Loss & Damage

Assessing the Risk of Loss and Damage Associated with the Adverse Effects of Climate Change in Bangladesh

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Foreword

This paper is the result of a year-long discussion on loss and damage in Bangladesh under the leadership of the International Centre for Climate Change and Development (ICCCAD) and its director, Dr. Saleemul Huq. The authors would like to thank Professor Ainun Nishat, Dr. Munjurul Hannan Khan, Mr. M. Shamsuddoha and other experts, who contributed to discussions to better understand loss and damage in Bangladesh.

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List of Acronyms

ADB	Asian Development Bank
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BCAS	Bangladesh Centre for Advanced Studies
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCCRF	Bangladesh Climate Change Resilience Fund
BCCTF	Bangladesh Climate Change Trust Fund
BIWTA	Bangladesh Inland Water Transportation Authority
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladeshi Water Development Board
CATSIM	Catastrophe Simulation
CAPRA	Comprehensive Approach for Probabilistic Risk Assessment
CCA	Climate Change Adaptation
CCC	Climate Change Cell
CGEIS	Centre for Environment and Geographic Information Services
CIF	Climate Investment Funds
DEFRA	Department for Environment, Food and Rural Affairs
DOE	Department of Environment
DRASS	Drought Assessment
DRR	Disaster Risk Reduction
ECLAC	Economic Commission for Latin America and the Caribbean
EM-DAT	Emergency Events Database
FAO	Food and Agriculture Organisation
GCM	Global Climate Models
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information Systems
GoB	Government of Bangladesh
IAM	Integrated Assessment Models
IWM	Institute of Water Modelling
ICRD	Integrated Coastal Resource Database
LDC	Least Developed Country
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NWRD	National Water Resource Database
ORCHID	Opportunities and Risks from Climate Change and Disasters
PKSF	Palli Karma Sayahan Foundation
PPCR	Pilot Program for Climate Resilience
PRECIS	Providing Regional Climates for Impacts Studies
RCM	Regional Climate Models
SAARC	South Asian Association for Regional Cooperation
SARRSO	Space Research and Remote Sensing Organization
SMRC	Meteorological Research Centre
WARPO	Water Resources Planning Organisation
UKCCRA	UK Climate Change Risk Assessment
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction

Executive summary

The issue of climate change-related loss and damage has received substantial international attention in recent years. The United Nations Framework Convention on Climate Change established a work programme to enhance understanding of loss and damage at COP 16 in 2010. More recently loss and damage emerged as one of the most important issues in the global climate change negotiations at COP 18 in Doha. At the national-level, however, there has been little consideration of how to respond to those climate change impacts that communities and households may not be able to adapt to. As a first step to developing a response, decision-makers in vulnerable developing countries will need to enhance their understanding of how loss and damage will impact people, resources and infrastructure.

This paper examines the issue of loss and damage assessment in the national context of Bangladesh to understand how relevant tools and methodologies as well as these assessments in general can be enhanced. In addition, the paper will provide lessons and recommendations that will benefit other developing countries that are vulnerable to the impacts of climate change. To this end, this analysis explores how different assessment models and methodologies have or could be applied in Bangladesh and what challenges and opportunities emerge from this process.

First, this paper compares and contrasts select examples from the spectrum of assessment models that spans the independent but inter-related disciplines of climate change adaptation and disaster risk reduction. While each model has its own unique advantages and disadvantages, two common problems emerged: first, most models fail to adequately account for intangible impacts that required a more qualitative approach, and second, most methodologies do not take into account broader socio-economic changes that could affect exposure and vulnerability.

Second, this study looks at what types of data inputs are required for the different models examined, what types of data are available in Bangladesh and what gaps or deficiencies exist in this information. This analysis found that while Bangladesh has a relative abundance of post-disaster data and significant household survey data that can assist in assessing exposure and vulnerability, there is a shortage of localised information on climatic hazards and stressors (e.g. soil salinity). In addition, current data collection and management practices impede information sharing between different government departments and limit the development of more comprehensive and robust data sets.

Third, this review explores what capacity, infrastructure and resources would be required to effectively implement and manage a loss and damage assessment mechanism in Bangladesh. The evaluation found that the Government of Bangladesh (GoB) has invested disproportionately in infrastructure relative to other human and scientific resource requirements. Furthermore, the absence of a national-level knowledge-sharing network – particularly with respect to cooperation and collaboration between government agencies – serves as a barrier to making information more accessible and improving overall assessment capacity.

Finally, this paper examines how the communication to decision-makers might be improved in order to prompt appropriate action at the policy level. It was observed that decision-makers are more likely to act when climatic risks are categorised according to probability and severity and framed in a manner that presents clear options for mitigating these risks. Furthermore, the role of assessments in policy-making can vary significantly depending on the decision-making structures that are in place and the GoB's general approach to addressing climate change impacts. These approaches fall into two basic policy-making paradigms: the first is top-down and driven by scientific estimates and projected scenarios while the second is bottom-up and driven by vulnerability analysis and development needs. Based on Bangladesh's current assessment capacity and the availability of requisite data, this paper recommends a bottom-up, vulnerability-centred approach to climate change management, which is most likely to enhance resilience to climate change while addressing existing development needs – leading to "no" or "low regrets" outcomes.

Evaluating loss and damage is a complex and multi-faceted task. Determining how existing methodologies for assessing climate change- and disaster-related risk can be used to develop a comprehensive estimate of tangible and intangible loss and damage is a process that has only just begun. Determining how assessment mechanisms can be adapted to the unique characteristics and circumstances of vulnerable developing countries is another challenge that will need to be addressed as this process moves forward. In the national context of Bangladesh, there are human, material and informational resources that can

be leveraged to develop a better understanding of those climate change impacts that are “beyond adaptation”. Increasing investment in capacity building and scientific infrastructure as well as developing more collaborative practices and institutions will likely improve this understanding substantially. Over time, and with better knowledge of the challenges that will emerge as the impacts of climate change become increasingly severe, Bangladesh and other vulnerable countries can work together to develop solutions based on their shared experience.

1. Introduction

1.1. Background

Loss and damage from the impacts of climate change is being incurred in countries across the globe, but is especially acute in developing countries given their underlying vulnerability (Warner et al., 2012). As a result of the global failure to reduce emissions in order to mitigate climate change and reduce its impacts, residual loss and damage – or the impacts of climate change that will not be addressed by adaptation - is inevitable. It is under this premise that loss and damage has become an issue of increasing interest for developing countries.

Bangladesh is one of the countries for whom loss and damage has become an issue of significant concern. Often characterised as one of the countries most vulnerable to the impacts of climate change, Bangladesh is a least developed country with a GDP per capita of USD 780 and with 31.5 percent of the population living below the national poverty line (World Bank, 2013). In addition to its high poverty levels, Bangladesh's geography and position as a low lying delta make it highly vulnerable to natural hazards like floods, storm surges and cyclones – among others (Nishat et al., forthcoming). In recent years, two "mega cyclones" hit Bangladesh – Sidr in 2007 and Aila in 2009 - affecting millions in the coastal regions. In addition, the impacts of slow onset climatic processes like sea level rise and salinisation are increasing, which has prompted many policy makers to begin looking for answers to address residual loss and damage.

While the reality of loss and damage unfolding at the local level is becoming increasingly obvious, the issue has gained increasing prominence in the global climate talks under the United Nations Framework Convention on Climate Change (UNFCCC) since the establishment of the work programme on loss and damage in the Cancun Adaptation Framework at COP 16 in 2010.

The work programme was differentiated into three thematic areas: assessing the risk of loss and damage, approaches to address loss and damage and the role of the Convention in the implementation of approaches to address loss and damage at the 34th session of the Subsidiary Body for Implementation in 2011. At COP 18 in Doha in late 2012, Parties decided to continue the work programme, identified areas of further research and committed to establishing institutional arrangements to address loss and damage under the UNFCCC in late 2013 at COP 19 in Warsaw.

As of yet, there is no universally agreed-upon definition of loss and damage within the UNFCCC process. Moreover, loss and damage has several dimensions. There are direct losses such as the loss of agricultural yield and indirect losses such as the loss of income as a result of the loss of agricultural productivity. In addition, loss and damage can be both tangible and intangible. Intangible loss and damage is often referred to as non-economic losses and includes loss of culture, the mental and psychological impacts of climate change and the repercussions of current climate change impacts that will be felt by future generations. Consequently, loss and damage is a complicated concept to understand, which has made research on the topic challenging. However, for the purpose of this paper loss and damage was characterised as those impacts of climate change that are beyond adaptation.

This paper is based on the first thematic area of the work programme and follows a set of elaborative questions included in the annex of the decision stemming from COP 17 in Durban in 2011. This research was undertaken as part of a national research project to facilitate greater understanding of how to address loss and damage in Bangladesh. However, understanding the methodologies, gaps and needs associated with assessing the risk of loss and damage in Bangladesh will ultimately help other developing countries faced with similar challenges.

1.2. Context

This paper was inspired by the question of how to assess the risk of loss and damage associated with the adverse effects of climate change - posed at the international level in the UNFCCC negotiations - and tries to identify what it means in a national context. The authors sought to understand what is needed in order to assess the risk of loss and damage in Bangladesh, with the hopes that this would inform both national and international processes.

It is hoped that as the risk of loss and damage is demonstrated, countries will be motivated to take more action

At the international level, loss and damage has been inherently linked with both mitigation and adaptation based on the premise that higher mitigation ambition and more successful and widespread adaptation can reduce future loss and damage. Assessments are integral to ensuring that these links are made, especially with regard to mitigation. It is hoped that as the risk of loss and damage is demonstrated, countries will be motivated to take more action on mitigation and adaptation, both individually and collectively. Depending on the emissions scenarios realised, climate thresholds may be crossed (IPCC, 2012a: 13) after which ecosystems will be altered forever along with the human societies dependent on them. While thresholds remain poorly understood (Ibid), assessments that identify areas at high risk could help prevent those thresholds from being crossed if they prompt appropriate action to be taken.

At the national level, assessing the risk of loss and damage is an important component of developing a comprehensive set of policies, programmes and strategies to reduce future loss and damage before it occurs. However, the science behind risk assessments is still emerging and it has to be recognised that some methodological issues still remain. One of the issues associated with assessing the risk of loss and damage (to the extent that these assessments have been undertaken) is the fact that predominantly only those future impacts that are measurable are usually included in assessments and will ultimately be addressed. Thus, risk assessment can be a very subjective process and one that allows some loss and damage to go unacknowledged and thus unaddressed. This is especially true of non-economic losses, but can also apply to the loss of livelihoods and other loss and damage that has economic repercussions. Before embarking on a risk assessment process, it is therefore important to conceptualise what risks need to be known and thus measured. In the Bangladesh context, it is important to understand how climate change impacts are at risk of inflicting damage on infrastructure and other assets as well as resulting in losses to lives, livelihoods and potentially influencing migration patterns.

comprehensive risk assessment tools can help inform more robust risk management and adaptation strategies

The implementation of comprehensive risk assessment tools can help inform more robust risk management and adaptation strategies. In particular, assessments can allow policymakers to develop an understanding of the costs and benefits to investing in risk management and adaptation and where these investments should be made. However, as elucidated above there will be some impacts that will be beyond the reach of adaptation. Assessments will also help identify where approaches to address residual loss and damage – such as risk retention and risk transfer tools – will have to be developed and implemented.

This paper should be viewed as the beginning of a long discussion on the needs associated with assessing the risk of loss and damage in Bangladesh, which is the first step towards addressing loss and damage. There is much more that needs to be understood in order to develop more robust approaches to assess risk and understand how loss and damage is being incurred, both now and in the future. In addition, the science behind assessing loss and damage is young – though quickly evolving. A lot has changed, even in the year in which this research was undertaken.

1.3. Methodology

This paper is primarily based on a desk review of secondary literature. However, several key experts in the fields relevant to risk assessment were consulted during the course of the research. In addition, a stakeholder workshop was held to elicit the opinions of key stakeholders working in the field, especially on gaps and needs related to assessing the risk of loss and damage. Another objective of the consultations was to better understand the areas of intervention needed to reduce future loss and damage.

The research questions that this paper seeks to answer are as follows:

1. What methods and tools are available for risk assessment, including their requirements, strengths and weaknesses, and can they address social and environmental impacts?
2. What are the data and information requirements for assessing impacts and climate risks, at different levels and for a broad range of sectors and ecosystems? What data is available and where are the gaps?
3. What are the capacity needs for applying risk assessment methods on the ground, including for facilitating their application in developing countries?

4. How can the results of risk assessments be optimally formulated in order to support decision-making? What are the desired methods for presenting the results of risk assessment exercises so that they drive decision-making?

The science behind assessing loss and damage and the associated risks is new and emerging. There is little literature on how to undertake these assessments and very few case studies. For an overview of current methodology on assessing risk, this paper relied on the background paper prepared for the UNFCCC expert meeting on assessing the risk of loss and damage, held in Tokyo, Japan in March 2012 (Surminski et al., 2012). The background paper will be referred to throughout this paper and readers interested in learning more about current methodologies to assess risk are encouraged to read this document. The authors recognise that knowledge on assessing loss and damage has evolved since the background paper was written. To whatever extent possible, the data provided in this paper has been updated with more current information. However, as pointed out above, there is little literature on assessing the risk of loss and damage. Thus, the authors relied heavily on the guidance of the background paper. Therefore, this paper can be seen as an attempt to understand what processes at the international level mean for a country like Bangladesh.

2. Methods and Tools for Risk Assessment

Methods and tools to specifically assess the risk of loss and damage have not yet been developed (Surminski et al., 2012: 6). However, methodologies and tools exist to assess the risk of climate change impacts in both the disaster risk reduction (DRR) and climate change adaptation (CCA) communities (Ibid: 6). The following section will introduce key terms and highlight some of the issues associated with mapping risk.

2.1. Mapping the Dimensions of Risk

This section will examine the key dimensions of risk that are taken into account in the process of mapping climate change-related loss and damage, namely hazard, exposure and vulnerability. A brief review of each of these elements of risk is provided below, followed by a brief overview of how risk-mapping exercises can be used to facilitate the assessment of loss and damage.

Hazard

A hazard is defined as "the potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources" (IPCC, 2012b: 560). In the context of risk mapping, the potential impacts of climatic hazards for a specific geographic area are analysed through sophisticated modelling techniques that assess the probability and consequences of impacts. Additionally, these models can be used to differentiate historical hazard risks from current and future risks that are affected by the impacts of climate change.

Assessing the hazard risks associated with the impact of a cyclone, for example, would be analysed in terms of wind speed, rain (intensity and total rainfall), storm surges and flooding in an impacted area. In the future, efforts to map the potential impacts of climate change on this phenomenon would have to take into account the rising level and increasing temperature of the sea, which can potentially lead to higher storm surges, thus increasing the extent of inland flooding and increases in maximum wind speed (IPCC, 2012a).

Exposure

Exposure is defined as "the presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected" (IPCC, 2012b: 559). In the context of risk mapping, exposure can be identified geographically by determining, to the most accurate extent possible, the number, type and location of people, infrastructure as well as assets within an area at risk. Beyond historical information, accounting for exposure to future climate change impacts and the development pathways of the at-risk region requires the application of dynamic models that incorporate the evolving parameters of hazards as well as settlement patterns, infrastructure plans and changes in socio-economic conditions (IPCC, 2012a).

For developed countries with established property markets it is often possible to obtain relatively up-to-date data on the presence of structures and infrastructure and – through an analysis of zoning maps and census data – population estimates for at-risk areas (Khan et al., 2013). In developing countries, however, records of property and zoning are generally not as developed or accessible, which makes the task of mapping exposure more difficult (Ibid). Furthermore, while it may be possible to procure data on population and physical infrastructure, identifying sites of social or cultural significance may require specific and detailed qualitative research (For a more detailed discussion of the challenges posed by data gaps, see section 3.2).

One example of mapping exposure would be to identify and assess the people, infrastructure and assets in a town adjacent to a river affected by seasonal flooding. Based on the nature of the hazard (i.e. the extent of the flood), such an analysis would seek to answer questions such as: how many homes and roads would be inundated and to what extent? What public infrastructure (hospitals, schools, etc.) would be inundated, and how would this affect public services? What would be the total area of cropland affected? And so on. Additionally, to account for exposure to future climate change impacts and development in at-risk areas, a comprehensive assessment of exposure must also consider how shifting weather patterns and increased glacial run-off might affect flood levels and how the anticipated development of settlements or infrastructure in specific areas might affect exposure.

Vulnerability

Generally defined as the "propensity and predisposition to be adversely affected", vulnerability is an internal measure of susceptibility that encompasses a vast range of economic, social, cultural, demographic, institutional, political, and environmental factors (IPCC, 2012b: 564). In this context, vulnerability is situation specific: with similar exposure to climatic hazards, the varying physical and social characteristics of communities, households and individuals result in differential levels of loss and damage (Dow, 1992; Lavell, 2003). However, factors like poverty and the absence of social support networks are likely to aggravate vulnerability levels, regardless of what type of hazard is experienced (Cardona et al., 2012).

At the macro level, vulnerability might refer to the susceptibility of communities to economic impacts resulting from the destruction of mangrove forests that provide critical eco-system services or the destruction of road infrastructure that leads to a collapse of local markets. At the micro level, impoverished households who settle on marginal land (e.g. on a floodplain or steep slope) and occupy poorly constructed homes are more likely to incur loss and damage.

Effectively assessing loss and damage risks depends on responding to the unique challenges posed by specific hazards

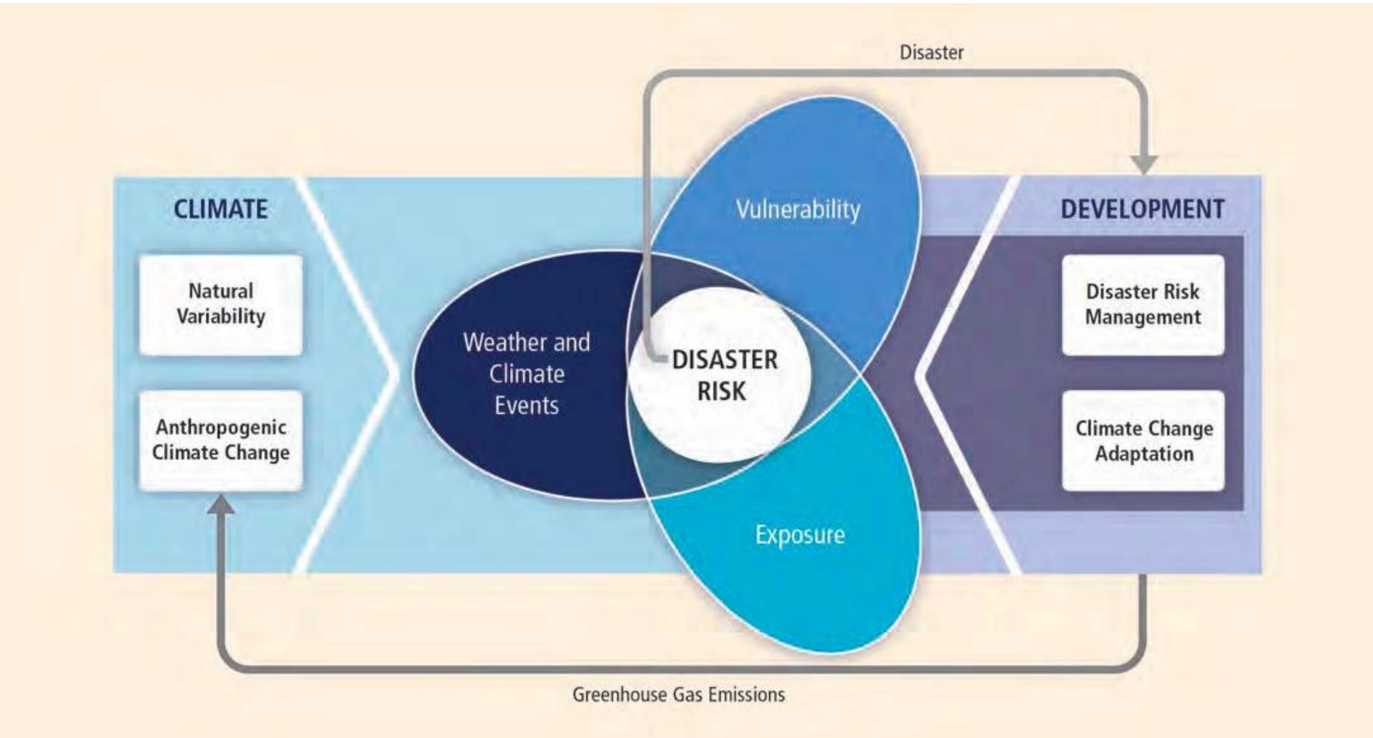

Figure 1: Venn Diagram of Hazard, Exposure and Vulnerability Diagram (IPCC, 2012)

Due to its complex and multi-faceted nature, there is no singular or comprehensive approach to assess vulnerability (Ibid: 72). Effectively assessing loss and damage risks depends on responding to the unique challenges posed by specific hazards. While it may be difficult to fully incorporate all of the various factors of vulnerability, mapping vulnerability – particularly by blending statistical information with qualitative research in the at-risk community in question – can still yield valuable information.

The two schools of DRR and CCA differ in the way in which they treat vulnerability. While DRR sees vulnerability as the, "predisposition to be affected or as an internal risk factor" (Birkmann, 2006 in Surminski et al., 2012: 7), CCA, in contrast, defines vulnerability as: the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. (IPCC, 2007: 283 in Surminski et al., 2012: 7).

The IPCC's Special Report on Extreme Events (SREX) – a report that both DRR and CCA experts collaborated on – maintains that "[e]xposure and vulnerability are dynamic, varying across temporal and spatial scales, and depend on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors" (IPCC, 2012: 7). Loss and damage is therefore caused by the interaction of a hazard with the aspects of an exposed element (or person) that make it vulnerable (Suminski et al., 2012: 8). Thus, exposed elements have to be vulnerable in order to incur loss and damage (Ibid).

2.2. Evaluating Assessment Methods and Tools

There are two ways to assess loss and damage: looking at past losses or estimating future losses (Surminski et al., 2012: 10). Some assessment tools take a pre-disaster approach while some assess losses after the disaster has occurred (Ibid: 11).

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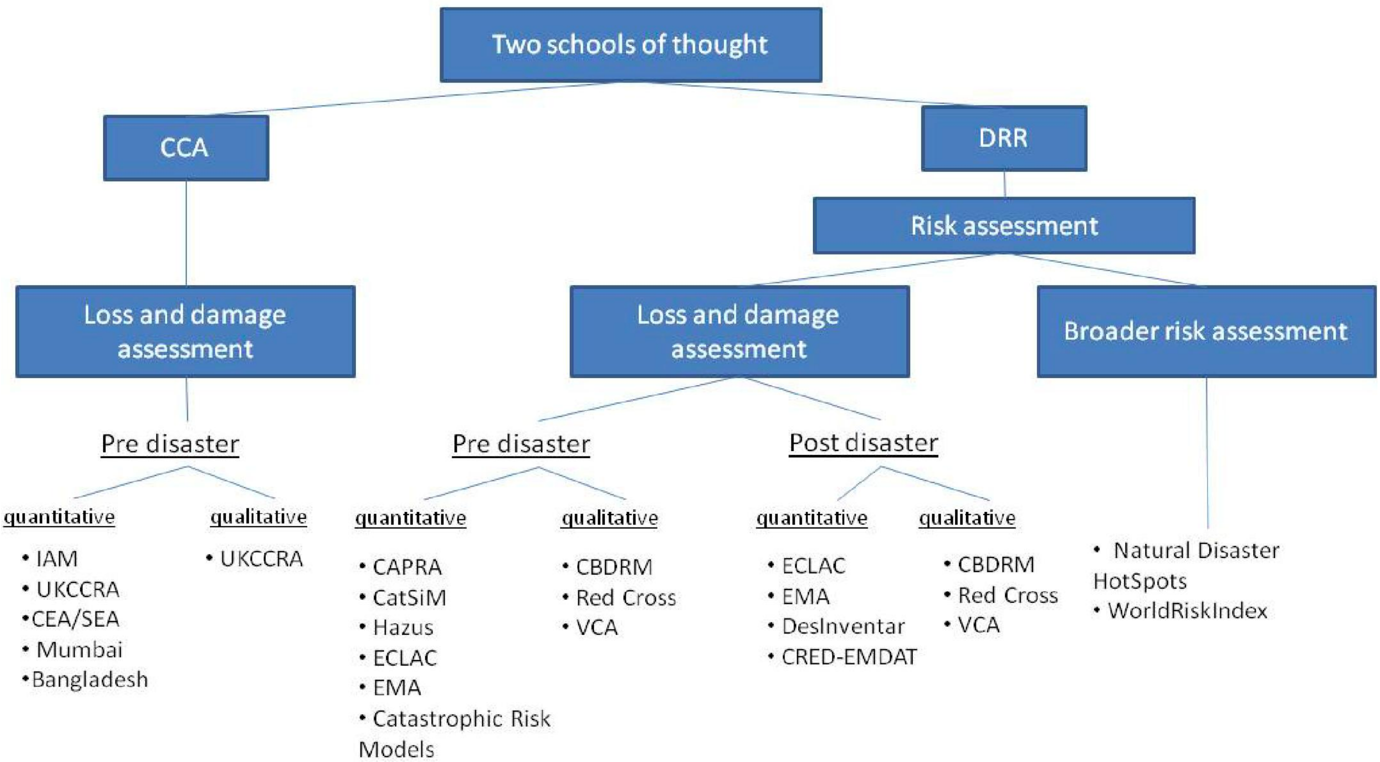

Figure 2: Overview of Different Approaches, Methodologies and Tools for Loss and DamageAssessment (Surminski et al., 2012)

The background paper prepared for the UNFCCC expert meeting on assessing the risk of loss and damage provides an overview of 18 different methodologies, featured below in Figure 2, from the fields of CCA and DRR (Ibid). This section will examine a number of risk assessment methods and tools reviewed in the background paper that could be relevant in national efforts to address loss and damage in Bangladesh.

Catastrophe Risk Models

Catastrophe risk models use *Monte Carlo*[1] methods to estimate potential losses based on the probability, magnitude, and location – and the corresponding exposure of that location – of specific hazards (Ibid). The damage function that is calculated through this exercise is then used to project realised property losses for specific events, determining, among other information, the probability of a pre-determined loss being exceeded in a given year (Ibid).

Such models generally have difficulty incorporating the additional data that would be necessary to calculate complex climate change-related losses in multiple sectors of developing countries like Bangladesh (Ibid). There are two notable exceptions, however: the CATastrophe SIMulation (CATSIM) and the Comprehensive Approach for Probabilistic Risk Assessment (CAPRA) models can be applied across sectors and hazards, enabling policymakers to develop and evaluate a wide variety of disaster risk management plans. While these tools represent a potentially viable method for assessing loss and damage in countries like Bangladesh, they also require a high level of expertise and knowledge that would likely necessitate substantial capacity building.

Integrated Assessment Models

Another approach, Integrated Assessment Models (IAMs) – a downscaled version of comprehensive Global Climate Models (GCMs) – can be used to evaluate "the relationship between emissions, effects on the climate and the physical, environmental, economic and social impacts caused by climate change" (Ibid: 20).

These models are useful in assessing loss and damage in that they can be easily adjusted to incorporate new information as it emerges. However, they are often criticised as overly simplistic for a number of reasons: damage functions are typically based on a large number of assumptions (and relatively little underlying data), and they are unable to account for how different impacts interact (De Bruin 2009; Ortiz and Markandya, 2009). This is particularly relevant in the context of Bangladesh, which is exposed to a host of sudden and slow onset impacts with overlapping consequences for water, soil and weather systems. Additionally, their emphasis on loss of income fails to incorporate climate change implications for capital (De Bruin, 2009).

WorldRiskIndex

A third assessment model that may be applied to evaluate climate change-related loss and damage is the WorldRiskIndex. This index uses indicators of social, economic and environmental vulnerability to assess the exposure, susceptibility, coping capacity and adaptive capacity of specific geographical regions (Surminski et al., 2012). While this index is not necessarily a tool for quantifying loss and damage, it is useful in evaluating climate change impacts relative to the specific vulnerabilities of societies rather than the nature of hazards or climatic stressors – an approach that should be embraced (Birkmann et al., 2011). As it does not focus beyond national level impacts, it is a relatively shallow tool for analysing loss and damage, but nevertheless provides a useful frame for highlighting risk factors that merit additional attention (Surminski et al., 2012).

UKCCRA

A fourth assessment method was recently developed by the government of the United Kingdom to assess the impacts of climate change in the UK. The UK Climate Change Risk Assessment (UKCCRA) combined scientific projections, stakeholder consultations, the findings of various government reports, peer-reviewed literature and new analysis specific to this project to assess "risks and opportunities" from 2012 through 2100 (Ibid). Beginning with an initial list of 700 risks across all sectors, a short-list of 100 key risks was developed based on the probability and magnitude of impacts (Defra, 2012). While the comprehensiveness of this approach is admirable, like other assessment tools, it has been criticised for its inability to quantify certain risks due to a lack of data (Surminski et al., 2012). Additionally, it does not account for broader societal (e.g. socio-economic and demographic) changes, nor does it seek to assess the complex interplay between risk factors (Ibid).

Mumbai Flood Risk Assessment Case Study

The final model examined in this analysis – the Mumbai Flood Risk Assessment Case Study - is a form of catastrophe model that seeks to demonstrate

[1] Monte Carlo methods are stochastic techniques based on the use of random numbers and probability statistics to investigate problems (Surminski et al., 2012: 17).

current vulnerabilities to climate change impacts at the city scale and quantify the costs and benefits of adaptation options (Ibid). This tripartite assessment determines current and future vulnerabilities, quantifies relevant risks, then identifies and evaluates potential adaptation options (Ibid). The Mumbai Flood Assessment Case Study uses a simplified catastrophe risk model that applies downscaled PRECIS model (Providing Regional Climates for Impacts Studies) climate projections to compensate for the relatively fewer data inputs available for cities in developing countries, such as Mumbai (Ranger et al., 2011). Despite this flexible approach, this model is limited by its failure to incorporate future population growth and economic development and the increased uncertainty that comes with applying regional climate models at the municipal scale (Surminski et al., 2012).

ECLAC Damage and Loss Assessment (DaLA) Methodology

In contrast to many of the above models, the DaLA methodology is not a risk assessment tool, but an *ex-post* model that assesses loss and damage that has already been incurred as a result of disasters. The model, which was originally developed by the UN's Economic Commission for Latin America and the Caribbean (ECLAC) in 1972, has become a globally recognised assessment tool employed by a wide range of countries and international organisations (GFDRR, 2010). The ultimate aim of the ECLAC model is "to measure in monetary terms the impact of disasters on the society, economy and environment of the affected region" (ECLAC, 2003: 6). Using quantitative data derived from relevant government agencies and stakeholders, maps, surveys, remote sensing and a variety of other sources, this model aims to conduct a rapid assessment of direct damages and indirect losses in areas affected by extreme climatic events (Ibid). Direct damages are assessed in terms of the monetary value of physical assets that have been wholly or partially destroyed, while indirect losses are evaluated based on projected negative changes to production and the flow of goods and services (Ibid). The assessment process is geared towards timely rather than comprehensive assessments in order to meet the pressing needs of affected populations and secure as much reconstruction assistance from donors as possible before attention is diverted by other events (Ibid). Beyond assessment, the model can also provide valuable insight into policy and programme changes that may be required to address the *ex-post* needs of populations in the affected areas (Ibid). While this model provides a useful mechanism for quantifying the monetary impacts of disasters, like many of the aforementioned risk assessment models, it fails to incorporate less tangible impacts. Furthermore, its focus on conducting assessments rapidly at the expense of comprehensiveness may be well suited to addressing climate change-related extreme events, but with respect to slow-onset processes, a more thorough approach will likely be necessary.

there is no comprehensive assessment method available that covers all aspects of loss and damage

All of the above models illustrate different potential approaches that can be used to evaluate loss and damage in the developing country context and require a variety of different inputs. At present, there is no comprehensive assessment method available that covers all aspects of loss and damage; rather, those undertaking these assessments must choose the method that is best suited for the specific scenario they are investigating as well as their financial, human and material resource capacity. The section below examines strengths and weaknesses of two methods that have been employed by government agencies and research institutes in Bangladesh to assess the impacts of drought in its north-western region.

2.3. Mapping Drought in Bangladesh

While Bangladesh is most known for its vulnerability to monsoon flooding and coastal storm impacts, the country has historically experienced significant loss and damage as a result of drought, especially in its north-western regions (Mukherjee, unpublished). Droughts generally occur in two seasons: the *Kharif* and the *Rabi*. The *Kharif*, which lasts from June-July to October, affects transplanted *aman* (winter rice) crops during the critical flowering stage – particularly in areas with a low capacity to retain soil moisture (Ramamasy and Baas, 2007). The *Rabi*, which is also known as the "pre-*Kharif*" drought, is generally the result of persisting high temperatures and affects transplanted *aus* (autumn) rice, *boro* (summer) rice, pulses, wheat, and potatoes, among other crops (Ibid; CCC, 2008). The linear progression of drought, from climatic variability through meteorological, agricultural and hydrological effects to impacts, is illustrated below in Figure 3.

In the years ahead, climate change is expected to increase the vulnerability of Bangladesh's at risk western regions to drought by increasing rainfall variability and the number of cumulative days with high temperatures (Ramamasy and Baas, 2007). To better understand the impacts of climate change on drought risks in western and north-western Bangladesh, the Center for Environment and Geographic Information Services (CEGIS), in partnership with the Bangladesh Agricultural Research Council (BARC), has undertaken a process to map the impacts of drought in at-risk areas.

The Drought Assessment (DRASS) Model

The Drought Assessment (DRASS) model was developed to help rapidly identify and categorise drought severity in key vulnerable regions (Ahmed and Chowdry, 2006). The model is comprised of two basic components: the first is to assess water availability, while the second is to examine agricultural water demand and potential impacts on crop yield (Ibid). As inputs, DRASS incorporates data and modelling information from the Institute of Water Modeling (IWM), the Water Resource Planning Organization and CEGIS's own topographic data (Ibid). The result is GIS-based projections on water availability and crop yields. Using this model, a study conducted by CEGIS and the FAO found that three of four drought vulnerable north-western districts – Saphar, Porsha and Nachole – experience crop reductions of 30 to 40 percent in an average year as a result of drought (Ibid).

While the development of the DRASS model is an important step in on-going efforts to improve how we assess and map the risks posed by climate change impacts, integrating this model with other socio-economic data and projections – which are largely omitted from this model – could yield a more comprehensive picture of how drought is affecting specific at-risk regions. For example, with respect to health-related risks, Dey (2011) has shown that drought can increase instances of dysentery and diarrhoeal disease by up to 28 percent and 45

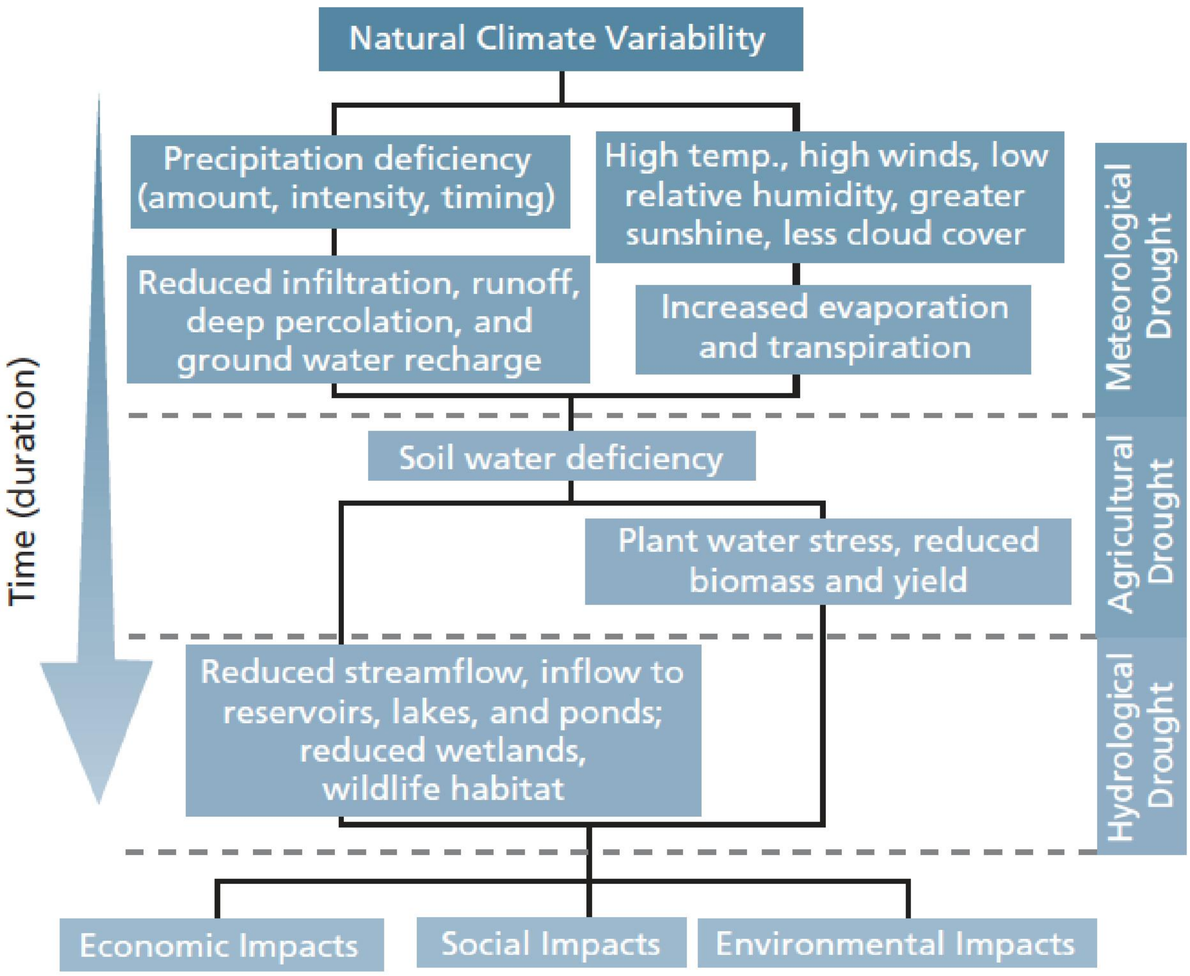

Figure 3: Types of Drought and their Impacts over Time (Ramamasy and Baas, 2007: 10)

percent, respectively. These impacts, in conjunction with the negative effects of drought on food security and human nutrition, also serve to increase human mortality rates (Ahmed and Chowdry, 2006). However, the DRASS model does not account for health or other social or economic impacts beyond the realm of agriculture – an omission that significantly limits the scope of this tool as a mechanism for evaluating the full spectrum of loss and damage incurred as a result of drought.

Participatory Agricultural Risk Assessment Model
In contrast to the DRASS model, a more participatory-oriented, qualitative assessment model to identify and assess climate-related risks at the community level – particularly with respect to agriculture – has been developed by Bangladesh's Ministry of Food and Disaster Management (MoFDM) (Surminski et al., 2012). This system is comprised of two general components: a suite of participatory tools that serves as the primary mechanism for identifying and categorising climate risks and secondary agro-meteorological information that is used to inform these exercises (Ramamasy and Baas, 2007). The process for identifying and assessing climate risks is undertaken in seven steps (Ibid):

1. Articulate climate risks and community impacts;
2. Community-based risk mapping;
3. Assess community perceptions of climate risks;
4. Identify and describe of community capacities and vulnerabilities;
5. Rank climate risks;
6. Identify and secure community agreement on risk thresholds;
7. Articulate a response to climate risks (reduce, transfer or accept).

Overall, this process serves as a comprehensive, though small-scale tool to "assess climate-related hazards, vulnerabilities and risks in agriculture, identify key climate risks that have significant impact on communities in general and livelihoods in particular, and assess the community perception of risks associated with past and current climate variability" (Surminski et al., 2012: 15). Specific outputs from this participatory process also include a climate risk map that identifies at-risk areas, vulnerable community members, resources available to help manage these risks and a "local resource map" that serves as a geo-referenced inventory of land, livelihood activities and infrastructure (roads, water sources, markets, banks, etc.) (Ramamasy and Baas, 2007).

This participatory assessment methodology is differs from the DRASS model in two distinct ways. First, it adopts a broader outlook on the impacts of climate change that extends beyond a simple quantification of water availability and crop loss and into the specific social and economic risks presented by these impacts. Second, while informed by secondary information on climate risks, it is a distinctly qualitative approach focused on "bottom-up (risk) identification rather than conventional top-down agro-meteorological approaches" (Ibid: 30). However, like the DRASS model, this participatory methodology does not incorporate future social, economic or demographic development pathways that could affect projections.

These two models are examples of different ways of undertaking risk assessment: hazard-centred modelling approaches with a narrow scope of focusing on direct impacts and more qualitative participatory assessment processes. While drought is just one of a wide variety of climate risks faced by Bangladesh, these methods provide insight into how loss and damage can be assessed through a systematic and localised approach, especially if different approaches are combined. Despite their differences, both approaches seek to develop risk maps to identify current and future climate risks on a scale that is relevant to decision makers. The following section provides some additional context on the application and value of risk mapping processes.

2.4. Risk Mapping

Risk mapping is an important mechanism to identify, in a geographically specific way, how hazards can impact populations, infrastructure and assets. The models discussed above present an array of different options for Bangladesh in terms of how climate risks can be assessed and mapped. Overall, these mechanisms provide an insightful tool for decision makers and additional human and material resources should be dedicated to improving this type of assessment modelling in Bangladesh.

Risk mapping is an important mechanism to identify, in a geographically specific way, how hazards can *impact populations, infrastructure and assets*

However, there are some key issues – both general and specific – that must be addressed if risk mapping is to provide the type of useful and accessible information that will be of value to decision makers. For example, in undertaking risk mapping it is important to incorporate both local and scientific knowledge (Surminski et al., 2012). While the exercise of mapping climate change-related risk cannot be entirely comprehensive given existing gaps in available data (see next section) and scientific uncertainty, it is nevertheless an important first step in identifying the specific risks faced by Bangladesh at the regional and even local level.

Risk mapping initiatives within the developing country context must work towards building a more integrated approach for impacts assessments

Risk mapping initiatives in a developing country context must work towards building a more integrated approach for assessing the impacts of climate change. The Department of Environment's (DoE) Climate Change Cell (2008: 88) has identified two key areas to be developed by future research:

1. "Integrated 1st order physical modeling of climate change: This modeling will establish linkage[s] between magnitudes of difference in elements of climate change and levels of impacts on biotic and abiotic components of environment for medium and long term considerations" and
2. "Integrated 2nd order physical modeling of climate change: This modeling will link the results of 1st order modeling with macro-economic implications of such results under medium and long term."

First order modelling centres on forecasting climate-related hazards, while second order modelling aims to assess how these projected impacts will affect a country's economy and physical infrastructure over the medium and long-term. Establishing linkages between first and second order modelling would represent a significant advancement in understanding *who* and *what* is exposed to climate risks, but this will first require significant investments in human and material resources (see Section 3). Additionally, while this integrated model will improve hazard-related mapping, it does not address a broader gap that has been identified in loss and damage assessment methodology: the failure to account for future social and economic development (Surminski et al., 2012).

Accounting for Future Generations

The data that is incorporated in assessment models may vary significantly depending on projections of future climate change impacts, socio-economic conditions and development pathways. Failure to effectively incorporate future projections of changing exposure and vulnerability – for example, due to changed settlement patterns and poverty reduction – is one issue that can serve to increase uncertainty regarding future outcomes (Ibid).

Assessment models cannot rely solely on historical data, but must incorporate long-term climate change data and broader socio-economic indicators

Thus, to ensure that projections are as robust as possible, assessment models cannot be based solely on historical data, but must look beyond the status quo to examine long-term climate change and anticipate how broader socio-economic changes will influence climate risk in the years to come (Ibid).

Risk mapping can contribute to an improved understanding of localised impacts in Bangladesh

This section has sought to provide a general overview of tools and techniques for assessing climate risks, highlighting the advantages and shortcomings of each. In the context of Bangladesh, two drought assessment models were examined to compare and contrast quantitative and qualitative approaches. Finally, it explored how a risk-mapping component can contribute to an improved understanding of localised impacts in Bangladesh and noted that assessment methodologies must take greater account of projected socio-economic change. The following section will explore what data will be required to conduct effective assessment processes in Bangladesh, review what data is currently available and what gaps have yet to be addressed.

3. Data and Information Requirements for Assessing Risk

This section seeks to build on the above analysis by conducting a broad review of assessment data and information needs based on the aforementioned assessment methods, and more generally, across the three dimensions of risk (hazards, exposure, and vulnerability). These needs will then be cross-referenced with the data and assessment information that is currently available in the national context of Bangladesh, in order to identify gaps and areas for improvement that must be addressed to advance national efforts in assessing loss and damage. Surminski et al. (2012) identified some general needs associated with better assessing the risk of loss and damage in developing countries. The most significant need is availability and access to high-quality data on climate and vulnerability (Ibid: 3).

Information about certain climate change impacts, such as slow onset processes, are not adequately represented in global loss databases

The authors recommend the enhancement of databases for information on loss and damage at the national, sub-national, and local levels. In addition, information about certain climate change impacts – especially slow onset processes like sea level rise – are not adequately represented in the global loss databases that are used in some assessment models (e.g. WorldRiskIndex) (Ibid: 4). The tools analysed in the paper also tend to use a narrow definition of loss and damage, which the authors posit may lead to underestimations of loss and damage.

3.1. Evaluating Data and Information Needs

Regardless of the specific method or tool, all climate change loss and damage assessments must incorporate information and data about climatic hazards (both in terms of current variability and future projections) and vulnerability and exposure (Ibid). In the first instance, data on climatic hazards should include geographically specific observations of climatic variability obtained through direct measurement, and must be "accurate, representative, homogenous and of sufficient length if they are to provide useful statistics" (Ibid: 26). Data for precipitation, temperature and a number of other climatic characteristics are widely available from organizations such as the US National Aeronautics and Space Administration (NASA) or National Ocean and Atmospheric Administration (NOAA), but, especially in developing countries, it is much more difficult to obtain localised, robust data for variables such as wind speed or soil moisture (Ibid).

data must be downscaled through either dynamical or statistical techniques for the information to be accurate and relevant enough for national assessments

Beyond observed data, assessments of climate change-related hazards must also incorporate future projections based on Global Climate Models (GCMs) and/or Regional Climate Models (RCMs). Because these projections cover a broad geographic area, data must be downscaled through either dynamical or statistical techniques for the information to be accurate and relevant enough for national assessments (Ibid)[2]. This process is not always accurate, however, and can generally be expected to increase the level of uncertainty in projections (Ibid; Kerr, 2011).

information needs are highly dependent on the specific tools and methodology applied

With respect to the data required to assess exposure and vulnerability, information needs are highly dependent on the specific tools and methodology applied. At the micro level, quantitative data may be gleaned from government records of property and

[2] "Dynamical downscaling" involves nesting projections for a smaller geographic area within a larger dataset, while statistical downscaling is done by establishing statistical relationships between global and regional variables (Surminski et al., 2012).

infrastructure, social and demographic statistics and other historical records (Surminski et al, 2012). At the macro level, data on public resource needs and development pathways may be obtained from urban and regional planning departments as well as public financial institutions (Ibid).

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Table 1, below, provides an overview of the various data and information inputs required for the aforementioned assessment models.

Bangladesh currently has a variety of data and other relevant information that could be applied in the assessment of current and future climate change-related loss and damage.

Approach	Hazard and Risk Modelling	Exposure	Vulnerability
Catastrophe Risk Modelling	Needs probability of occurrence, location, magnitude, and duration of event Uses Monte Carlo analysis to generate statistics	Needs information about age, destruction, building code, and location	Needs information about physical damage and repair costs
CatSim	Requires intensity and return periods of damaging events	Probability of occurrence and destruction in monetary terms) is modelled as a function of hazards (frequency and intensity)	Focus on fiscal and economic data Financial vulnerability, measured in terms of the potential resource gap, is assessed by simulating the risks to the public sector and the financial resilience of the government
CAPRA	Needs probabilities of occurrence of events	Georeferenced assets in a given area such as population data and data about physical structures	Components and elements at risk that could be quantified such as socio economic data based on local, regional and national statistics
IAM	Global scale climate change projections	Damage function estimates for sectors and regions based on extrapolated study results and presented as a fraction of income	Considered as an aggregated function of per capita income
UKCCRA	UK Climate Projections 2009: probabilistic projections of climate change for the UK	Socio-economic and demographic factors, fixed in time	Social vulnerability Adaptive capacity
Approach in Mumbai case study	Rainfall observations (30 years), extended empirically using weather generator Projections: one RCM (Precis), SRES A2 scenario, statistically downscaled to station level, and empirically extended using weather generator	Exposure map including population and properties	Refers to damage cost to a property for a given water depth, uses average mean damage ratio per type of property, applies 2005 flood event footprint

Table 1: Data Requirements for Selected Modelling Approaches Focusing on Main Components (Surminksi et al., 2012)

Historically, Bangladesh has been impacted by relatively frequent and severe climatic and weather-related hazards, which have resulted in millions of fatalities. Table 2 provides a summary of select hazards experienced in Bangladesh from 1904 to 2012.

Beyond this historical data on climatic hazards in Bangladesh, more detailed information on hazard, exposure and vulnerability risks is available through government departments and other public sector entities. Much of this data has been generated through post-disaster loss and damage assessments, which provide valuable insight into the socio-economic impacts of some extreme events and also improve baseline data. As Bangladesh is a country with significant experience in dealing with climatic and weather related disasters, in many areas there is specific data about housing, roads and other infrastructure that have been destroyed and rebuilt in recent years. While the Department of Disaster Management and Relief (DoDMR) oversees the Government of Bangladesh's (GoB) overall response to such events, individual departments are tasked with evaluating and addressing affected resources that fall within their mandate.

For example, in response to the 2007 Cyclone Sidr, the impacts on water and sanitation infrastructure were assessed by the Department of Public Health Engineering while those for affected schools were calculated by the Ministry of Primary and Mass Education (GoB, 2008).

a wide range of research has yielded specific information at the national, regional and local levels

Type of Event	Specific Event	Number of Events	Fatalities	Total Affected	Damage (USD)
Drought	Drought	7	1,900,018	25,002,000	n/a
	Average per event		271,431	3,571,714	
Extreme Temperature	Cold wave	17	2,076	238,200	n/a
	Average per event		119	17,400	
	Extreme winter conditions	2	230	101,000	n/a
	Average per event		115	50,500	
	Heat wave	2	62	n/a	n/a
	Average per event		31	n/a	
Flood	Unspecified	31	44,847	177,076,392	4,024,100
	Average per event		1,447	5,712,142	129,810
	Flash flood	11	261	7,634,577	729,000
	Average per event		24	694,053	66,273
	General flood	40	7,053	127,463,937	7,285,300
	Average per event		172	3,114,974	177,690
	Storm surge/coastal flood	2	51	473,335	-
	Average per event		26	236,668	
Storm	Unspecified	49	5,706	2,356,857	850,000
	Average per event		116	48,099	566
	Local storm	28	1,835	1,245,958	16,401
	Average per event		66	48,925	566
	Tropical cyclone	85	626,846	73,566,523	4,765,979
	Average per event		7,375	865,489	56,070
TOTAL			2,588,985	415,158,779	17,670,780

Table 2: Climatic and Weather-related Hazards in Bangladesh: 1904-2012 (EM-DAT, n.d.)

In addition, there is also an abundance of household level socio-economic data available from the Bangladesh Bureau of Statistics (BBS).

Beyond government statistics, a wide range of academic and scientific research has yielded specific information at the national, regional and local levels that may be applied to assess loss and damage. The following provides a brief overview of available data that may be applied towards loss and damage assessments. This summary will examine each of the three dimensions of risk (hazard, exposure and vulnerability) and select climate change modelling efforts that have been undertaken in Bangladesh to date.

Hazard Data

At present a variety of different agencies are engaged in generating a range of hazard related data. A number of databases and predictive models have been developed to aggregate this information.

The Bangladesh Meteorological Department (BMD) maintains 36 weather stations across the country that are used to collect localised information on a variety of climatic information, including evaporation, humidity, solar radiation, rainfall, sunshine hours, temperature and wind speed (Mukherjee, unpublished). The BMD also collects satellite data from Japanese and American satellites, which is processed and analysed by the national Space Research and Remote Sensing Organization (SPARRSO). Additionally, the South Asian Association for Regional Cooperation (SAARC) oversees the SAARC Meteorological Research Centre (SMRC) that is involved in the collection and analysis of climatic data specifically for climate change research, including over 20 years of historical data from three tidal gauges along the coast of Bangladesh (CCC, 2008).

Given Bangladesh's complex riverine and oceanic systems, there are several departments responsible for generating different types of water-related data, namely: the Bangladesh Water Development Board (BWDB); the Water Resource Planning Organization (WARPO); the Institute of Water Modelling (IWM), the Bangladesh Inland Water Transportation Authority (BIWTA), the Flood Forecasting and Water Centres and the Centre for Environment and Graphic Information Services (CEGIS).

Between these various organisations, there is significant infrastructure to facilitate effective data collection.

Significant infrastructure to facilitate effective data collection already exists in Bangladesh

For example, the BWDB has a network of over 300 water gauges to monitor discharges from major and medium rivers across the country, while the BIWTA has 43 tidal stations to monitor localised fluctuations in sea levels in coastal areas (CCC, 2008; Mukherjee, unpublished).

Data generated from the above agencies and other public sector entities is aggregated by two key databases: the National Water Resource Database (NWRD), the largest geospatial database in the country, managed by WARPO and a second topographical database managed by CEGIS. In total, the NWRD has 452 layers of data, including geo-referenced data on meteorology, surface and ground water, soil and agriculture, forests as well as a wide array of general data demarcating coastlines, catchment areas, river boundaries, etc. (WARPO, n.d.). Within the NWRD exists a secondary catalogue of data, called the Integrated Coastal Resource Database (ICRD), designed specifically to provide decision makers with accessible information on Bangladesh's 19 coastal districts (WARPO, 2005). An aggregate database that draws on the above sources, among others, has also been developed by CEGIS. Additionally, the BBS (2009a) has issued a Compendium of Environmental Statistics that provides an abundance of data relevant to the assessment of hazards.

Exposure

At present, Bangladesh has a relatively large volume of available data that may be used in assessing what population groups, infrastructure and assets are at risk of incurring climate change-related loss and damage. Through CEGIS topographic maps and the NWRD, it is possible to view an assortment of data on population, housing, settlement patterns, transport infrastructure, cropland area, public infrastructure and other information on a regional and sometimes local scale (CCC, 2008). Additionally, various government agencies and international organizations that have participated in post-disaster loss and damage assessments have also generated similar baseline data for affected areas (see above) as well as post-disaster assessments on how specific sectors and assets have been impacted (GoB, 2008). Beyond local level data on the exposure of specific populations and infrastructure, basic social and economic data generated by the various surveys administered by the BBS or historical financial data can be a useful tool in efforts to assess exposure.

Vulnerability Data
As there is no specific or comprehensive method for determining vulnerability, there are also no standard information inputs that are required to assess vulnerability. Inputs for the aforementioned assessment models vary significantly, ranging from complex measures such as adaptive capacity and social vulnerability to basic socio-economic data such as per-capita income, fiscal and economic statistics, and historical information on physical damage and repair costs for previous disasters.

Perhaps the largest source of general social and economic data is the BBS. The 2011 population and housing census, for example, provides a baseline of regional and municipal level data on population density, average number and age of occupants per household, occupation, etc. (BBS, 2011). In addition to census data, the BBS also generates data from issue-specific surveys such as the welfare monitoring survey, which generated statistics on livestock ownership, availability of water and sanitation, food security, housing construction and assets (BBS, 2009b). Beyond these special reports, the BBS also publishes statistics on foreign trade, a statistical yearbook and a yearbook of agricultural statistics (WARPO, 2005).

3.2. Gaps and Needs

Despite the broad spectrum of data described in the preceding paragraphs, there are a number of important and significant information gaps that must be addressed in order to improve the accuracy and comprehensiveness of loss and damage assessment models. These gaps are partially due to existing data collection and management systems in Bangladesh, but broader theoretical issues about how loss and damage is calculated are also relevant to this discussion. While some of these gaps are specific to the national context of Bangladesh, many of these issues are apparent in other developing countries as well.

Absence of Localised Data
One notable gap in Bangladesh's available information resources on hazard, exposure and vulnerability lies in the fact that much of the data is regional or national in scale and therefore not precise enough for local level decisions (Mukherjee, unpublished). While some agencies such as the BMD, BWDB and BIWTA have established relatively broad networks of data gathering infrastructure, there is a lack of information in specific areas – notably, for soil and surface water salinity and inland storm surges – that is not being addressed (WARPO 2005; Mukherjee, unpublished). Furthermore, with respect to national risk mapping initiatives in Bangladesh, dependence on downscaled hazard-related data from regional and global climate models fosters greater uncertainty in the accuracy of projections (WARPO 2005; Surminski et al., 2012).

The government must invest in scientific infrastructure and capacity building to ensure that gaps are addressed

For example, with respect to the validation of temperature and precipitation, regional-level analysis obtained through collaboration between the UK's Hadley Centre, SPARRSO, BMD and the Bangladesh University for Engineering Technology (BUET) has tended to overestimate results (Ahmed and Chowdry, 2006). To address these gaps in observable data, the GoB must make greater investments in relevant scientific infrastructure and build capacity to ensure that data is properly collected and maintained and that projections are verified.

Quantifying Intangible Loss and Damage
One common criticism of risk assessment models and processes is that they are overly focused on material loss and damage that can be easily identified and quantified (e.g. lives lost, houses destroyed, crops damages, etc.) (Lal et al., 2012). Meanwhile, less tangible impacts on ecosystem services, culture, and social structures are often not adequately accounted for in the assessment process (Surminski et al., 2012). This persisting focus on tangible impacts can largely be attributed to the fact that intangible impacts are inherently difficult to incorporate into risk assessment models. Of the models examined in this paper, some have sought to better address this deficiency: selected IAMs have used "willingness to pay" as a means of quantifying less tangible, non-market impacts of climate change, while the UKCCRA has developed a formula that calculates social welfare in order to place a specific value on certain risks (Defra, 2010; Surminski et al., 2012).

Because intangible impacts are difficult to incorporate into risk assessment models, they focus mostly on tangible impacts

Pursuing these avenues in Bangladesh may be feasible, but would also likely require additional data on willingness-to-pay as well as social and environmental statistics required by the UKCCRA approach to calculate social welfare. In addition, it will be necessary to integrate qualitative research methods into the broader spectrum of assessment model inputs.

Absence of Data Collection and Management Standards

Agencies such as CEGIS and WARPO – particularly through their NWRD and ICRD databases – provide an excellent clearinghouse for data that is directly relevant to the assessment of climatic and weather-related impacts. Yet, cooperation problems between government departments continue to inhibit information sharing between institutions in different regions of the country (WARPO, 2005). Even within departments, inefficient top-down information flow reduces the accessibility of data for those who might be able to make use of it (Ibid).

a common set of standards, platforms and templates could help to increase inter-agency information sharing

Part of this problem stems from technical barriers resulting from disparate data collection and management methods between organisations. On this matter, there is broad agreement among stakeholders that a common set of standards, platforms and templates could help to increase inter-agency information sharing (Mukherjee, unpublished). However, an additional issue impeding better cooperation on data sharing is a lack of departmental capacity to collect, analyse, process, synthesise and assimilate data, so that it can be disseminated in a timely manner (WARPO, 2005).

Specific Data Gaps

The authors have identified several specific gaps in available data for risk assessment modelling in Bangladesh, as well as potential opportunities for improving how this information is “packaged” to better serve risk assessment. These gaps result from some of the aforementioned issues, such as inadequate infrastructure and downscaled projection data. In other cases, data that could prove helpful to this process (see Table 1) has never been collected before (Mukherjee, unpublished). The following list of gaps highlights some of these issues (a longer list produced by the DoE’s Climate Change Cell can be found in Appendix I):

- Property databases by sectors with geo-referenced locations for individual properties;
- Meteorological data on temperature, rainfall, cloud formation, wind speed, wave motion on smaller spatial grids (ideally, 25km-50km) than currently available for most areas (250-350km) (Mukherjee, unpublished);
- Data on the occurrence of each hazard, their scientific characterisation including spatial and time dimensions as well as other characteristics (such as depth and duration for floods);
- Information on lags and leads among the various hazards and their proximate climatic factors – local, national, sub-regional and regional and, where applicable, also global or multi-regional (such as ENSO);
- Information related to vulnerabilities and their quantification by hazard type, size of area, population (and their characteristics) and ecosystems exposed to each hazard by each occurrence;
- Information related to damages to physical assets such as housing, infrastructure, capital assets in enterprises (farm and non-farm), inventories in factories or farms, stocks of outputs and inputs for productive and other purposes;
- Integrated statistical information on mortality, morbidity, and health with qualitative research on environmentally-related health effects (e.g. increased ground or surface-water salinity);
- Information related to losses such as immediate flow of goods and services (outputs of farm and non-farm enterprises), and economy-wide losses due to linkage effects;
- Costs of adaptation; information on losses unredeemed after adaptation and their valuation;
- Budgetary adjustments (national and local) due to financing of post or pre hazard adaptation measures.

4. Capacity Needs for Applying Risk Assessment Methods

By recognising research and knowledge management as a major pillar of its 2009 Bangladesh Climate Change Strategy and Action Plan (BCCSAP) (2009), the GoB has demonstrated a clear interest in improving its understanding of climate change risks. This thematic area of the BCCSAP focuses specifically on improving climate and hydrological modelling efforts, bolstering environmental monitoring and expanding research into the relationship between climate change, livelihoods, food security and vulnerability – all of which are relevant to climate risk assessment (Ibid).

The Government of Bangladesh has demonstrated a clear interest in understanding climate change risk

To accomplish these objectives, however, enhanced knowledge and capacity will be required. The paragraphs below outline Bangladesh's current capacity and investments in climate risk assessment, and subsequently, reviews key capacity needs that must be addressed to facilitate the advancement of comprehensive climate change risk assessment at the national, district, and local levels.

4.1. Overview of Current Capacity and Knowledge Base

Institutional Capacity

The GoB has dedicated significant political capital to mainstreaming climate change activities across ten different ministries, in which the development of climate modelling capacity has figured prominently. While two of the six thematic areas – Capacity Building and Research and Knowledge Management – outlined in the BCCSAP are directly relevant to the development and implementation of climate risk assessment systems and processes, the GoB has not made these issues funding priorities relative to investments in, for example, infrastructure.

Financial Investment

From 2009 through 2012, the GoB pledged over USD 500 million in mitigation and adaptation financing through two major climate change funds, the Bangladesh Climate Change Trust Fund (BCCTF) and the Bangladesh Climate Change Resilience Fund (BCCRF), as well as a third multilateral fund known as the Pilot Program for Climate Resilience (PPCR) (TIB, 2012). As of March 2012, roughly USD 189 million had been dispersed through these three channels for a wide range of projects, including several focusing on capacity building, research and knowledge management (Ibid).

Of the 62 projects approved for funding under the BCCTF as of March 2012, seven were research and knowledge management projects and four were capacity building, representing 10 percent and 4 percent of approved BCCTF funding respectively (MoEF, n.d.). These projects include the creation of a permanent surveillance network to monitor groundwater salinity in coastal areas and the creation of a salinity assessment model under the BWBD, capacity development to further the study of climate change impacts within the SPARRSO and the expansion and modernisation of climate change monitoring and assessment facilities in Chittagong (Ibid). Among approved projects and programmes under the PPCR, USD 500,000 has been approved for the Climate Change Capacity Building and Knowledge Management Project, which is being implemented and funded by the Asian Development Bank (ADB) (CIF, 2012). No specific knowledge or capacity-related initiatives were identified under the BCCRF (Ibid).

Knowledge Networks

At the international level, knowledge networks should provide a channel for the transfer of specialised knowledge and technology from developed to developing countries. Additionally, these networks should enable developing countries to absorb the lessons learned on the development and operation of assessment systems from both developed countries and their neighbours in the global South (UNSIDR, 2009). One example of knowledge sharing between climate scientists and decision makers in Bangladesh is the Opportunities and Risks from Climate Change and Disasters (ORCHID) program. Developed by the Institute for Development Studies in the UK and funded by DFID, this programme aims to increase awareness and knowledge of climate risks among foreign donors as well as development planners and managers (Trærup and Olhoff, 2011). The GoB has also established a variety of bilateral and multilateral connections with foreign research institutions (such as the Hadley Centre and the UK's Met Office) and international organisations (such as the ADB) that help to contribute knowledge, technology, and funding for a variety of assessment-related projects.

At the national level, knowledge networks should seek to connect experts responsible for undertaking and overseeing climate risk assessment with other researchers, technicians and analysts across both the public and private sectors. Stronger, formalised relationships need to be built between government entities responsible for assessment and research institutions studying the dynamics of hazards, exposure and vulnerability that are relevant to the assessment process. The GoB's partnership with institutions like the Bangladesh Centre for Advanced Studies (BCAS) and the BUET on hazard-related assessment projects is one example of how external bodies have been enabled to help build knowledge and expertise in climate risk assessment. The GoB-Palli Karma Sayahak Foundation (PKSF) partnership is a valuable conduit for traditional knowledge on assessing and adapting to climate risk, which is especially important as it is these types of grassroots institutions that often serve as the best advisers and correspondents with local communities (UNISDR, 2009).

4.2. Current and Future Capacity Needs

Depending on the specific needs and resources of the country in question, it may be advisable to pursue a qualitative approach rather than an expert driven, quantitative approach – particularly where there is an emphasis on local participation and significant limitations in available quantitative information (Surminski et al., 2012).

the most prominent capacity need is the development of sufficient human resources to manage the assessment process

The issues addressed below transcend the particular context of Bangladesh and provide some insight into how assessment measures must be advanced across the developing world.

Human Resources – Developing Skills and Expertise

Perhaps the most prominent capacity need is the development of sufficient human resources to manage the assessment process, from start to finish. While the types of expertise that will be required ultimately depends on the model that is used, most assessment initiatives will require an adequate base of technical skill and expertise to enable the timely and precise collection of field data, the synthesis and formatting of information, the analysis and interpretation of results, the design of assessment models, the identification and compiling of relevant data, the operation and maintenance of risk projection programs and the effective communication of results.

In the national context of Bangladesh, the development of an effective assessment processes is held back by deficiencies in scientific capacity, both in terms of general data collection and analysis, but particularly by the lack of capacity to operate and maintain sophisticated climate change models (BCAS, 2010). Enhanced cooperation and knowledge sharing with developed countries – through initiatives like the ORCHID project – will help to address these gaps and build capacity and expertise over time. Furthermore, the continuous or repeated application of climate risk assessments models is, in and of itself, a mechanism for building capacity (Hamill and Tanner, 2011).

Financial Investment

Modelling climate risk can be an expensive undertaking, particularly if the assessment approach that is selected is complex and sophisticated (Surminski et al., 2012).

Ensuring a sufficient and continuous flow of financial resources is critical to the development and maintenance of assessment capacity

Ensuring a sufficient and continuous flow of financial resources is critical to the development and maintenance of assessment capacity, information inputs and infrastructure. While significant funding has been allocated to the BCCSAP's thematic areas of research and knowledge management and capacity building, most BCCTF funding has been directed towards infrastructure projects (MoEF, n.d.). A recent report has revealed that infrastructure has received 44 percent of all BCCTF funding, while capacity building and institutional strengthening – the most underfunded of all six thematic areas – received 1.93 percent (Pervin, 2013).

Breaking Down Institutional Barriers

The GoB, through the 2009 BCCSAP, has made significant commitments towards mainstreaming CCA and mitigation activities throughout relevant government ministries and line agencies (GoB, 2009). For example, the DoE's Climate Change Cell, created in 2004, is working to coordinate climate change-related activities between focal points across multiple ministries. The GoB's Planning Commission, housed within the Ministry of Planning, is actively working to integrate climate resilience and national development planning (Pervin, 2013). However, while individual departments pursue their own progressive climate change initiatives, significant barriers remain that inhibit cooperation and collaboration between different ministries (Shamsuddoha et al., 2013).

breaking down "bureaucratic silos" between different government entities is a necessary step towards facilitating effective knowledge sharing

In the context of climate risk assessment, breaking down "bureaucratic silos" between different government entities is a necessary step towards facilitating effective knowledge sharing and also the timely dissemination of important data that may be applied in assessment modelling.

5. Assessment of Communication and Decision Making Structures

Conducting a thorough and comprehensive assessment of climate risks is a complex and multi-faceted task that requires substantial investment in human and material resources, coordination between multiple organisations, and, often, the successful manipulation of sophisticated modelling software. Yet, if the assessment results that emerge from this process are not effectively communicated to decision makers at the policy and political level, the entire process will be jeopardised. The section below outlines several general and specific issues that must be addressed to ensure the development of effective communication of climate risk assessments between scientific and technical experts and policy-makers. In addition to these general lessons on assessment communication, this section provides an overview of the institutional framework in which climate change issues are addressed in Bangladesh.

5.1. Improving Communications Tools and Techniques

One key approach that can help make assessments relevant and informative to decision makers is an active effort on the part of scientific and technical experts to frame results in a manner that is action-oriented. To this end, there should be a deliberate and explicit effort to convey the inherent complexity and uncertainty of projections as well as clear instructions for how the information can and cannot be used to inform policy (Hammill and Tanner, 2011; Lal et al. 2012).

important to ensure that communication tools are relevant to decision makers

Beyond this, it is important to ensure that communication tools are relevant to decision makers and to that end the format, visual displays and medium should be tailored to the specific audience in question (Surminski et al., 2012). Some useful techniques and tools that have been used to communicate risk assessments include:

- Creating distinctive classes or "levels" of loss and damage that differentiate between high, medium and low level risks – based on probability and consequence – can help to signal areas where action is required most urgently (Lal et al., 2012; Surminski et al., 2012);
- Incorporating accessible visual displays, such as maps, charts or even technological platforms to better explain assessment results (Surminski et al., 2012); and
- Using intermediaries who have a unique understanding of both the assessment process and the needs of decision makers, and who are well respected by both parties, can help bridge existing gaps in communication, knowledge and interests. While such actors may already play a role in the process on one side or the other (or both), where no such intermediary is present, it may be advisable to insert someone who can fulfil this role into the process (Lehtonen and Peltonen, 2006).

Overall, the scientific community must find "better and faster ways to interact and communicate substantial findings to policymakers and to support the development and implementation of solutions for emerging problems" (UNISDR, 2009: 14).

5.2. Building Better Decision Making Structures

Effectively communicating climate risks and loss and damage assessments requires a great deal of collaboration within and between various government departments and research institutions. To successfully convey results, there need to be opportunities for interaction – during, before and after the assessment process – between the scientists, technicians and analysts responsible for assessments and decision makers responsible for integrating results into current and future planning initiatives.

Facilitating interaction between these groups does not always happen easily or on its own. Diffuse organisational structures and disparate (or sometimes competing) mandates can serve to limit the quality and number of interactions. In many cases, this divide is further complicated by the prevalence of social and hierarchical norms, but also internal differences in how information is structured and communicated (in terms of format, language and medium, for example).

In Bangladesh, a persisting delay between scientific and technical knowledge and policy action exists

Ensuring that the institutional structures in place serve to increase the frequency and quality of exchanges between policy-makers and those responsible for developing and communicating risk assessments is a critical component in reducing these barriers.

Institutional Structures in Bangladesh

In Bangladesh and other developing countries, there is a persisting delay between scientific and technical knowledge of climate change risks and policy-level action (BCAS, 2010). One of the key issues inhibiting effective integration of scientific and technical expertise and advice into policy-making and development planning is the relative absence of formal systems to facilitate the dissemination of information and knowledge (UNISDR, 2009; BCAS, 2010).

Considerations for Improvement

One way to increase the uptake of assessment results and knowledge into development and climate change planning is to facilitate regular engagement between existing policy-making and assessment bodies, so that decision makers can directly benefit from the latest information on climate risks (UNISDR, 2009).

Facilitating learning opportunities between experts working on different components of risk analysis is important

This is especially important given the uncertainty that surrounds climate risk assessment. Through regular monitoring and learning opportunities, policy makers are able to follow any changes in the anticipated severity, scale and timing of impacts as they are discovered. Additionally, it is also important to facilitate learning opportunities between experts working on different components of risk analysis– namely, those working on the "hard", "soft" and "applied" sciences: scientists, social scientists and engineers (Ibid).

Beyond the above-mentioned institutional reforms, the approach to assessment that is undertaken by governments has a profound effect on how climate risks will be or will not be acted upon. According to Lal et al. (2012), there are two general types of approaches undertaken to assess and develop policy responses to climate risks: a top-down, science-driven approach ("Scenarios-Impacts-First") and a bottom-up, policy-driven approach ("Vulnerability-Thresholds First"). Under the science-driven approach, the development of policy responses and activities begins once a projected climate change scenario has been established (Ibid). In contrast, the policy-driven approach begins by identifying system goals and constraints, considering the extent to which these may be affected by the impacts of climate change, establishing impact thresholds and identifying risk response strategies that will improve the robustness and resilience of the system under future climate change (Ibid).

a policy-driven, vulnerability-oriented approach should be pursued

The policy driven approach is a useful framework for identifying no-risk or low-risk activities that can be undertaken in the short-term to achieve general improvements in resilience, despite uncertainties about future impacts. However, this approach has been criticised for its lengthy assessment process, heavy dependence on expertise and overly qualitative focus (Agrawala and van Aalst, 2008; Lal et al., 2012). On the other hand, a scenario-driven approach can help to raise awareness of climate risks and explore potential adaptation responses, but also requires sufficient data for sophisticated modelling (Lal et al., 2012). Additionally, this approach emphasises adaptive responses that are heavily dependent on the selected climate impact scenario(s) and a given set of assumptions about socio-economic and climatic uncertainties (Ibid).

In the context of Bangladesh, a policy-driven, vulnerability-oriented approach should be pursued, for a number of reasons. First, despite on-going capacity building efforts, the GoB does not yet have the data-gathering infrastructure and expertise to provide the breadth and depth of information that would likely be required for a scenario-oriented approach. The science-driven approach also gives less consideration to current risks from natural climate variability, which, given the historical frequency and severity of extreme weather events in Bangladesh, is a notable omission. However, Lal et al. (2012) note that many studies now advocate a complementary fusion of these two approaches that leverages their respective quantitative and qualitative focus.

As Bangladesh builds its hazard assessment capacity and resources and expands its current qualitative assessment systems and expertise, an integrated approach will help to ensure that assessments can be effectively translated into concrete policy responses.

6. Summary of Findings and Recommendations

Assessing climate-related loss and damage is a complex and evolving field. This paper has attempted to contribute to this emerging area of interest by examining key issues related to how risk assessments are conducted within the context of Bangladesh. A wide variety of issues have been explored, including methodology, data requirements, capacity needs, and communications structures necessary to facilitate the effective implementation of climate risk assessments that yield actionable results. The below paragraphs

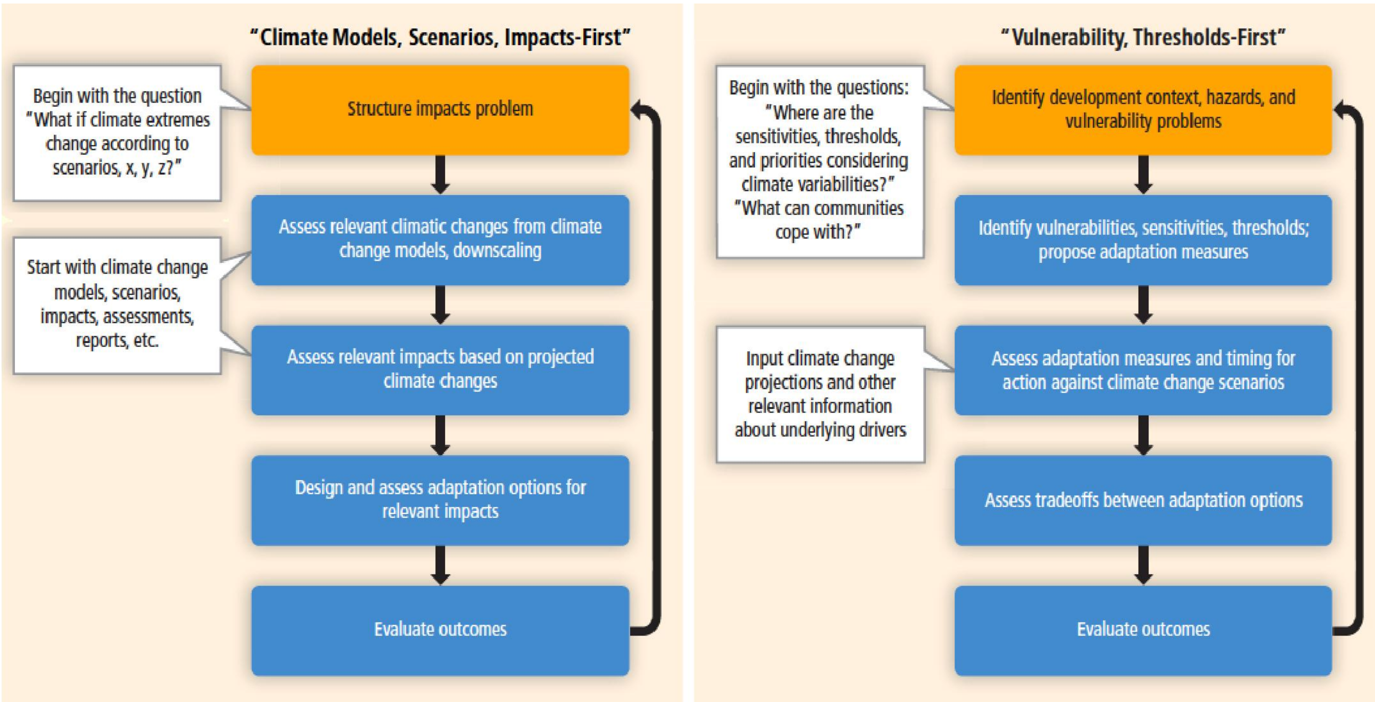

Figure 4: Top-down Scenario, Impacts-first Approach (left panel) and Bottom-up, Vulnerability Thresholds-first Approach (right panel) (Lal et al., 2012)

highlight once again some of the issues examined and provide key recommendations for each.

Improving Risk assessment Tools and Methods in Bangladesh

While all of the assessment models examined in this analysis have their own unique strengths and weaknesses, there are two key issues that should be addressed to make assessments more robust. First, while most of the examples in this paper focus on sophisticated mechanisms for incorporating climate-related hazard projections, none take adequately into account how projected social, economic or demographic changes might impact exposure or vulnerability in future years. Second, while most of the models adopt either a qualitative or quantitative focus, none seek to leverage the complementary benefits of both approaches in a comprehensive manner that addresses multiple hazard risks and socio-economic factors. In the case of Bangladesh, this is an avenue that should be pursued with greater rigour, given existing expertise and resources developed for participatory research and the relative absence of adequate quantitative data in many areas.

Data and Information Requirements for Assessing Impacts and Climate Risks

Regarding the generation and maintenance of data for assessment processes, this paper has examined how information requirements vary depending on the applied methodology. As with many developing countries, in Bangladesh discernable gaps in observable, local-level data exist. This is due to a combination of inadequate infrastructure and expertise and should be addressed by increasing national and international investment in capacity building. In the interim, Bangladesh should focus on assessment methods with a more qualitative and participatory focus, that are not dependent on a robust data set for sophisticated hazard modelling.

Capacity Needs for Applying Risk Assessment Methods

While the GoB has expended significant financial and political will to mainstream climate change into the activities of relevant ministries, it has disproportionally invested in infrastructure-related adaptation projects, short-changing capacity development – both in terms of human resources and scientific equipment and monitoring infrastructure. Enabling greater knowledge sharing and human resource development will require that successful knowledge networks that have emerged at the international level be downscaled to facilitate greater cooperation and collaboration between government departments and other research institutions at the national and local levels. Bangladesh should seek to break down departmental "silos" and invest more in building assessment capacity for hazard-related climate modelling as well as the assessment of vulnerability and exposure.

Optimising Risk Assessment Results for Decision-makers

As effective policy action is the ultimate aim of the assessment process, it is critical that assessment results be communicated in a way that provides a clear picture to decision makers about the extent of projected impacts and what actions may be undertaken to address these issues.

it is critical that assessment results be communicated in a way that provides a clear picture to decision makers

This paper has highlighted a number of tools and techniques that have been employed in other developed and developing country contexts and should be applied in Bangladesh: namely, framing techniques such as categorising risks according to severity and probability, which make it easier for decision makers to set priorities. Additionally, two key approaches were evaluated: a top-down approach that is science-driven and based on climate change scenarios and a second approach that is bottom-up and based on vulnerability thresholds. This latter approach is recommended for Bangladesh, as it facilitates actionable "no" or "low-regrets" activities that will serve to increase resilience and also address existing development objectives in the process.

The selection and development of a comprehensive climate risk assessment mechanism is a long process, particularly in a developing country such as Bangladesh. However, it is in this context that effective climate risk assessment is most needed. In the years ahead, the impacts of climate change will present a host of serious and multi-faceted threats; understanding and predicting these risks is crucial to facilitating a timely and effective response.

7. Conclusion

Loss and damage is already being incurred in countries around the globe – both developing and developed. Given current levels of greenhouse gas emissions, it is likely that climate change impacts and associated loss and damage – from both extreme events and slow onset processes – will continue to increase.

assessing the risk of loss and damage is the first step towards developing approaches to address loss and damage

Many of these impacts will be "beyond adaptation" and thus approaches to address residual loss and damage will need to be developed and implemented. Consequently, assessing the risk of loss and damage is the first step towards developing approaches to address loss and damage. However, it is important to first develop an understanding of what needs to be known before tailoring methodologies for assessing the risk of loss and damage. This is especially important as in general only those risks that are systemically assessed and evaluated get addressed.

In the Bangladesh context, developing assessment models that account for social and economic changes and are able to effectively blend qualitative and quantitative methodologies will help to broaden the scope of loss and damage assessments. In the years ahead, greater investment in data gathering infrastructure and expertise could generate the data needed for more advanced assessment techniques and the capacity to carry them out. To this end, establishing more active connections between various government agencies and research institutions at the national level can improve how data is shared and applied. Finally, tailoring the assessment results to convey policy needs to decision makers and institutionalising a bottom-up policy-making philosophy that centres on vulnerability can help to ensure that future efforts to address loss and damage are well-informed and appropriate.

In Bangladesh, there are lessons to be learned that can be of value to other developing countries facing similar challenges

As we begin to explore how international efforts to assess and address loss and damage can inform national-level conversations and processes, it is clear that the solutions for each country may vary significantly. The unique challenges that Bangladesh faces with respect to its ability to collect, manage and process data on climate change impacts as well as developing and applying advanced methodologies to assess the risks of loss and damage are linked to the specific socio-economic circumstances of the country. However, it is also clear that there are lessons to be learned that can be of value to other developing countries facing similar challenges, such as the importance of building capacity in assessment and modelling, investing in scientific infrastructure, and building better national networks between researchers and policy makers. While capacity, financial, and institutional barriers and deficiencies vary significantly between countries, these are all issues that, to a varying degree, need to be addressed to advance the loss and damage agenda. By learning from their respective experiences with this process, vulnerable countries can move forward together.

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Appendix I: Data Requirements by Sector

Sector	Data Requirements
General	Population, technology, production, consumption
	Emission quantum
	Temperature
	Atmospheric concentrations
	Radiative forcing and global climate
	Regional climate and weather
	Profiles of sea level rise
	Climatic thresholds
	Direct impacts on crops, health, infrastructures, forests, ecosystems etc.
	Income, expenditure, livelihoods, additional risks and vulnerabilities
	Price parameters
	Discount rates
	Key macroeconomic indicators of development
Water	Hazards and decadal frequency
	Levels of vulnerability per hazard
	Risks per vulnerability
	Existing infrastructures
	Projected loss of water infrastructures (embankments, sluices, irrigation structures, etc.)
	Existing production levels in crops, fisheries and livestock
	Projected loss of crops, fisheries and livestock
	Existing households and housing structures (including public and private assets and buildings)
	Projected households and housing structures (inc. public and private assets and buildings)
	Existing GDP in water sub-sector, growth trend and PRSP goal
Road	Length of roads, regional and national highways
	Hazards and their decadal frequency
	Levels of vulnerability per hazard
	Risks per vulnerability
	Projected loss of road infrastructures (road, bridges, culverts, spillways, protective works etc.)
	Population and households
Health	Existing vulnerabilities and risk levels due to water-borne and vector-borne diseases
	Projected vulnerabilities and risk levels due to water-borne and vector-borne diseases
	Costs of present public sector spending on mitigation of health disasters
	Projected costs of public sector spending on mitigation of health disasters
	Existing infrastructures for public drinking water, health and sanitation services
	Projected needs for additional public drinking water, health and sanitation services
	Present net land available for crops round the year
	Expected loss of net land for crops round the year due to climate change impacts
Agriculture	Present yield levels for all crops
	Projected yield levels for all crops due to climate change impacts
	Price of products (present and future)
	Expected damage frequency and damage profiles for the future
	Salinity levels (present and future)
	Present levels of use of fertilizers, pesticides
	Future expected levels of use of fertilizers and pesticides

Source: CCC, 2008.

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 Development and Knowledge Network (CDKN)

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

International Centre for Climate Change and Development (ICCCAD)

Based in the Independent University, Bangladesh (IUB), the International Centre for Climate Change and Development's aim is to develop a world-class institution that is closely related to local experience, knowledge and research in one of the countries that is most affected by climate change. ICCCAD supports growing capacity of Bangladesh stakeholders, as well as enabling people and organizations from outside the country to benefit from training in the field, where they are exposed to the adaptation "experiments" and increasing knowledge. Through the expertise and research outputs of ICCCAD and its local partners, international organizations will be able to continue to share and transmit knowledge of climate change and development challenges around the world for the benefit of other LDCs, and their governments, donors and international NGOs. ICCCAD has begun running regular short courses for NGOs, donors, the media, government staff, private sector, etc. As well as initiating courses for local participants and Bangladeshi stakeholders, it provides tailor-made courses for organizations and departments that are seeking to enhance their capacity in regard to climate change.

For further information:

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