves fewer socioeconomic and environmental interactions and feedback loops than estimating the indirect losses for a country or region.

Take the example of a farmer who lost his maize crop in a flood disaster. Applying the definitions above, the farmer's crop loss would be considered a direct loss and assessed based on the market value per bushel. If the farmer had had crop insurance or had received external aid, he would have been able to recoup some of his direct losses. As such, the flood disaster would have caused the country's government or the farmer's insurance significant costs, while the farmer might have even been made whole with all his (direct) losses replaced. For the country, direct losses associated with the flood disaster included all farmers' crop losses as well as other direct physical and human losses.

However, the farmer lost not only his crop and income. Subsequent effects of the flood could cause the following indirect losses for the farmer's household: e.g., lower crop yields in subsequent years due to erosion, need to sell livestock to supplement income, children dropping out of school to work on the fields, farm workers losing their source of income, and so on.

Assessing the country's indirect losses from the flood disaster though would be vastly different than for the household of the farmer. At the country level, indirect losses could include need for grain imports, rise in food prices, abandonment of farms and migration, and so forth. Thus, indirect losses are much more difficult to assess then direct losses because they require complex modelling and an understanding of system interactions and feedbacks.

Aside from identifying indirect losses, their quantification is even more problematic. What is the worth of lost years of education or forced migration? Can a value be assigned to the loss of territory or cultural heritage? It can but not without challenges as discussed in section 4.

In addition to indirect and non-monetized losses, there is furthermore a lack of information on disaster costs. This, however, cannot be explained by methodological challenges. Costs are actual monetized expenditures and not estimates – at least theoretically. For instance, the amount of insured damages is equivalent to claims paid by insurance agencies and consequently a cost to the insurance industry. However, claims information is of proprietary nature and distributed across numerous

[25] Barthel, Fabian, and Eric Neumayer. "A Trend Analysis of Normalized Insured Damage from Natural Disasters." Climatic Change 113, no. 2 (2012): 215-37.

[26] Cochrane, Hal. "Economic Loss: Myth and Measurement." Disaster Prevention and Management 13, no. 4 (2004): 290-96; Constanza, Robert. "The Value of Natural and Social Capital in Our Current Full World and in a Sustainable and Desirable Future." In Sustainability Science: The Emerging Paradigm and the Urban Environment, edited by Michael P. Weinstein and R. Eugene Turner. 99-109. New York: Springer, 2012.; Cropper, Maureen L., and Sebnem Sahin. "Valuing Mortality and Morbidity in the Context of Disaster Risks." Washington, D. C.: The World Bank, 2009.

insurers making it difficult to access and aggregate. Disaster-related expenditures by governments[27] and non-governmental organizations, although often public, are rarely consolidated or identified as post-disaster costs. Unlike indirect and non-monetized losses, which are difficult to assess and measure, costs are measured and generally expressed in monetary terms but accessing this information is difficult.

Further complicating the issue is the fact that there are overlaps between the different types of losses and costs. The different types of losses as well as costs cannot be simply added in order to determine the full impact of a disaster. The degree to which there are overlaps and "double-counting" in loss estimates is unclear. Research in this area is largely absent due to methodological challenges mentioned above as well as the unavailability of data on costs.

...methodological, empirical, proprietary, as well as administrative barriers impede realistic estimations of loss and damage...

Overall, methodological, empirical, proprietary, as well as administrative barriers impede realistic estimations of loss and damage. There are not only data access and data reliability issues but also significant knowledge gaps particularly in the area of indirect and non-monetized losses. Thus, significant advancements in the documentation of losses and costs, loss modelling, output validation, valuation of indirect as well as non-monetized losses, and access to cost data are necessary to generate reliable, consistent and comprehensive estimates of loss and damage. Without such advances, impact and risk assessments remain biased toward direct losses and physical damage. Again, direct (i.e. physical damage) and insured losses dominate today's impact assessments; costs, indirect as well as non-monetized losses of disasters are largely missing. This is the backdrop against which the suitability of loss and damage databases will be evaluated.

3. Data Gatekeepers: The Utility of Loss and Damage Databases and their Influence on Loss Estimates

Disaster loss databases are excellent tools providing broad and public access to loss and damage data. They collect, consolidate, and manage loss data in a central repository that is quickly and easily accessible. The number of national databases has significantly increased over the past decades reflecting their increasing value in risk management. At present, there are 42 loss and databases at the national or regional level (Table 1). Many loss and damage databases include a wide spectrum of hazard types. For the purpose of this report, only databases covering climate-sensitive hazards are considered. The overview presented here includes all national loss and damage database utilizing the DesInventar system as well as additional databases listed in the loss and damage database catalogue hosted by the Global Risk Information Platform (GRIP)[28]. Table 1 and Figure 3 provide a tabular and visual summary of active loss and damage databases. Inactive or rarely updated databases are excluded from this overview.

3.1 Overview of International and National Disaster Loss Databases

At the international level, there are two disaster loss databases with global coverage. The most widely known of these is EM-DAT[29], which was established in 1973 by the Center for Research on the Epidemiology of Disasters (CRED) at the Catholic University of Louvain, Brussels. Its long-standing experience with loss and damage data collection has made CRED along with re-insurance companies such as MunichRe and SwissRe a thought leader on loss and damage data needs and quality standards.
Another publicly accessible, global database is the Global Disaster Identifier Number (GLIDE) database. The Asian Disaster Reduction Center (ADRC), which maintains the GLIDE database, generates a unique

[27] Many government expenditures (partially) reimburse disaster victims or provide some form of aid. Thus, one could ask if disaster costs at the federal level are actually costs to the taxpayer and the society at large?

[28] http://www.gripweb.org/gripweb/

[29] Accessible via http://www.emdat.be/database.

identifier for certain disaster events based on user requests. Thus, the GLIDE database is not comprehensive and has the sole purpose of linking loss and damage across databases and to advance event and data comparability.

In addition to these publicly accessible disaster loss databases, there are several peril databases of proprietary nature – particularly in the insurance and re-insurance sectors (e.g., Swiss Re, Munich Re). The majority of available disaster loss databases exist at the national level – about 75 percent of which utilize the DesInventar data management approach. The subsequent discussion will therefore briefly outline the DesInventar system and discuss specific benefits and shortcomings rather than discussing individual databases.

3.2 DesInventar Data Management

Dating back to the mid-1990s, members of the network LA RED (Network of Social Studies in the Prevention of Disasters in Latin America) initiated the systematic data collection of loss information in Latin America. The group's brainchild is the development of the tools and methodology behind the Disaster Inventory System, better known as DesInventar.[30] This data management system consists of guidelines for data collection, data entry and database management along with a database and data entry interface. The popularity of this ready-made data management system continues to grow, adding national databases at a slow but steady pace. At present, 33 out of the 42 loss and damage databases are utilizing the DesInventar system. See Table 2 for key attributes of DesInventar-based disaster loss databases.[31], [32]

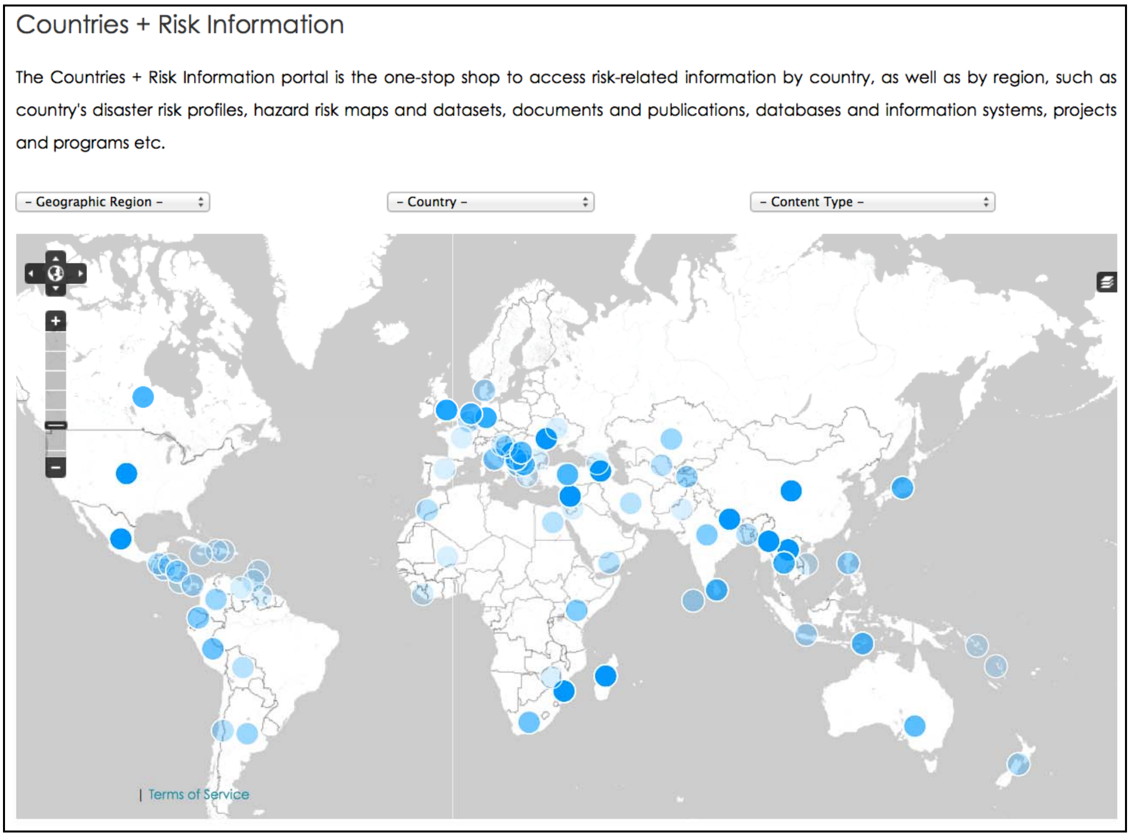

Figure 3: Screenshot of the Countries + Risk database portal hosted by the Global Risk Information Platform (GRIP).The blue dots identify countries that have national/regional loss and damage databases.
Source:
http://www.gripweb.org/gripweb/?q=countries-risk-information

[30] http://www.desinventar.org/en/desinventar.html

[31] It is important to note, that DesInventar allows for customization. Aside from the preset definitions and categories, users are able to define additional categories of hazards, impacts, and causes according to local conditions and needs.

[32] DesInventar. "Disaster Inventory System: Methodological Guide, Version 8.1.9." 22, 2009.

Country	*Type*	*Ownership*	*Temporal Coverage*
Andean Information System for Disaster Prevention and Relief	regional	Andean Information System for Disaster Prevention and Relief	n/a
Argentina	DesInventar	Centro Estudios Sociales y Ambientales	1970-2009
Australia	national	Emergency Management Australia	1622-present
Bangladesh	national	Ministry of Food and Disaster Management	1970-2009
Barbados	regional, DesInventar	Caribbean Disaseter Emergency Response Agency	n/a
Bolivia	DesInventar	VICEMINISTERIO DE DEFENSA CIVIL	1970-2010
Canada	national	Public Safety	1900-present
Chile	DesInventar	Department of Environmental Sciences and Natural Resources of the University of Chile	1970-2009
Colombia	DesInventar	OSSO Corporation	1914-2011
Costa Rica	DesInventar	Comisión Nacional de Prevención de Riesgo y Atención de Emergencias	1970-2010
Dominican Republic	DesInventar	LaRed	1970-2009
Ecuador	DesInventar	Secretaría Nacional de Gestion de Riesgo	1970-2010
Egypt	DesInventar	Information and Decision Support Center	1980-2010
El Salvador	DesInventar	National Service of Territorial Studies	1900-2011
Guatemala	DesInventar	Facultad Latinoamericana de Ciencias	1988-2010
Guyana	DesInventar	Sociales	1972-2011
Honduras	DesInventar	Permanent Commission for Emergency Management	1998-1999
India	regional, DesInventar	State Disaster Management Authority of Mizoram	1992-2010
Indonesia	DesInventar	National Agency for Disaster Management (BNPB)	1815 -present
Iran	DesInventar	UNDP	1895-2011
Jamaica	DesInventar	University of West Indies	1973-2002
Jordan	DesInventar	Civil Defense	1981-2010
Laos	DesInventar	National Disaster Management Office	1990-2012
Maledives	DesInventar	Ministry of Defense	1980-2007
Mali	DesInventar	Protection Civile	1999-2012
Mexico	DesInventar	La Red	1970-2009
Morocco	DesInventar	Ministry of Environment	1970-2009
Mozambique	DesInventar	National Disaster Management Institute	1979-2009
Nepal	DesInventar	National Society for Earthquake Technology	1971 - present
Nicaragua	DesInventar	Ministry of Defense	1998-1999
Panama	DesInventar	Sistema Nacional de Protección Civil	1929-2011
Peru	DesInventar	Centro de Estudios y Prevencion de Desastres	1970-1999
Phillipines	national (password required)	Office of Civil Defense, National Disaster Coordinating Council	1969 - 2009
Solomon Islands	DesInventar	SOPAC	1568-1964
Sri Lanka	DesInventar	Disaster Management Center	1974 - present
Timor Leste	DesInventar	National Disaster Management Directorate	2001-2011
Trinidad - Tobago	DesInventar	n/a	n/a
United States	national	Hazards Vulnerability and Research Institute, University of South Carolina	1960 - present
United States	national	National Climatic Data Center	2006-present
Venezuela	DesInventar	CENAPRED	1970-2007
Vietnam	national	Central Committee for Flood and Storm Control	1989-2008
Yemen	DesInventar	Ministry of Environment	1970-2011

Table 1: List of countries with national and/or regional loss and damage databases (Source: GRIP).

Data	*Hazard Types*[33]	*Loss Categories*
Unit of Analysis: best resolution available; can range from sub-national levels to city neighbourhoods Source: secondary (e.g., newspapers, NGO reports, government reports, etc.); all loss-causing events are entered (no thresholding) Availability: public, online from http://www.desinventar.org Download formats: tables (.xls, .cvs) and graphics (.png, .kml) Documentation: user manual, methodological and technical guidelines; meta-data	Mass movements (e.g., landslides, mudslides, etc.) Avalanche Biodiversity decline Coastline changes Drought Lightning Biological hazards (e.g., influenza outbreak, locusts) Fog Wildfires Frost High winds Hail Tropical cyclones Riverine and flash floods Heavy rainfall Sedimentation and accretion Heavy snowfall Severe thunderstorm Storm surge Tornado	Number of fatalities Number of injured people Number of missing people Number of people affected directly (e.g., destruction of home) Number of people evacuated temporarily Number of people relocated permanently Monetized direct loss (in local currency and US$) Number of livestock lost number of area of destroyed or affected agriculture (in hectares) destroyed or impassable roads (in meters) Number of education facilities incl. child care facilities affected directly and/or indirectly Number of health care facilities affected directly and/or indirectly Number of homes with minor damage Number of homes with extensive to catastrophic damage Information (affected/not affected) on water and sanitation, transportation and communication networks; emergency aid/management infrastructure; as well as educational, agricultural, health, energy, and industry sectors

Table 2: Hazard types and loss categories reported by DesInventar databases

[33] DesInventar includes a wide range of hazards including technological and chemical events. Only, climate-sensitive hazards are listed here.

DesInventar has two unique features compared to other loss and damage databases – analytical capabilities and the documentation of "causes" associated with a loss event. A "cause" represents an underlying or triggering mechanism unrelated to the hazard itself but important in explaining its impacts. The idea behind this approach is the widely recognized fact that hazard events are of natural origin but the underlying socioeconomic drivers are what turns a hazard into a disaster. Examples of "causes" include behavioural practices, building design, atmospheric conditions, and so forth. Any information listed as a cause in a DesInventar database should be considered descriptive, anecdotal information unless noted otherwise since it is difficult to determine a cause or driving force without empirical research and evidence.

The implementation of analytical features distinguishes DesInventar from other databases. Aside from tabular information, DesInventar generates maps as well as graphics (histograms and pie charts) with a high degree of customization. All outputs can be downloaded. However, the ability for quick analytics comes with some limitations. Losses are only reported in absolute terms without the ability to standardize by population or area. Thus, DesInventar relies on the user to inflation-adjust and standardize loss information (e.g. per capita, per square mile) for further analysis. Common analytical steps that require such user input are, for example, comparisons of two regions to each other or trend analysis for a single community.

3.3 Database Management Practices and their Influence on Loss and Damage Estimates

As discussed in section 2, loss and damage estimates vary in terms of reliability and accuracy based on the issues surrounding loss types and loss quantification (see sections 2.4 and 2.5). Reporting and/or combining different types of losses results in diverging loss estimates. What is a largely ignored but important issue, is the effect that the design and management of a database has on the reporting of losses.

Users of loss data are rarely aware of the biases introduced by the design and purpose of the database itself. That said, there are several known shortcomings and biases within databases, including:[34]

1. Hazard bias: Hazard types tend to be unequally represented within a disaster loss database. This can be due to the selective use of data sources, collaboration with a specific data provider, data preparation guidelines, and so forth. As a result, many databases contain better information on acute disasters (e.g., earthquakes) than low impact (e.g., severe thunderstorms) or chronic disasters (e.g., coastal erosion).
2. Temporal bias: The quality and quantity of loss estimates vary over time. Historic loss estimates, for example for the 1970s and prior, tend to be of lower quality and more difficult to collect (i.e. require archival work). Technological improvements in loss collection, reporting, and communication make today's loss estimates appear more prevalent. However, an increase in the frequency of disasters losses within a database could solely be a factor of better reporting and not necessarily a sign of changing hazard return periods. Likewise, databases tend to evolve over time and in many instances estimation techniques or data preparation guidelines are modified throughout the lifetime of the database, which could also introduce a temporal bias.
3. Threshold bias: Low-impact and chronic events are underreported in loss and damage databases since it is more difficult to find reports and loss estimates associated with such events. Additionally some databases apply thresholds excluding loss events below a certain threshold (e.g., EM-DAT). Again, such an approach undervalues the importance of chronic and frequent (though not catastrophic) events and ignores the cumulative effects of chronic and low-impact events.
4. Accounting bias: Non-monetized and indirect losses – especially social and environmental – are largely absent. Monetized and direct losses dominate. This leads to an

[34] Gall, Melanie, Kevin A. Borden, and Susan L. Cutter. "When Do Losses Count? Six Fallacies of Natural Hazards Loss Data." *Bulletin of the American Meteorological Society* 90, no. 6 (2009): 799-809.

underestimation of the full impact of an event. Excluding indirect and non-monetized losses leads to simplistic loss assessments and reduce disasters to their physical damage.

5. Geography bias: Not every region within a country or even globally is equally represented within a database. This often depends on data access – e.g., some regions lack newspapers, radio, etc. It can also be rooted in a specific focus or mission of the agency operating the disaster loss database.

These biases often go undetected in loss assessments. However, understanding them is essential for a sound interpretation of trends and patterns in loss and damage data.

4. How to Improve Loss and Damage Databases to Better Assess Climate Change Impacts at Local and Regional Levels

As discussed in section 2, there are significant methodological and conceptual shortcomings in measuring loss and damage comprehensively. Database administrators have limited influence on the quality loss and damage data since they generally do not conduct any loss appraisals. But they assume responsibility for data management and data curation, such as database design, event classification, attribution, database accessibility, data compatibility, and more.

The subsequent sections propose modifications to disaster loss databases to better serve the information needs of the climate change community. All suggestions build upon existing database efforts and the valuable experience gained over the past decades in using loss data for disaster risk management.

4.1 Action #1: Expand Loss Assessments with Indirect and Non-Monetized Loss and Damage Information

The lack of indirect and non-monetized loss data, especially regarding social, cultural and environmental losses, is a major shortcoming of existing loss and damage databases. The inability to consider non-monetized losses severely underestimates the effects of climate change. Currently, indirect and non-economic losses are included – if at all – at a very generic level focusing on socioeconomic impacts (see DesInventar).

There is a huge potential to advance loss estimation techniques and probabilistic forecasts by including impacts on informal economies, adverse environmental effects and perhaps attempting to value (monetize) those effects. Drawing on research in ecological modelling and ecosystem valuation including cultural services[35] could possibly provide a starting point for broadening loss assessments. As long as informal economies, natural and cultural resources and ecosystem services are not valued, shocks to those systems will not be reflected in risk assessments – both in the context of climate change and disaster risk management. If valuation cannot be achieved in the near future, an alternative solution could be the establishment of new qualitative rather than quantitative loss categories that capture non-monetized losses.

4.2 Action #2: Add Climate Change-Related Hazard Types Based on Hazard Origin

In general, natural hazards are classified either based on their origin (e.g., geological, hydrological, meteorological, technological, biological or man-made) or their characteristics (e.g., magnitude, speed of onset, duration, etc.). All existing disaster loss databases exclusively utilize the origin-based hazard classification approach. For example, a flood event falls into the category of hydrological hazards, which is then further broken down by flood type (e.g., riverine flood, flash flood, ice jam flooding, levee failure, storm surge, etc.). A drought has a meteorological origin with different drought types (e.g., agricultural drought, hydrological drought, etc.).

To capture and document the adverse effects of climate change, new hazard types (e.g., ocean acidification, desertification, sea-level rise, etc.) need

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[35] Daniel, T. C., A. Muhar, A. Arnberger, O. Aznar, J. W. Boyd, K. M. Chan, R. Costanza, *et al.* "Contributions of Cultural Services to the Ecosystem Services Agenda." [In eng]. *Proceedings of the National Academy of Sciences of the United States of America* 109, no. 23 (Jun 5 2012): 8812-9.

to be developed that follow the origin-based logic – perhaps even a new hazard origin (e.g., climate change). When doing so, it is imperative that such new hazard types possess enough specificity i.e. the causal relationship between the hazard and outcome (loss and damage) must be clear. This would require the climate change and adaptation community to translate slow-onset events (e.g., ocean acidification, desertification, sea-level rise) into more specific, damage-causing hazards.

Climate change as a hazard is too generic as hazard types due to difficult attribution. For example, climate change itself does not cause damage but hazards such as coastal erosion, saltwater intrusion, coastal flooding, etc. do. The following list, although incomplete, provides a starting point and suggestions of new hazard types that could be included in loss and damage databases to capture climate change effects:

- Coastal flooding
- Coastal erosion
- Saltwater intrusion
- Coral bleaching
- "Mal"-calcification (inadequate calcification of shells)
- Hypercapnia
- Desertification
- Species loss
- Habitat shift
- …

Such new hazards would follow the traditional classification approach of loss and damage databases by linking the type of impact to the outcome (loss and damage).

4.3 Action #3: Add and Standardize Climate Change-Relevant Loss Categories

What is and is not included in a loss and damage database dates back to the decisions made during the design process of the database. Some databases resort to the smallest common denominator in loss estimates and report only hazard type, location, date, fatalities, injuries and monetized direct losses. Using a small set of variables has the advantage that all events in the database are likely to have complete information across all variables.

DesInventar databases have generally 15 different loss categories (Table 2). A large set of variables captures the impact more widely but bears the risk of creating a false sense of accuracy and limits comparability between events due to missing data. For example, DesInventar distinguishes between seven categories of humanitarian impacts: number of people killed, injured, missing, affected directly, affected indirectly, evacuated, and relocated. Not only is it difficult to get reliable information on all these attributes but there is a high risk of overlapping information and double-counting. Let's take the example of a person who was injured, then evacuated and treated elsewhere, and ultimately decided to stay where he/her lived temporarily rather than returning back home: this person would be counted three times in DesInvetar – as injured, evacuated and relocated. While the estimates on each loss attribute would be correct, it is not possible to sum the various loss categories due to overlaps between them.

It could be beneficial to revise or update loss categories, ideally producing a list with a standard set of loss categories that also include more climate-centric loss categories such as loss and damage related to forestry, fishery, agriculture, etc. Non-monetized loss and damage could be measured in units lost (e.g., number of species lost, acreage of arable land lost, etc.) or as a deviation from average or "normal" (e.g., reduction in shell calcification). This, however, would require extensive inventorying efforts to establish pre-climate change levels across social, economic, and environmental systems that can serve as future baselines. Without a sound reference point, it is difficult to assess climate change impacts that lead to decline or reduction.

Revising or modifying loss categories in databases does not necessarily generate a better or more comprehensive picture of loss and damage. The lack of data in the various loss categories is a consequence of inadequate data collection and loss appraisal efforts. This problem is a reflection of issues surrounding loss estimation rather than a reflection on loss and damage databases themselves. Thus, a discussion on loss categories is inevitably connected to the discussion of data collection standards and procedures. Raising the quality standards of loss data can only be achieved during the collection phase. Initiating a loss standardization/harmonization effort would also provide an opportunity to expand traditional loss assessments and to push the research community to develop new methods to account for indirect and non-monetized losses.

4.4 Action #4: Establish Database Standards to Ensure Compatibility and Comparability

Disaster loss databases need to accommodate various levels and scales of data aggregation to support loss assessments and sound risk management decisions. The most common aggregation methods are by hazard type (e.g., floods), by disaster event (e.g. Cyclone Nargis), location/region (e.g. Southeast Asia), across time (e.g. 1980s), and loss category (e.g., total death toll).
A simple question such as – How much damage did a tropical cyclone cause and what areas were most heavily affected? – is difficult to answer for many disaster loss databases. In fact, most databases will contain data entries by location, hazard type, and loss type and not necessarily a specific disaster. Only a database with the capacity to link smaller events/disasters to a more complex event will be capable of answering this question. This could be achieved, for example, with event identifiers, which few databases contain.

At the international level such an identifier exists: for sufficiently large disasters a GLIDE (Global Identifier) number is issued by the Asian Disaster Reduction Center. However, the GLIDE number is only integrated into a few databases. In theory, losses stemming from the same event (e.g., tropical cyclone, tsunami, etc.) but housed in separate national databases can be connect (and compared) through this global identification number to tally losses.

Differences in hazard and loss definitions are another leading cause for vastly disparate estimates between databases. For example, DesInventar databases do not use the term "landslide" – generally defined as the movement of wet and/or dry materials down a slope.[36] Instead, DesInventar uses the term "alluvium" – defined as torrents of water, which drag great quantities of solid material (pebbles, graceland rocks).[37] How to aggregate landslide losses from different databases when terminology and definitions are not standardized?

Such variations in hazard definitions occur most frequently with multi-hazard events (e.g., tropical cyclones) and complex events (e.g., drought,). Tropical cyclones, for example, can bring heavy rainfall, flooding, storm surges, high winds, and tornadoes. In most (if not all) disaster loss databases, such losses are reported as individual hazards (i.e., flooding, erosion, storm surge, etc.) and not as tropical cyclone.

These concerns are not trivial issues and pose major obstacles in utilizing data from different databases simultaneously.[38] For many years, stakeholders at the international level (e.g., Munich Re, EM-DAT, UNISDR, Swiss Re) have worked together to overcome these conflicts. As a result, the group has recently completed the harmonization of hazard types though only EM-DAT, Swiss Re, Munich Re and select national disaster loss databases have implemented this common standard.[39] In addition, the Integrated Research on Disaster Risk's (IRDR) working group DATA is coordinating additional standardization efforts. Objectives of this working group are, among others, the development of database standards (e.g., loss categories, hazard types), database compatibility as well as outreach.

These standardization efforts, however, are steeped in traditional disaster risk management and do not consider categories for hazards arising from climate change (e.g., coral bleaching, desertification, etc.). Disaster risk management tends to operate at the local and national level without the need to consolidate and aggregate data from multiple databases. This contrasts the needs of the climate change community where both an understanding of local as well as regional conditions are critical for the development of adaptation strategies. For the purpose of climate change assessments, national loss

[36] Keller, Edward A., and Robert H. Blodgett. *Natural Hazards: Earth's Processes as Hazards, Disasters and Catastrophes*. 2nd ed. Englewood Cliffs, New Jersey: Prentice Hall, 2007.

[37] DesInventar, "Disaster Inventory System: Methodological Guide, Version 8.1.9."

[38] Wirtz, Kron, Löw, and Steuer, "The Need for Data: Natural Disasters and the Challenges of Database Management." *Natural Hazards,* doi: 10.1007/s11069-012-0312-4.

[39] Below, Wirtz, and Guha-Sapir, "Disaster Category Classification and Peril Terminology for Operational Purposes."

and damage databases have to be compatible in order to allow for data aggregation and comparisons across hazard, loss, space and time. In other words, disaster loss databases need to standardize event identification, hazard types, and loss categories (e.g., direct, indirect, monetized, non-monetized, etc.).

4.5 Action #5: Document the Investments Made in Disaster Recovery and Climate Change Adaptation

Climate-centric loss and hazard categories are not the only information missing from disaster loss databases. All existing disaster loss databases exclude costs. Moreover, what society spends on hazard mitigation and climate change adaptation is also excluded. The cost of sea walls, dykes, irrigations systems and so forth are all measures to prevent and reduce the impacts of storm surge, sea-level rise, drought, and other impacts of climate change. Unfortunately, these costs are not documented. To overcome this problem, supplementary "climate investment databases" could be developed similar to the PERI Presidential Disaster Declarations database, which documents all federal dollars disbursed to U.S. counties after major disasters.[40]

Documenting costs provides the opportunity to explore the cost-benefit relationship between hazard mitigation, climate change adaptation, and disasters. Only few studies exist that trace the relationship between adaptation investments and avoided losses from disasters. [41] Better data on adaptation investments and perhaps cost-benefit analyses could aid in garnering support for future investments.

4.6 Action #6: Implement Periodic Reviews of Loss Estimates and Expand the Loss Estimation/Accumulation Period

Possibly the most critical concern regarding the suitability of loss and damage data is the limited time frame applied to the determination of impacts. Direct losses occur during the actual exposure to the event. Indirect and non-monetized losses as well as costs, however, accumulate and unfold gradually after the event. For example, a tropical cyclone might destroy fishing boats, mangroves, and reduce the shrimp harvest. Most likely, the only losses considered in loss and damage databases will be the direct property loss of boats and possibly the estimated impacts on the shrimp harvest. The loss and damage database will not document lower shrimp yields and lower incomes for local fishermen in subsequent years.

The time lag in the manifestation of loss and damage should necessitate regular updates of loss estimates – weeks, months or perhaps even years after the event. Meteorological and hydrological hazards such as floods and droughts cause damage long after the event is over, affecting crop yields, altering planting seasons, eroding soil, and so on. To capture such delayed impacts, event estimates and database records need to be updated.

How long is the aftermath? Climate change concerns shift the time dimension. When do indirect impacts or the effects of climate change end? If there is no end date, would this mean that loss estimates would be continuously raised over time or are these generational costs? While traditional loss assessments focus on direct damage and the initial exposure and destruction phase, assessing the full impact of climate change would require a significant expansion of time horizons. For the purpose of climate change assessments, loss estimation techniques should be extended to account for longer time periods – but for how long?

As important as the extension of the loss estimation horizon is the development of loss records dating back as far as possible. Climate change is gradual and only detectable in long data records. Since climate scientists work in increments of 30 years establishing loss and damage records of at least 60 years would provide a more reliable period for analyses. Currently, more than two thirds of the existing disaster loss databases (Table 1) start record keeping in the 1970s or later.

In conclusion, we find that disaster loss databases are suitable for the needs of the climate change community, though, they require some modifications to enhance their utility,. The six actionable activities outlined above draw on the current structure of

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[40] http://www.peripresdecusa.org/mainframe.htm

[41] Tol, Richard S. J. "Is the Uncertainty About Climate Change Too Large for Expected Cost-Benefit Analysis?". *Climatic Change* 56, no. 3 (2003): 265-89.

existing disaster loss databases. Expanding disaster loss databases to better assess the effects of climate change seems feasible and logical given the overlapping interests. Standardization issues regarding hazard types, event identifiers, and loss categories should be pursued to ensure inter-database compatibility. Linking the multitude of disaster loss databases and merging data analytically will increase their utility and explanatory power. Again, collaborative approaches and joined efforts are needed to harmonize loss and damage databases.

In addition, significant improvements in regard to data quality are needed. This, however, goes beyond the scope and capabilities of disaster loss databases. Possible steps to increase data accuracy and quality are briefly outlined in the next section.

5. Recommendations Beyond Loss and Damage Databases

In order to effectively utilize loss and damage databases for the needs of the climate change community, additional recommendations are proposed.

1. Devote More Resources to Improve Data Collection

Loss and damage databases rely on available data. Most loss and damage databases utilize secondary data reported by humanitarian organizations, the media and other sources. Such estimates are often crude estimates and inadequately discern between the different types of loss (e.g., direct, indirect, costs, etc.). Ideally, loss estimates are based on primary data collection such as windshield surveys, damage assessments using satellite imagery, and so forth – an assessment strategy that could be repeated, verified and updated if necessary. Without accurate, observed data on observed loss and damage it is impossible to calibrate existing climate impact models and to develop probabilistic forecasts. [42] Unfortunately, many organizations and countries do not have the resources for such efforts. More investments in training and the use of technology (e.g., satellite imagery) are needed to move forward.

2. Improve and enhance historic climate records

Loss and damage databases document the adverse impacts of natural hazards. They cannot provide climatological data. Establishing frequency or reoccurrence intervals for extreme temperatures, high wind events, tropical cyclones requires climatological record keeping. Maintaining climate event records generally falls into the mission area of national meteorological agencies. Establishing a time record of wind speeds, temperatures, rainfall, and so forth will allow for the detection of changes in climatic patterns. Such information is of particular importance to countries largely unaffected by acute, natural disasters. The occurrence and effects of chronic, slow-onset hazards is should be tracked in loss and damage databases as much as in climatological records. Support for national weather agencies is key to this issue

3. Measure and monitor changes in vulnerability and resilience

Loss and damage are directly correlated with levels of vulnerability, adaptation, and resilience. For example, if a community's vulnerability decreases, it is much more susceptible to catastrophic impacts – for singular disaster events as well as for climate change. As such, it is recommended to document, measure and monitor changes in vulnerability, adaptation, and resilience over space and time. Making the connection and linking vulnerability and resilience to disaster losses is not without methodological and

[42] United Nations Framework Convention on Climate Change. "Current knowledge on relevant methodologies and data requirements as well as lessons learned and gaps identified at different levels, in assessing the risk of loss and damage associated with the adverse effects of climate change", FCCC/TP/2012/1, http://unfccc.int/resource/docs/2012/tp/01.pdf

conceptual challenges as highlighted in the G20 report.[43] Nevertheless, it is pivotal to investigate the underlying causes of losses – independent of physical impacts. Monitoring the trend of losses should be as important as the trends in vulnerability and resilience to climate change. Vulnerability and resilience are the starting point for effective hazard mitigation and climate change adaptation strategies.

4. Improve probabilistic forecasting for proactive climate risk management
Today's risk management is a reaction to past events. Future climate change impacts, however, will likely go beyond known hazard and damage patterns. Hence, comprehensive and proactive climate risk management requires both historic loss and hazard information as well as probabilistic forecasts and decision-making based on robustness of choice. This will be particularly challenging for "new" climate change-related hazards such as sea-level rise, ocean acidification, and so forth.

Implementing these general recommendations will improve the quality and utility of disaster loss databases. Modifying existing loss and damage databases according to the six actionable activities outlined earlier will serve both the needs of the climate change community as well as the disaster risk management community.

While climate change will likely alter hazard and loss patterns, societal changes such as urbanization alter exposure and vulnerability. The societal burden of disaster losses is therefore always a function of hazard magnitude/intensity, vulnerability and resilience. Establishing a link between disaster impacts and climate change requires better knowledge on all fronts: climatology, impacts, vulnerability and resilience. Disaster loss databases document the outcome of this relationship. They provide excellent information to assess losses and monitor progress in disaster and climate change risk management. It seems beneficial for the climate change community to draw on these strengths and utilize disaster loss databases to better understand the relationship between climate change, vulnerability and resilience.

[43] Government of Mexico and The World Bank, "Improving the Assessment of Disaster Risks to Strengthen Financial Resilience."

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The Loss and Damage in Vulnerable Countries Initiative

Accepting the reality of unmitigated climate change, the UNFCCC negotiations have raised the profile of the issue of loss & damage to adverse climate impacts. At COP-16, Parties created a Work Programme on Loss and Damage under the Subsidiary Body on Implementation (SBI). The goal of this work programme is to increase awareness among delegates, assess the exposure of countries to loss and damage, explore a range of activities that may be appropriate to address loss and damage in vulnerable countries, and identify ways that the UNFCCC process might play in helping countries avoid and reduce loss and damage associated with climate change. COP-18, in December 2012, will mark the next milestone in furthering the international response to this issue.

The "Loss and Damage in Vulnerable Countries Initiative" supports the Government of Bangladesh and the Least Developed Countries to call for action of the international community.

The Initiative is supplied by a consortium of organisations including:

Germanwatch

Munich Climate Insurance Initiative

United Nations University – Institute for Human and Environment Security

International Centre for Climate Change and Development

Kindly supported by the Climate and Development Knowledge Network (CDKN)

For further information: **www.loss-and-damage.net**

Germanwatch

Following the motto "Observing, Analysing, Acting", Germanwatch has been actively promoting North-South equity and the preservation of livelihoods since 1991. In doing so, we focus on the politics and economics of the North with their worldwide consequences. The situation of marginalised people in the South is the starting point of our work. Together with our members and supporters as well as with other actors in civil society we intend to represent a strong lobby for sustainable development. We endeavour to approach our aims by advocating fair trade relations, responsible financial markets, compliance with human rights, and the prevention of dangerous climate change.

Germanwatch is funded by membership fees, donations, grants from the "Stiftung Zukunftsfähigkeit" (Foundation for Sustainability), and by grants from a number of other public and private donors.

You can also help to achieve the goals of Germanwatch and become a member or support our work with your donation:

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