Loss and Damage associated with Climate Change Impacts

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Abstract

The impacts of climate change that are not mitigated, or appropriately adapted or coped with, are referred to as 'loss and damage'. The global community has recently recognized that addressing and financing the 'residual' loss and damage from climate change requires a different approach as such costs cannot or have not been appropriately mitigated or adapted to. Although international pressures to weigh a country's contribution to climate change financing against their contribution to climate change has been proposed, no such legally binding climate change deals have been fashioned. Most parties have only agreed to non-binding actions to either reduce emissions or finance loss and damage in low-income, vulnerable countries. This is because the concept of loss and damage and the approaches to address the concept have been widely contested and debated. Additionally, the lack of a global consensus on an appropriate mechanism to attribute gradual and extreme natural calamities to climate change has further intensified the debate. Given this background, this Chapter seeks to synthesize the key issues surrounding this debate. The objectives of this Chapter are to review the definitions of loss and damage; examine the evolution of its significance in the international climate politics; present a comparative analysis of the approaches to address climate change induced loss and damage; and outline empirical evidence of loss and damage in geographically and economically vulnerable nations.

Keywords: Loss and damage; vulnerable countries; mitigation and adaptation; residual; approaches; climate change financing; attribution

1. Introduction

In its effort to combat climate change, the global community focused on rapid reduction of greenhouse gases (GHGs) by implementing enhanced mitigation efforts from the early 1990s to the mid-2000s. By the mid-2000s, scientific evidence indicated the likelihood of global temperature rising between 3°C and 4°C above the pre-industrial level within this century (IPCC 2007). This evidence suggested that mitigation efforts alone will not be sufficient to avoid climate change as some of the climate change impacts may already have started to take effect. Although steep cuts in global GHGs could stabilize atmospheric GHG concentrations at lower levels than under the status quo, they likely would be above the current levels thus resulting in further rises in global temperatures. The projected impacts of a 3°C to 4°C temperature rise would lead to serious consequences for humans and ecosystems due to dangerous sea level rise, unprecedented heat waves, severe drought, and major floods in many parts of the world (IPCC 2014).

Once it became clear that mitigation efforts would be insufficient to avoid all climate change impacts, adaptation became a necessary complement to mitigation (Ott et al. 2008). Adaptation was defined by the Intergovernmental Panel for Climate Change (IPCC) (2001) as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". As of 2007, global adaptation cost estimates ranged between $4 billion a year to well over $100 billion (Parry et al. 2009). These estimates led to the establishment of the Green Climate Fund (GFC) in Durban, South Africa in 2011 during the 16th session of the Conference of Parties (COP), with the objective of raising a minimum of $100 billion per year by 2020 to support sustainable and climate resilient development (Institute for Policy Studies 2014; Green Climate Fund 2014). This came to be known as the 'adaptation fund'.

However, adaptation also appeared to have its limit. It became increasingly apparent that the adaptation cannot successfully contain all the adversities invoked by climate change. Such remnants of the adverse effects of climate change came to be known as 'residual loss and damage'. Widespread international understanding and agreement on the distinction between adaptation and loss and damage was deemed essential in recognizing that not all adversities of climate change can be successfully mitigated or adapted to. Such remnants of the ill effects of climate change impacts were forecasted to account for two-thirds of all potential impacts across

all sectors over the longer term (Parry et al. 2009). This recognition highlighted the need to allocate adequate compensation and relief efforts, above and beyond the GCF, to help the victims of loss and damage in geographically and economically vulnerable countries.

The term loss and damage appeared in the United Nations Framework Convention on Climate Change (UNFCCC) negotiations in 2007 at COP 13, where the Bali Action Plan called for enhanced action on adaptation including the consideration of "disaster risk reduction strategies and means to address loss and damage associated with climate change impacts in vulnerable countries" (Loss and Damage in Vulnerable Countries Initiative 2012). Loss and damage was recognized as a separate concept from adaptation in 2008, when the Alliance of Small Island States (AOSIS) proposed a Multi-Window Mechanism to address and finance the distinct concept of loss and damage due to climate change impacts. This was followed by the establishment of the UNFCCC Work Program on Loss and Damage in 2010, and the Warsaw International Mechanism on Loss and Damage in 2013. In addition, the Loss and Damage in Vulnerable Countries Initiative was formed in 2012, with the aim of understanding both the national context and the range of accessible implementation options for addressing loss and damage (Loss and Damage in Vulnerable Countries Initiative 2012). However, no official lifetime commitment by developed countries to provide funds to the vulnerable communities has been undertaken as yet. Hence, the initiatives could be seen as weak attempts by the rich countries to admit liability for their contributions to climate change.

In this chapter we synthesize the debates surrounding the classification of loss and damage and also uncover the issues around an appropriate compensation mechanism. The purpose of the chapter is to not add to the already substantive literature on loss and damage but to provide a review of the concept; historical treaties and conventions that finally led up to increased international focus on the issue; and the empirical heterogeneity in its estimate and impact across a multi-country sample. The remainder of this chapter is structured as follows: section 2 provides an in-depth examination of the definition and debates surrounding the concept of loss and damage. Section 3 accommodates a study of the international conventions and treaties on climate change and examines the gradual recognition of the need to address loss and damage in the international climate politics. This is followed by a discussion in Section 4 of the different approaches in addressing loss and damage such as: monetary vs. non-monetary costs; and insurance vs. compensation. Finally, Section 5 provides empirical evidence of the global and international estimates of loss and damage as well as multi-country evidence of loss and

damage experienced by some of the most geographically and economically vulnerable countries in the world.

2. Definition of Loss and Damage

A widely accepted definition of loss and damage does not exist. The framing of the definition and its conceptual discussion continue to evolve within the UNFCCC and the academic literature with different groups displaying heterogeneous understanding of the terminology and concept. The UNFCCC defined the concept as one of the "impacts associated with climate change in developing countries that negatively affects human and natural systems" (UNFCCC 2012).

However, the definition offered by the UNFCCC was found to be at its nascent stages, and was therefore found to lack much clarity. This led to the formation of the Loss and Damage for Vulnerable Countries Initiative in 2012, headed by the Government of Bangladesh, to understand the meaning of the concept and how it can be approached in vulnerable countries (Loss and Damage in Vulnerable Countries Initiative 2012). The UNFCCC and Warsaw International Mechanism for Loss and Damage act as guides to the initiative. Loss, was defined by the Loss and Damage in Vulnerable Countries Initiative, as the "negative impacts that cannot be repaired or restored (such as loss of geological freshwater sources related to glacial melt or desertification)"; whereas damage was defined as the "negative impacts that can be repaired or restored (such as windstorm damage to the roof of a building)". Therefore, the Loss and Damage in Vulnerable Countries Initiative views loss and damage as the avoidable and the unavoidable costs associated with climate change impacts.

The Loss and Damage in Vulnerable Countries Initiative definition also identified the need to include "the full range of climate change related impacts from (changes in) extreme events to slow onset process and combinations thereof". This definition included a continuum of climate change events and not only the extreme calamities resulting from climate change. The UNFCCC's Working Program on Loss and Damage called for a similar attempt to investigate a range of tools and approaches to address all forms of loss and damage resulting from climate change, ranging from slow onset to extreme weather conditions (UNFCCC 2012). However, the convention itself does not define loss and damage as the Work Program, which again indicates the lack of consistency and clarity of the concept.

Another working definition of loss and damage, compiled by Action Aid (2010), characterized loss and damage as consequences of the adverse effects of climate change that cannot be (or have not been) adapted to. This gave rise to the ideology of 'residual' loss i.e. unavoidable and unavoided loss and damage and recognized that certain aspects of climate change cannot be appropriately adapted to, given the limited resources available by many of the vulnerable nations affected by climate change. Action Aid (2010) summarized different categories of loss and damage, of which unavoided and unavoidable loss and damage were regarded as residual loss and damage (Table 1).

INSERT TABLE 1 HERE

Unavoided costs can also be classified as the 'avoidable costs of loss and damage', i.e., the costs of climate change impacts that can be avoided through appropriate mitigation and/or adaptation. However, such costs are not always avoided due to limited capacity or resource. It is very important to regionally and internationally allocate appropriate resources, such that the resulting loss and damage can be reduced or mitigated completely. In least developed countries (LDCs) this often implies that such resulting loss and damage will only be adapted to if national benefits from adaptation exceed national losses and damages. Therefore, often the loss and damage resulting from slow onset events and the victims of such slow onset events are ignored or not given sufficient attention to.[1] This remains to be one of the major, but often sidelined, issues in the international climate change debate. Additionally, even in the case of unavoidable loss and damage, appropriate financing/funding still remains to be a problem. This is due to the 'attribution problem' in climate change science, which can be briefly described as the inability to completely underpin the loss and damage due to weather related events to climate change.[2]

A technical representation of residual (unavoidable and unavoided) loss and damage was compiled by OECD (2002). This is represented in Figure 1, where residual unavoidable and unavoided impacts of climate change with adaptation are demonstrated by the dotted line.

INSERT FIGURE 1 HERE

[1] For more information on this, refer to Section 5.
[2] This 'attribution problem' and the resulting financing issue will be examined in greater detail in Section 4.

Unavoidable and unavoided residual loss and damage reflects ill effects that have not been mitigated and which cannot/have not been adapted to. One must also note that for stakeholders to undertake adaptation measure, the benefits from adaptation ('effect of adaptation') must be greater than adaptation costs. Although the diagram above seems straightforward enough, the effect of adaptation and the impact of climate change (its cost) are quite hard to calculate and reproduce in such a simple two-dimensional linear frame. Another schematic representation of the residual damage as compiled by Parry et al. (2009) is presented in Figure 2.

INSERT FIGURE 2 HERE

Figure 2 (a) represents the short-term non-linearity of climate change impacts. Lower adaptation costs are associated with higher avoided damage, therefore giving it a low incremental adaptation cost to avoided damage ratio. This curve is estimated to fluctuate greatly across sectors and gives one a clearer picture of the variability and non-linearity of such a concept. Figure 2 (b) represents a longer time period of adaptation to damage, which illustrates that over the longer term all damages will not be adapted to, due to its lack of economic viability or structural feasibility (Parry et al.2009). The above representation also considers the trend in damage due to asset growth, therefore normalising asset damage, such that the increase in damage is not associated with an asset growth.

Finally, the impact of loss and damage should be narrowed down to the ones that can be attributed to climate change by drawing a fine line between bad weather and natural calamities that can be attributed to climate change. However, the lack of traceability of such events to climate change has induced reluctances by many stakeholders to officially commit to any binding financial agreements. This is commonly referred to as the 'attribution problem' in climate science. Various methods of calculating the odds of relating extreme natural calamities to climate change have been devised to aid the allocation of climate change related funds (Hulme et al. 2011). One such event attribution, termed as the probabilistic event attribution, compiled by Stone and Allen (2005), seeks to differentiate between weather changes caused as a result of human interference and "bad luck" (Hulme et al. 2011).

3. History

This Section presents a history of evolution of the concept of loss and damage including the formation of the Loss and Damage in Vulnerable Countries Initiative and the Warsaw International Mechanism for Loss and Damage.

3.1. Conventions and Treaties

Various conventions and treaties were established over the years starting from 1979, which led up to the formation of the IPCC in 1988, followed by the creation of the UNFCCC in 1992. The role of the IPCC is to "assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and migration" (IPCC 2013). The scientific evidence on climate change, gathered by the IPCC, underlined the severity of the issue and played a major role in the creation of the UNFCCC (IPCC 2014). The UNFCCC was formed to work to limit average global temperature increases and the resulting climate change, and to cope with the unavoidable loss and damage (UNFCCC 2014). A summary of the major climate change conventions and treaties, post the initiation of the UNFCCC is presented in Table 2.

INSERT TABLE 2 HERE

3.2. Loss and Damage in Vulnerable Countries Initiative

The Loss and Damage in Vulnerable Countries Initiative was commenced by the Government of Bangladesh and expanded with the help of the Climate and Development Knowledge Network (CDKN), which appointed a consortium of specialists including Germanwatch, United Nations University−Institute for Environmental and Human security (UNU−EHS), International Centre for Climate Insurance Initiative (ICCAD) and Munich Climate Insurance Initiative (MCII), and was implemented from 2012 (Loss and Damage in Vulnerable Countries Initiative 2014).

The Loss and Damage in Vulnerable Countries Initiatives are to:

- Understand the scope and significance of loss and damage associated with the adverse impacts of climate change;
- Developing and co-creating an approach and vision for loss and damage among decision makers and relevant stakeholders;
- Assisting least developed countries and other vulnerable countries to develop a coherent approach to the loss and damage debate;
- Identifying and beginning to take necessary steps to support a paradigm shift on loss and damage in the coming years.

Source: Loss and Damage in Vulnerable Countries Initiative (2014)

The activities of the UNFCCC and Warsaw International Mechanism for Loss and Damage guide the initiative. The initiative follows four main activity areas to support less developed nations in their plight to reduce and mitigate loss and damage due to climate change impact and to "create momentum in the climate change debate" (Loss and Damage in Vulnerable Countries Initiative 2014). These activities include supporting and strengthening the position of LDCs in loss and damage negotiations in the UNFCCC Work Program on loss and damage; conceptually framing loss and damage and providing policy assistance; providing country specific insights on the adverse effects of loss and damage; and imparting the cumulative results of mitigation and adaptation efforts in Bangladesh as an analytical tool for other vulnerable countries.

3.3. Warsaw International Mechanism for Loss and Damage

The Warsaw International Mechanism for Loss and Damage was established to address the loss and damage due to climate change, including 'extreme and slow onset events' in economically and geographically vulnerable countries (UNFCCC 2013). Two year work plans were drawn up for the initiative during the resumed initial meeting in September 2014, which involved understanding the concept of loss and damage of extreme and slow onset events; risk management; comprehending the current coping and adaptation mechanisms and drawing up socio-economically appropriate policies to adapt to monetary and non-monetary residual losses as a result of climate change (UNFCCC 2014). The introduction of the mechanism was seen was a "notable step forward" as it allowed to address and implement socio-economically appropriate policies to adversities of climate change in vulnerable communities (Warner 2013).

The primary roles of the Warsaw International Mechanism are to:

- Facilitate support of actions to address loss and damage;
- Improve coordination of the relevant work of existing bodies under the Convention;
- Convene meetings of relevant experts and stakeholders;
- Promote the development of, and compile, analyze, synthesize and review information;
- Provide technical guidance and support;
- Make recommendations, as appropriate, on how to enhance engagement, actions and coherence under and outside the Convention, including on how to mobilize resources and expertise at different levels.

Source: UNFCCC (2014)

4. Approaches to Address Loss and Damage

This Section summarizes the different approaches and their challenges for assessing and addressing loss and damage. Monetary and non-monetary nature of loss and damage is discussed first followed by a range of economic instruments that can be used to address these costs. Finally, the attribution problem which lies at the center of the loss and damage debate is discussed in detail.

4.1. Monetary vs. Non-monetary Costs

Climate change invokes both monetary and non-monetary loss and damage in vulnerable countries. These categories are also known as economic and non-economic loss and damage. Monetary or economic loss and damage refer to the costs for which economic or monetary estimates are readily available, such as structural damage and crop failure due to flooding[3]. Non-monetary losses are those that cannot be measured in monetary or economic terms, such as loss of biodiversity, loss of livelihoods or number of deaths caused by flooding. As these goods are not traded in the market, the monetary estimates of loss and damage caused to these goods are not readily available and hence, these items are generally ignored by the loss and damage accounting (Morrissey and Smith 2013). The concept of non-monetary costs was also highlighted in COP16 in Copenhagen where the parties recognized that all social and

[3] A wide range of the estimates of the monetary costs from climate change have been estimated in previous studies, the details of which have been covered in Section 5.1.

environmental loss and damage cannot be adequately captured by monetary measures. However, as such costs are difficult to quantify and monetize, it can be quite problematic to analyze the costs for inaction for such costs.

Non-market valuation techniques are often used to assign monetary values to the goods and services that are not traded in the market. Many studies, such as 'valuing the ocean' study by the Stockholm Environment Institute (SEI), instead of employing market values to decipher loss and damage, monetized the costs of climate change to the ocean by focusing on five areas, namely: fisheries, sea-level rise, storms, tourism and the ocean-carbon-sink (Stockholm Environmental Institute 2012). They pinned monetary values on such components by employing two scenarios: low climate change impact scenario, where emissions are reduced quickly; and a high climate change impact scenario, where the global emissions continue to rise for the next few decades (Stockholm Environmental Institute 2012). However, the results of the study were criticized as it only considers variables that can be "realistically altered by humans and can be monetized" (The Guardian 2012). Thus, the study only took into account the avoidable costs of loss and damage from climate change. Therefore, even though some studies have tried to monetize the marketed and non-marketed goods affected by climate change, not all non-marketed costs were effectively captured.

4.2. Insurance vs. Compensation

The concrete proposal put forth by the AOSIS in 2008 highlighting the need to finance a 'Multi-Window Mechanism to Address Loss and Damage from Climate Change Impacts' placed the issue of financing loss and damage under the limelight. The proposed mechanism suggested three inter-dependent components for compensation: (1) insurance, (2) rehabilitation/compensation and (3) risk management (AOSIS 2008). The insurance component was proposed to manage financial risk from extreme weather events and to provide insurance to countries who cannot find access to insurance. The rehabilitation/compensatory component addressed the progressive unavoidable climate change impacts, such as sea level rise and ocean acidification. Finally, the risk management component was incorporated for risk assessment and management and to inform the insurance and the rehabilitation/compensatory component (AOSIS 2008).

The insurance option is one where regular payment by an individual to a private or public insurance entity subsists, such that the entity insures against any loss and damage that may be

accidentally incurred by the individual. Munich Climate Insurance Initiative (MCII) (2012) stated that "insurance options can support adaptation and risk resilience for extreme weather, but are not appropriate for many, usually slower-onset, climate-induced impacts". Therefore, insurance was suggested to be an appropriate adaptation measure against unpredictable extreme events and not for predictable, slow onset events (Warner et al. 2012). This is because insurance companies will only be prepared to provide insurance payouts if the loss and damage is entirely uncontrolled for and unforeseen. Insurance was suggested to be an adaptation, as opposed to a coping measure, as it reduces the impact of loss and damage and helps a timely recovery in the aftermath of extreme unforeseen calamities (Warner et al. 2012).

Insurance policies were found to be an unpopular method of financing loss and damage amongst the poorer households in geographically and economically vulnerable countries (Gine et al. 2008; Akter 2012). This was attributed to the lack of knowledge and affordability of insurance premiums in such countries. In some cases coupling microcredit with insurance schemes were seen as a viable option to extend insurance services to low-income households. For instance, in a study conducted by OECD (2005), the Grameen Bima insurance programs in Bangladesh were found to offer insurance with microcredit, where no premiums were required to be a member of the fund, but payments to the fund were bundled with the interest paid on loans. However, the program was seen to be taken up the middle class, as opposed to the low-income households, as the poor could not afford the premium (OECD 2005).

Compensation schemes in the context of loss and damage financing, are funds provided by states or institutions to reduce the impact of loss and damage. The compensation option is perceived to be more appropriate than insurance schemes in funding the loss and damage from the gradual and predictable impacts of climate change. Therefore, the loss and damage from gradually occurring predictable events such as rising sea levels and desertification are best funded by states or institutions. However, individuals not insured against unpredictable extreme calamities should be considered for compensation schemes. This includes individuals in the poorer counterpart of the society, who are not able to afford the insurance premiums. Additionally, the lack of sufficient resources in low-income vulnerable countries does not enable appropriate compensation for all. The effectiveness in reducing the impact of loss and damage of such compensation packages depends on the efficiency of state policies and their outreach approach.

4.3. Attribution

Attributing weather related range of slow set to extreme calamities to climate change, was found to be quite difficult and operates as one of the major limitations in climate change financing. The lack of good traceability measures also provides a good justification for many developed countries to reject liability and therefore fail to make any firm commitments to financing loss and damage in low-income countries. Hence, the following paragraphs examine the effectiveness and limitations of such attribution mechanisms and their potential role in aiding the global community with financing loss and damage from negative climate change impacts.

The most popular method in climate change attribution is the examination of another related variable, which is linked to the characteristics of the extreme natural event. This is done as it is difficult to gain any insights from examining any trends from extremely rare natural calamities (Huggel, et al. 2013). However, such studies have confirmed the link between some natural calamities and climate change, but not all. Increasingly, studies have identified that the increase in economic damages from extreme events has been attributed to increased 'exposed asset values' rather than an increased intensity of extreme natural calamities (Huggel, et al. 2013). To this end, Neumayer and Barthel (2010) calculated an actual-to-potential-loss ratio (APLR), which provided a normalization method to measure the economic loss after the onset of a severe natural disaster. Even though no upward trend in normalised loss and damage was found, the authors did not account for mitigation measures, which may have compromised the findings. Additionally, even if the increased loss and damage is accounted to increased asset value, this does not imply that the resulting loss and damage must not be compensated for. Such a finding, if anything, calls for increased insurance or compensation schemes to be implemented by regional and international bodies.

However, many limitations in relying on such attribution methods to allocate any loss and damage funds were found such as: the unreliability of such methodologies as they are based on climate estimates without climate change, which cannot be logically verified; the inability to accurately predict the percentage of overall risk attributable to human actions; and the undesirable shift in international climate change initiative from adaptation to compensation, if such methodologies are extensively used to allocate the international adaptation finance (Hulme,O'Neill and Dessai, 2011). The lack of good quality data may also affect the accuracy of such measures. However, even though many such objections to attribution measures exist,

formulating attribution mechanisms should be encouraged by the international community as it helps to reduce (to some extent) the moral hazard related to adverse events, where individuals will take greater risks (for instance building houses in flood prone areas) in the hope of being compensated. However, care must be taken in order to not get carried away by such measures. Successfully implemented techniques can help eradicate such uncertainty, which can aid the international community to identify the victims of climate change and to allocate funds to communities who are essentially negatively affected from climate change.

The global community should allocate sufficient funds such that until a clear measure of attribution is found, the civilians experiencing loss and damage, especially in geographically and economically vulnerable countries, as a result of climate change impacts do not suffer substantially. This was highlighted by the Philippines Senate Present Juan Ponce Enrile who stated that "developing countries like the Philippines should be receiving compensation... Instead, however, we are accepting, or worse, being 'forced' to avail of loans that are, in the long run, more disadvantageous for the country" (Climate Justice Now 2010).

5. Empirical Evidence of Loss and Damage

This Section presents monetary estimates of loss and damage due to climate change impacts both at the global and local level. The first sub-section summarizes the global estimates of loss and damage available in the literature. The second sub-section presents country specific local estimates of loss and damage from eleven most economically and geographically vulnerable countries in the world. It also outlines the existing loss and damage coping strategies used by the households in these countries.

5.1. Global Estimate of Loss and Damage

Various global estimates of loss and damage have been produced over the years. Global monetary estimates of loss and damage can be measured in terms of the social costs of carbon, which is defined as the "net economic costs of damages from climate change aggregated across the globe and discounted to the present" (IPCC 2007). IPCC's *Fourth Assessment Report* (AR4) disclosed that the peer-reviewed estimate of the social cost of carbon in 2005 has an average value of US$12 per tonne of carbon dioxide. However, the range from 100 estimates was found to be large ($3 to $95 per tonne of carbon dioxide), which demonstrates a substantial

degree of disagreement on its measurement (IPCC 2007). Natural disasters are estimated to have doubled from an average of 200 per year in 1998 to an average of 400 per year in 2008, whereas costs of natural disasters in monetary terms have increased seven fold (United Nations 2009; cited in Action Aid 2010). Therefore, future estimates of climate change have painted a dull portrait of an impending catastrophe.

Monetary values of loss and damage can also be calculated from the overall loss and damage caused by climate change after accounting for certain scenarios of mitigation and adaptation (Action Aid 2010). One such probabilistic estimation method, known as the Policy Analysis for the Greenhouse Effect (PAGE), calculates the regional and global impacts of climate change, social costs of greenhouse gases and also the cost of abatement and adaptation (UNFCCC 2014). This model helps one to calculate the economic loss from such climate change adversities. Action Aid (2010) put together a table for global loss and damage under a scenario of no mitigation and the lowest emission scenario proposed by UNFCCC. Adaptation costs were also derived from UNFCCC reports. The costs are accrued over the years 2000 to 2200 and presented in discounted Net Present Values (NPV).

INSERT TABLE 3 HERE

From the analysis presented in Table 3, it was inferred that with respect to the cost of impact, the optimal action is to combine mitigation and adaptation. However, even with successful mitigation, a residual loss of US$275 trillion was found. However, this method of calculation was found to be more appropriate to predict global, as opposed to regional, loss and damage. Regional calculations of loss and damage are mostly obtainable from local insurance estimates. However, such estimates in low-income developing countries may only adumbrate monetary loss and damage to important sectors such as energy and infrastructure, and neglect or overlook the loss and damage to most households. In such circumstances, national statistics are ones' best gamble in obtaining regional loss and damage statistics.

Although the calculation of residual loss and damage has been highly debated, as demonstrated by the noteworthy range of the formulated estimates, a common underlying theme of globally increasing loss and damage was found. Additionally, the calculations of monetary loss and damage also suggested that if appropriate measures are not taken to constantly curb global emissions, loss and damage, particularly to low-income vulnerable countries, would only

increase exponentially over time. Therefore, communities with a higher exposure to the risks of climate change and with lower adaptive capacity would experience a greater burden of loss and damage in comparison to others. Such vulnerable countries include the Alliance of Small Island States (AOSIS), threatened by the rise in sea level; and low-income developing countries, where a large proportion of the population relies on agricultural income, particularly susceptible to climatic fluctuations. Although, developed rich nations may experience greater monetary losses from extreme events due to a higher proportion of exposed assets, the loss and damage as a percentage of GDP is peripheral in comparison to the low-income vulnerable nations. This is demonstrated in the figure below which compares the monetary damage to the monetary damage as a *percentage of GDP* in both developing and developed countries.

INSERT FIGURE 3 HERE

Figure 3 shows the damages as a percentage of GDP are higher for low-income developing countries than for the developed rich nations. On average, the agricultural sector contributes substantially to a poor developing nations' GDP, which is particularly vulnerable to the weather changes that have resulted from climate change. Additionally, poorly built infrastructure and households in low-income developing countries is often unable to withstand extreme weather disruptions, causing greater damage as a proportion of GDP in such countries.

5.2. Country Specific Evidence of Loss and Damage

Country level evidence of loss and damage occurring due to climate change impacts in vulnerable countries is crucial in assessing the future risks of climate change in such countries. Table 2 summarizes the environmental and economic vulnerability facing eleven low-income countries due to climate change impacts. The specific nature of the vulnerability, monetary estimate of loss and damage resulting from unavoidable climate change impacts and coping strategies are summarized in the following paragraphs.

Bangladesh

In the case of Bangladesh, it was found that climatic susceptibility along with increased climate change has adverse consequences, especially in the coastal region. Frequent cyclones, such as Sidr (2007) and Aila (2009) caused massive loss and damage to the coastal population. . Cyclone Sidr claimed 4,234 lives, injured 55,282 people, damaged 8.9 million people's

livelihood (Ministry of Disaster Management and Relief 2014). The economic damage caused by Cyclone Sidr was equivalent to US$1.67 billion (Ministry of Disaster Management and Relief 2014). Eleven out of the 19 coastal districts were severely affected by Cyclone Aila. It claimed 190 lives, injured 7,000 people, killed 100,000 livestock and caused US$170 million worth of economic damage (UNDP, 2010 cited in Akter and Mallick 2013). The loss and damage experienced by a cyclone as powerful as Cyclone Sidr are expected to rise nearly fivefold to over $9 billion by 2050, accounting for 0.6 percent of GDP (World Bank 2010).

These cyclones forced saline water into the agricultural lands (Rabbani et al. 2013). The rise in sea level, also attributed to global climate change is expected to push saline water further inland; therefore severely affecting the agricultural productivity and the quality of drinking water in the coastal districts of Bangladesh (Rabbani et al. 2013). . High yielding rice varieties were unable to withstand the increase in soil salinity (Rabbani et al. 2013). . New varieties such as BINA 8 and BRRI 47, henceforth developed after 2009, to resist high salinity levels were however found to be inappropriate for the chosen region (Rabbani et al. 2013). . It is also estimated that the region incurred a decrease in its rice production by 0.1 million tons between 2008 and 2010, whilst the dangers of massive rural-urban and coastal-central migration looms in the near future, if the region continues to experience such frequent calamities. The total cost of loss to rice production due to salinity was estimated to be US $1.9 million from 2009-2011. Households livng in the Shyamnagar district of Satkhira list (2009).

Bhutan

The district of Punakha is referred to as Bhutan's 'rice bowl', where a substantial proportion of the population engages in small-scale farming (Kusters & Wangdi 2013). Kusters and Wangdi (2013) conducted a study on this region. A large proportion of the research participants recognized a pattern of unreliable monsoon and overall annual precipitation. This observation was confirmed by rainfall data collected over 1990−2008. This changing water availability was reported to have a negative effect on crop production. Coping measures adopted by the households include ritual performance (costing households between US$700 and US$900 per year), developing or modifying water-sharing arrangements, maintaining irrigation channels, changing cropping pattern, buying irrigation water from upstream villages and using water pumps. Improved availability of fertilizers and modern technology was found to greatly enhance agricultural productivity for many farmers. Nevertheless, most adaptation measures were not without costs, some are monetary and some are non-monetary. For instance,

unsuccessful water-sharing arrangements led to local conflicts, disrupting social cohesion. Maintenance of irrigation canals required a substantial contribution, which was typically found to be unaffordable by poor households, and therefore such households were excluded from such water sharing arrangements. Changing cropping pattern from rice to maize resulted in an economic loss equivalent to US$2,000 per acre.

Even though improved seed varieties and the availability of fertilizers and pesticides led to an overall increase in rice production in the district between 2002 and 2010, this improvement was not uniform across the whole region as poorer households failed to access these inputs. Therefore, the need to promote equal access to agricultural inputs is identified in the study. Additionally, the local officials often perceive the issue of Glacial Lake Outburst Floods due to the melting of glaciers and the threat of destabilizing ice-cored dams as a policy priority in comparison to changes in precipitation levels. This allowed them to overlook the problem of gradual changes in water availability, as the effects were less visible and less severe in relation to the impact of floods.

Burkina Faso

Burkina Faso is a semi-arid, landlocked country in western Africa. Ninety percent of its population is engaged in agriculture and livestock sectors (Belemvire et al. 2008 cited in Traore & Owiyo 2013). The high reliance on the agricultural and livestock by a large proportion of the population in the Sahel region of Burkina Faso implied that a substantial proportion of the population is engaged in activities that are weather sensitive. Therefore, their livelihoods depend significantly on climatic conditions. Traore & Owiyo (2013) found draught to be the main climatic stressor in the region. The occurrence of draught was confirmed by rainfall data, which indicated a high variation of rainfall and also a recent history of draught in the Sahel region. Severe negative impact on crop and livestock rearing was reported by a large percentage of the sampled households. Coping measures included reducing food consumption, selling property and livestock, cutting expenditure, receiving external support, migrating, earning extra income, transhumance and a small proportion of the sample reported resorting to begging. Modifying food consumption and selling property were found to be most popular coping mechanisms. However, from the households that reported to undertake coping mechanism, 71% indicated that they were still experiencing negative effects of the drought. The destruction caused by the onset of draughts, such as the lack of water for crop yields, led to the unavailability of water for the local people and their livestock, which further limited their future

coping and adaptation ability. The range of average crop production loss was reported to be between US$577 and US$636 per household, whereas the range of average livestock loss was found to be between US$1,922 and US$8,759 per herder in the region.

Ethiopia

Ethiopia is heavily dependent on rain-fed agriculture. Historically, the country is prone to extreme weather events mostly characterized by highly variable rainfall pattern. Using spatially-explicit analyses of climate change effects on selected key sectors of Ethiopia's economy, Robinson et al. (2013) found that the residual loss and damage might cost an annual average of US$0.4 to 3.0 billion. A case study was conducted by Haile et al (2013) in the lowlands of Gambella, Ethiopia. The area experienced frequent river flooding that severely affected its people and their livelihoods. The main source of livelihood of the participants was crop cultivation and livestock rearing. The 2007 extreme flooding severely damaged the crops of three quarters of the respondents of the study and damaged the household properties of a quarter of the respondents. Most of the participants described the effect of the flood as either 'very severe' or 'disastrous' (Haile et al. 2013). .

However, unlike in the case of Sahel in Burkina Faso, the ability to relocate livestock ensured a better source of livelihood for the livestock owners as opposed to the farmers, most of who reported that the yield of their next cropping season severely suffered as a result of the floods. Coping mechanisms included relying on assistance from NGOs, social networks, government support and religious organizations. NGOs and social networks provided support to the largest proportion of the affected households. Nevertheless, the erosive quality of some coping measures is highlighted; where the respondents believed that the goodwill and resources of their reliable contacts will gradually diminish, inhibiting their future coping ability. Hence, the reliance on social networks was not perceived to ensure a long-term adaptation solution. Moreover, a majority of the households who had undertaken preventive measures such as increasing the floor height, harvesting premature crops and constructing a high stage for livestock were unable to fully evade the negative effects of the 2007 flood. Additionally, as voluntary government resettlement plans are underway, the villagers are questioning its habitability as the new villages are lacking essential services such as health services and potential security.

Gambia

A study by Njie et al. (2007) estimated the residual damages from climate change in Gambia to range between US$123 million and US$130 million per year in the near term. For the more distant 2070–2099 period, residual damage cost estimated to range from US$955 million to US$1.0 billion (Njie et al. 2007). A case study conducted by Yaffa (2013) in severely drought prone regions of Gambia found that the varying level of rainfall, shorter duration of the rainy season along with rising temperatures implied severe calamity for its community that was mostly reliant on agriculture for their livelihoods. The prominent ill effects incurred by the community included food shortage, rise in food prices and reduction in crop production and livestock ownership. Similar coping measures, as seen in the previous case studies were adopted, where most of the measures were seen to aid short term relief.

Kenya

Climate change poses a serious threat to Kenya's economy. Currently climate change accounts for an approximate monetary loss of approximately US$0.5 billion per year which is equivalent to 2% of the country's GDP (Stockholm Environment Institute 2009). This cost is expected to rise and eventually claim 3% of Kenya's GDP by 2030 (Stockholm Environment Institute 2009). A forecasted increase in rainfall in Kenya, due to climate change, along with human activities such as deforestation and overgrazing, is speculated to have increased the severity of flooding in the low-lying coastal regions of Kenya (Opondo 2013). The main sources of livelihood in the flood prone regions are crop cultivation, livestock rearing and other non-agricultural activities such as fishing, small-scale trade and manual labor. It was found that more than three fourth of the farmers in the affected region reported that their livelihood had been severely affected by the flooding. Additionally, almost three fourths of all participants from all the occupational and income categories had reported that they were severely affected. The most common coping strategies included reducing food consumption and receiving help from local governments, NGOs and religious organizations. However, most coping strategies, as in the case of the previous case studies, were found to be short term solutions and most of such coping mechanisms implied 'long term negative effects on the household economy' (Geest and Dietz 2004 cited in Opondo 2013). For instance, undertaking the sale of property implied a reduced household asset base, unfavorable for a longer-term sustainable means of adaptation.

Micronesia

The case study examined below demonstrates a principal environmental concern of Micronesia, as well as other small island states of the Pacific Ocean. Monnereau & Abraham (2013) confirmed that the rising sea level (attributed to climate change) has led to severe coastal erosion in the coastal region of Kosrae and has threatened the livelihood and habitability of many of its inhabitants. A rise in the sea level and coastal erosion is particularly dangerous to such island territories as it leads to a reduction in island size. The study revealed that the households who had adopted coping measures such as building seawalls, reinforcing their homes, and planting trees provided only temporary protection for the local inhabitants and had adverse long term environmental effects. For instance, the building of sea walls and the planting of trees only provided short-term solutions and only protected small sections of coastline. This highlighted the requirement of a large scale or even state level investment to provide sufficient barriers for the coastline. However, no initiatives have been successfully implemented to date as previous studies had indicated that the building of sea walls was found to have caused current changes and beach loss. The majority of the participants had indicated that they suffered from the effect of coastal erosion and that the coping strategies pursued was not sufficient to counter its adverse effects.

Mozambique

With a large coastline, Mozambique was found to experience severe floods in the lowlands (central), which adversely affected the livelihood of the rural farmers. In the year 2007 itself, Mozambique experienced a total economic loss and damage of $71,000 from severe flooding (United Nations Office for Disaster Risk Reduction 2014). Brida and Owiyo (2013) provided an account of the struggle of the community and the coping and adoption measures adopted and their effectiveness. The government of the country undertook resettlement projects, relocating communities to the uplands (south). However, this turned out to be as disastrous to the community as the uplands experienced frequent draughts, forcing many to go back to the lowlands and endure the negative effects of the floods. Crop cultivation, livestock rearing and fishing were the most prominent sources of income in decreasing order of importance. Overall, a ‘double blow’ from both the floods and the droughts was found to affect the entire sample interviewed, where the greatest ill effect was experienced by the farmers (Brida and Owiyo, 2013). As a result of food shortage, food prices increased, therefore further intensifying the adversity. The most prominent coping mechanisms included looking for other sources of income that includes laboring for the better off households and selling property. However, as

seen in previous case studies, such measures did not provide any long-term solutions. Moreover, the government resettlement initiative was found to worsen the situation for many.

Nepal

Frequent floods are one of the recurrent natural disasters that affect Nepal. Between 1971 and 2007, a staggering amount of 2,500 floods were recorded, which claimed more than 3,000 lives and damaged at least 150,000 buildings. The region of Udayapur in Nepal was found to be particularly susceptible to increasingly severe floods and vulnerable to the impact of climate change (Bauer 2013). The two main rivers in Udaypur reported increased rate of flooding. This was worsened by manmade obstructions such as roads and bridge piers, along with other activities such as deforestation which made the rivers shallower and accelerated sedimentation. Agriculture constituted the largest source of livelihood for many. More than 4/5 of all households reported that their agricultural output has decreased over the past years. Prevention and coping mechanisms undertaken by the farmers such as constructing stonewalls and seeking help from institutions such as NGOs was inadequate to avoid the recurrent loss and damage. Another frequent coping mechanism was labor migration to cities and overseas. The relatives of the migrants often relied on their remittances as an extra source of income, but often male migration was associated with increased work load for the women.

Pakistan

Flooding and overflowing rivers caused substantial damage to 14 districts, particularly to the Southern and Northern parts of the district in 2010. The floods also severely affected crops and livestock, where the crops were either partially or completely submerged and the livestock suffered from a lack of fodder availability. A total country wide loss of US$1840 million was expected to have occurred in the agricultural sector (Hasnain 2011). . Food insecurity and malnutrition were also reported to have ocurred in poorer societies. Continued rain was found to destroy the infrastructure, which further impeded the delivery of aid (Hasnain 2011).. National response mechanisms included the use of military affiliated rescue and aid operations; civil society relief operations included aid and establishment of social welfare infrastructure; and international donor aid and assistance was provided to affected areas (Asian Development Bank and World Bank 2011).. In Baluchistan alone, one year from the crisis, 18,000 people were reported to be affected (Hasnain 2011). . Rebuilding projects are being undertaken with the aim of constructing a flood resilient society. However, the lack of proper pre-disaster awareness techniques prevents adequate preparation procedures. Therefore, loss and damage

due to extreme flooding can almost be perceived as an unavoidable consequence. Additionally, even though civilians were requested to not reside in low-lying areas or near rivers, such a request is unfeasible as most of the rural poor reside in such vulnerable areas.

Philippines

A total of 7,986 deaths and an economic loss of US$10 billion were reported in the aftermath of Typhoon Haiyan (EM-DAT 2012). The typhoon also caused significant damage to infrastructure and property, delivering wind speed up to 195 mph with gusts reaching 235 mph with 40-50 feet of floods (CNN 2013). Most of the residents were recorded to have taken sufficient coping and adopting mechanisms to frequent storms that hit the country. Local residents were reported to have never experienced a typhoon even remotely as brutal as Haiyan and were therefore defenseless (CNN 2013). National and international relief efforts were mobilized post disaster, although the collapse of the local airport slowed down the process. Local inhabitants, with little or no socio-economic assets and connections are still known to be suffering from the adversities of the typhoon and were soon after subject to the adversities. After the onset of such a calamity, the Philippines hosted the Conference of United Nations Risk Reduction and Management in Manila to emphasis the importance of an available, accessible and affordable disaster risk information system as part of the 'Post-Haiyan Tacloban Declaration' (The United Nations Office for Disaster Risk Reduction 2014). During the 2013 Warsaw Conference, the Philippine Climate Change Commissioner, Naderev Yeb Sano, fought back tears whilst warning the international community that his country is particularly suffering as a result of climate change, reflecting on the recently acquired news of his family's safe residence after Typhoon Haiyan (Philippine Daily Inquirer 2013).

6. Conclusions

Loss and damage was recognized as a separate concept from adaptation in 2008, when the AOSIS proposed a Multi-Window Mechanism to address and finance the distinct concept of loss and damage arising due to climate change impacts. This was followed by the establishment of the UNFCCC Work Program on Loss and Damage in 2010, and the Warsaw International Mechanism on Loss and Damage in 2013 to further comprehend and address the issue. The Loss and Damage in Vulnerable Countries Initiative, formed in 2012, was the largest independent entity solely dedicated to building a common understanding of loss and damage.

However, despite current global efforts in understanding the concept of loss and damage, the exact definition is still as elusive as ever and is still widely contested amongst stakeholders.

Additional issues such as distinguishing between avoidable and unavoidable loss and damage; slow onset and extreme loss and damage; and monetary and non-monetary loss and damage, were also highlighted in this Chapter. Discriminating between such categories of loss and damage from climate change adversities is essential as each category would require a different approach. For instance, in the case of avoidable and unavoidable loss and damage, it was pointed out previously that institutions and individuals must dedicate resources such that avoidable losses and damages can be successfully mitigated or adapted to, and unavoidable losses and damages can be appropriately financed. Additionally, the debate regarding the constituents of loss and damage impacts from climate change makes it quite difficult to converge on a global estimate, therefore impeding a concrete commitment to tackle such an adversity. However, a global climate deal is being furnished and will be executed in 2015, where parties have agreed to adhere to a legally binding international climate change deal. Nevertheless, this agreement was only concurred by the EU, some other European nations and Australia. Although, this can be seen as a significant step forward, the lack of commitment by all developed countries still poses a great obstacle in obtaining an ideal climate change deal.

The biggest limitation in forming a concrete climate change deal was found to be the attribution problem. This can be described as lack of solid traceability of adverse weather impacts to climate change, which was found to impede any solid commitments by countries. To resolve the attribution problem, many studies have devised mechanisms to examine to extent to which adverse weather impacts can be attributed to climate change. However, as of now, no globally agreed upon mechanism has been fashioned. Additionally, the degree of impact of loss and damage due to climate change on livelihoods differed substantially across developing and developed countries. On the one hand, civilians in developed countries were mostly insured against the loss and damage from natural calamities or their losses and damages were mostly compensated for, where insurance or compensation policies depended on country specific requirements and regional policies. On the other hand, the poor farmers and livestock owners in vulnerable low-income countries were found to suffer substantially as a result of such climatic changes.

Country specific loss and damage estimates and coping strategies from some of the most economically vulnerable countries have been analyzed in this Chapter. The degree to which

such adversities affected households depended on their socio-economic status and geographical location. The livelihood of the poorer farmers and livestock owners were generally seen to be affected the most due to their restricted mobility and limited livelihood options (after a partial/complete destruction of their farms and livestock from extreme natural calamities). Common coping measures for predictable events included modifying food consumption, selling property and livestock, cutting expenditure, receiving external support, and finding extra income sources. However, many of the coping strategies adopted by the locals were seen as temporary and some measures even eroded their long-term coping capacity. Additionally, extreme and unexpected events, such as typhoon Haiyan in the Philippines, addressed the need to identify disaster identification technologies to reduce the loss and damage from such natural calamities. Overall, the case studies of economically and geographically vulnerable countries highlighted the need to identify and implement long-term measures to mitigate loss and damage and the need for active collaboration between international organizations, NGOs and local governments to draw up cost-effective and feasible policies to combat such residual loss and damage.

7. Future Directions

Future directions for research include extended research work on regional or country specific insurance or compensation schemes for low-income countries, such that financing options that are best suited to address the environmental and social vulnerability of the region can be devised. Additionally, it was found that one of the biggest limitations in the climate change debate was found to be the ‘attribution problem’. Therefore, such a problem must be appropriately conceptualized and addressed, where better attribution techniques should be thoroughly examined and critiqued, and its applicability to the entire range of slow set to extreme climatic conditions should be studied.

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9. Keywords

Climate change; Loss and damage; definition of loss and damage; mitigation; adaptation; 'residual' loss and damage; greenhouse gases; insurance, compensation, low-income countries, LDCs; United Nations Framework Committee on Climate Change (UNFCCC); Conference of Parties (COP); Intergovernmental Panel on Climate Change (IPCC); IPCC Fourth Assessment Report; Alliance of Small Island States (AOSIS); UNFCCC Work Program on Loss and Damage; Loss and Damage in Vulnerable Countries Initiative; Warsaw International Mechanism on Loss and Damage; attribution; monetary costs; non-monetary costs; social cost of carbon; slow onset events; rising sea levels; natural disasters; Multi-Window Mechanism to Address Loss and Damage from Climate Change Impacts; Kyoto Protocol; global climate change deal; attribution mechanisms; Policy Analysis for the Greenhouse Effect (PAGE); coping mechanisms; impacts on the livelihoods; Bangladesh; Nepal; Philippines, Pakistan, Mozambique, Micronesia, Kenya, Gambia, Ethiopia, Burkina Faso, Bhutan, normalized loss and damage, flooding, cyclone, typhoon.

Table 1: Avoided, Unavoided and Unavoidable damage

Avoided damage	Unavoided damage	Unavoidable damage
Avoidable damage avoided Damage prevented through mitigation and/or adaptation measures	Avoidable damage and loss not avoided Where the avoidance of further damage was possible through adequate mitigation and/or adaptation, but where adaptation measures were not implemented due to financial or technical constraints	Unavoidable damage and loss Damage that could not be avoided through mitigation and/or adaptation measures, e.g. coral bleaching, sea level rise, damage due to extreme events where no adaptation efforts would have helped prevent physical damage

Source: Action Aid (2010)

Table 2: Precedent Conventions and Treaties

Year	Key Event/s	Description
1992	**AOSIS proposal for an insurance scheme**	• Proposal for an insurance scheme was put forward by the members of the Alliance of Small Island States (AOSIS), the principle objective of which was to create an International Climate Fund and an International Insurance Pool to finance measures and to provide appropriate financial insurance respectively to counter the adverse effects of climate change. However, the parties only agreed to the insurance pool ten years onwards, provided that over the 10 year period the "rate of global mean sea level rise will have reached an agreed figure" (Hayes and Smith 1993).
1995	The first Conference of Parties (**COP 1):** Berlin Mandate	• The COP1 held in Germany, where the Berlin mandate established the need for developed countries to "take the lead in combating climate change" and for developing countries to achieve sustainable economic growth (UNFCCC 1995).
1997	**COP 3: Kyoto Protocol Adoption**	• Adoption of the Kyoto Protocol is undertaken in Kyoto, Japan, setting legally binding emission reduction targets. • The summit recognized the greater role of developed countries in having historically contributed significantly to greenhouse emissions (through their previously active roles in industrial activity), and therefore placed a 'heavier burden'(UNFCCC 2014) on developed nations under the notion of 'common but differentiated responsibilities'(United Nations Framewrok Convention on Climate Change 1998).
2001	**COP 7: Marrakesh Accords**	• Formation of the Marrakesh Accords, which laid out the rules and details for the implementation of the Kyoto Protocol; set up adaptation methodologies; and formed a technology transfer framework (UNFCCC 2014).
2005	**Meeting of the Parties to the Kyoto Protocol (MOP 1)**	• Kyoto Protocol entered into force as the Russian Federation submitted its compliance(United Nations 2014). • Negotiations for the next phase of the Protocol under the Ad Hoc Working Group on Further Commitments for Annex Parties under the Kyoto Protocol (AWG-KP), later known as the 'Nairobi Work Program', was also agreed upon
2007	**COP 13: Bali Road Map**	• Introduction of the Bali Road Map in Bali, Indonesia, which included the 'Bali Action Plan'. This plan was envisioned to charter the way towards a post-2012 outcome (UNFCCC 2014). • The Bali Action Plan is divided into categories such as shared vision, mitigation, adaptation, technology and financing. • However, it is to be noted that no significant effort was made to differentiate between adaptation and loss and damage in this stage.
2008	**COP 14**	• Joint Implementation Mechanism of the Kyoto Protocol was initiated.

	AOSIS proposal of a Multi-Window Mechanism	• This was described by UNFCCC (2014) as an initiative that "allows a country with an emission reduction or limitation commitment under the Protocol to earn emission reduction units from an emission reduction or emission removal project in another country with similar commitments." • The Alliance of Small Island States (AOSIS) proposed a Multi-Window Mechanism to address and finance loss and damage from climate change impacts (Alliance of Small Island States 2008).
2009	**COP 15:Copenhagen Accord**	• Copenhagen Accord was developed at COP15 in Copenhagen, Denmark, where developed countries undertook emission reduction and mitigation and adaptation action plan for the period of 2010-2012, pledging $30 billion as start up finance (UNFCCC, 2014;UN, 2014).
2010	**COP 16: Cancun Adaptation Framework** **UNFCCC Work program to address loss and damage**	• Cancun Adaptation Framework was formed at the sixteenth Conference of the Parties, where governments of developed countries pledged comprehensive packages to assist developing countries to deal with climate change (UNFCCC 2014). • The Agreements also made the reduction pledges of the countries official, which formed the "largest collective effort to reduce emission in a manually accountable way" (United Nations 2014). • Cancun Adaptation Framework also established a work program to address the loss and damage impacts of climate change in LDCs vulnerable to the adverse effects of climate change (Loss and Damage in Vulnerable Countries Initiative 2012).
2011	**COP 17: Durban Platform for Enhanced Action** **Green Climate Fund**	• Plans to draw up a new universal climate change agreement by 2015, to deal with the adverse effects of climate change beyond 2020, were formed in Durban, South Africa. This led to the formation of the Durban Platform for Enhanced Action or the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) (UNFCCC 2014). • COP 17 also led to the formation of the Green Climate Fund (GCF), with an aim of raising $100 billion per year in climate financing by 2020(Institute for Policy Studies 2014).
2012	**COP 18: Doha Amendments to the Kyoto Protocol**	• Doha Amendments to the Kyoto Protocol commenced. • This includes: new commitments for a second commitment period from January 2010 until December 2020; a revised list of greenhouse gases to be reported by the Parties; and amendments to several articles of the Kyoto Protocol to issues pertaining to the first commitment period (UNFCCC 2014). • Governments also agreed to work speedily towards drafting a universal climate change agreement by 2015 (UNFCCC 2014). • Doha Convention further addressed international efforts and strengthened international cooperation on loss and damage as a result of climate change(European Commission 2013).

	Loss and Damage Initiative in Vulnerable Countries Initiative	• Loss and Damage Initiative was also implemented in February 2012, with the objective of partnering with vulnerable LDCs and other parties to better understand loss and damage (Loss and Damage in Vulnerable Countries Initiative 2012).
2013	**COP 19:Warsaw Outcomes**	• Decision to progress on the ADP Platform was agreed upon. • A rulebook for reducing emissions from deforestation and forest degradation; enhancing the conservation and sustainable management of forests and forest carbon stocks in developing countries (REDD+); establishing a mechanism to address loss and damage from long-term climate change impact; and agreeing on capitalizing the Green Climate Fund in the second half of 2014, as part of the Warsaw Outcome was undertaken (UNFCCC 2014).

Table 3: Monetary estimates under 'no mitigation' and 'mitigation and lowest emission' scenarios

	Trillion US$					
	No mitigation			Lowest emission scenario		
	Lower end	Mean	Higher end	Lower end	Mean	Higher end
Cost of impact (without adaptation)	270	1240	3290	100	410	1070
Cost of impacts (with adaptation)	170	890	2340	60	275	760
Adaptation costs	4	6	9	4	6	9
Mitigation costs				50	110	170

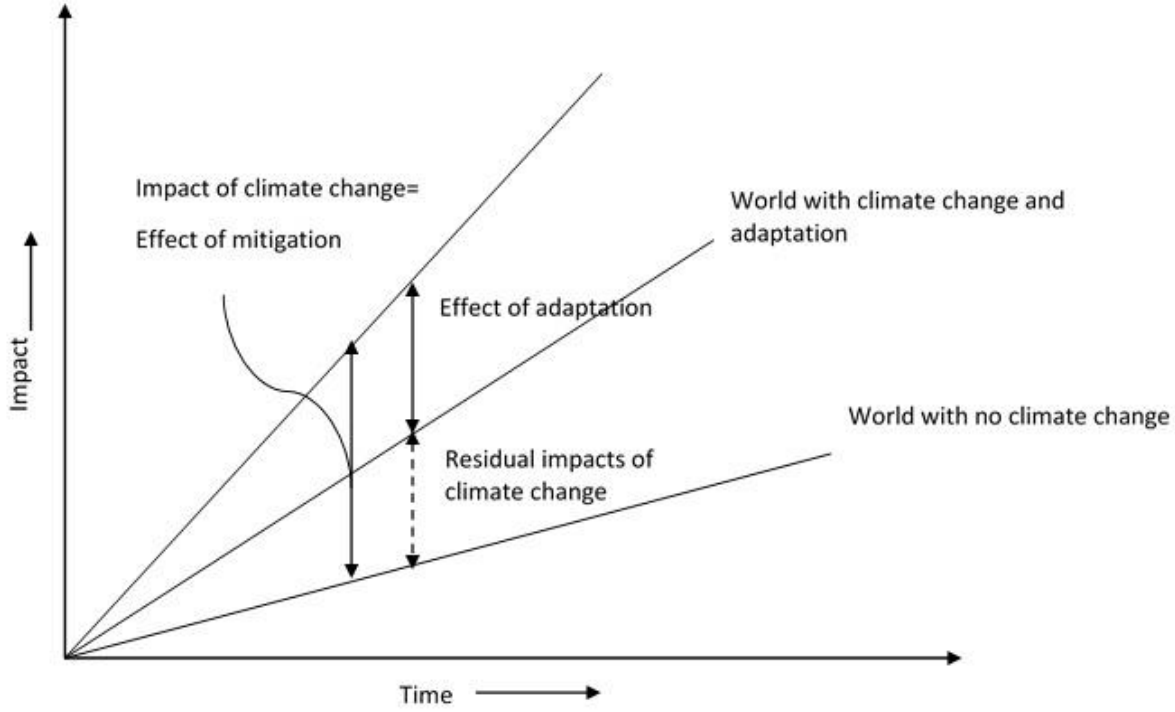
Source: Action Aid (2010)

Table 4: Climatic susceptibility, long- term climate change threat and livelihood impact in the nine disasters prone areas

Country	Region	Climatic susceptibility	Long-term threats	Livelihood impact
Bangladesh	Sathkira	Cyclones	Sea level rise, salinity intrusion	Rice, drinking water
Bhutan	Punakha	Glacial lake outburst floods	Changing monsoon	Rice
Burkina Faso	Sahel	Drought	Changing rainfall patterns	Livestock, crops
Ethiopia	Gambella	Floods	Changing rainfall patterns	Habitability, crops, livestock
Gambia	North Bank	Drought	Changing rainfall patterns	Agriculture
Kenya	Budalangi	Floods	Changing rainfall patterns	Livestock, crops, property, disruption of social and economic activities
Micronesia	Kosrae	Storms	Sea level rise, coastal erosion	Crops, livestock, fish
Mozambique	South/Central	Floods/droughts	Changing rainfall patterns	Housing, livelihood
Nepal	Udayapur	Floods	Changing rainfall patterns	Staple crops
Pakistan	Baluchistan	Flood, Glacial lake outbursts	Changing rainfall patterns	Agriculture, transport and communication
Philippines	Tacloban	Cyclones	Changing storm intensity	Lives, agriculture, livestock and property

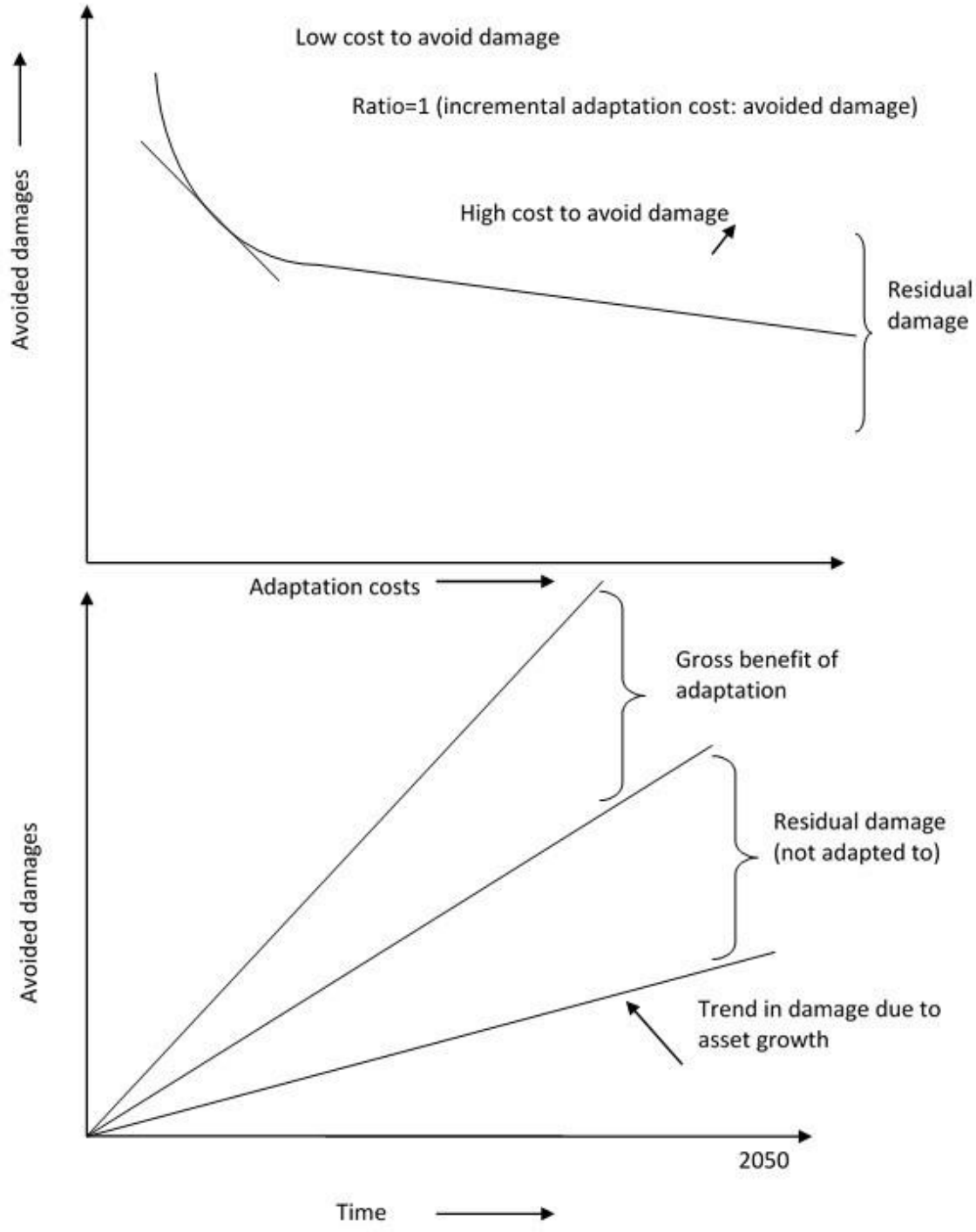
Source: Warner and Geest (2013) and (Roberts, et al. 2014)

Figure 1: Traditional representation of climate impacts and adaptation



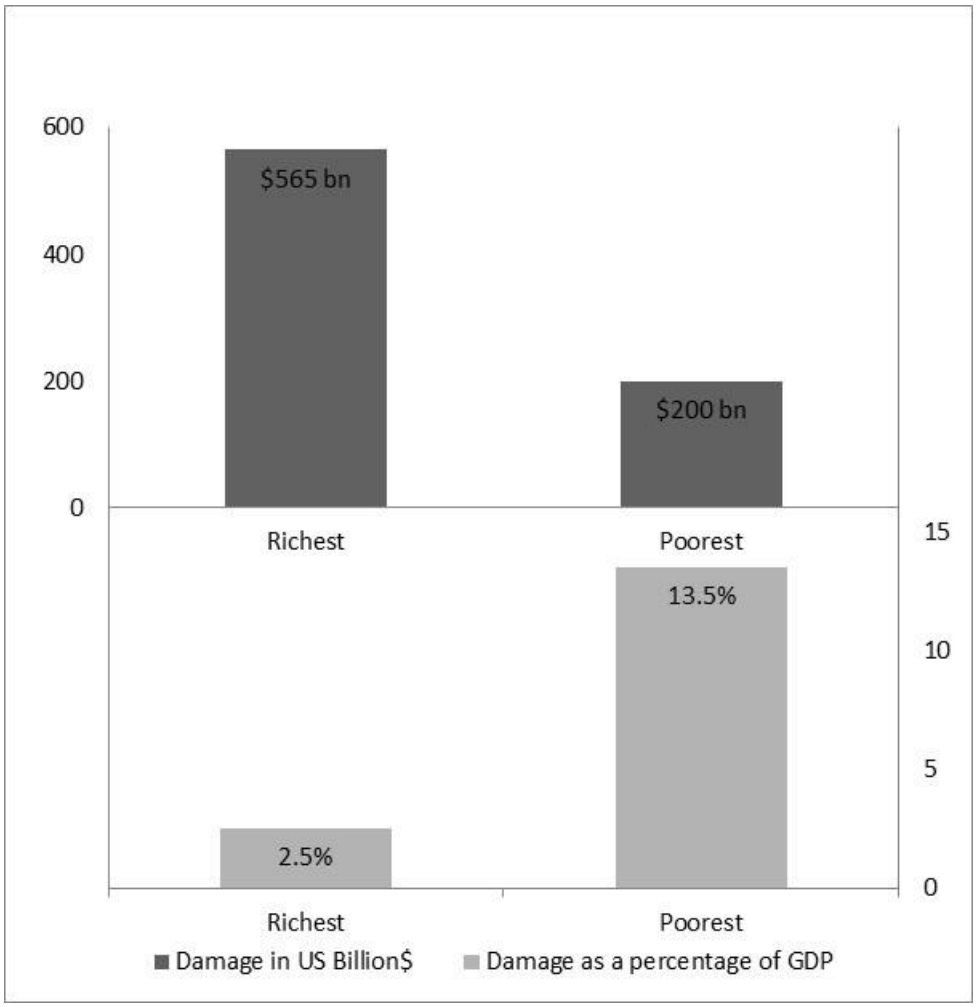
Source: OECD (2002)

Figure 2: Avoided damages and residual costs over the short term and long term



Source: Parry, et al. (2009)

Figure 3: Disaster losses, total and as a share of GDP, in the richest and poorest nations, 1985-1999



Source: United Nations Inter-Agency Secretariat for the International Strategy for Disaster Risk Reduction (2003)