Effective Finance for Food Security under Climate Change

A thesis submitted to Imperial College London for the degree of Doctor of Philosophy

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2015

Declaration of Originality

I hereby declare that this thesis is entirely my own work, except for that which has been appropriately referenced.

Helena Wright

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Acknowledgements

I would like to express my sincere gratitude everyone who has helped me during the course of the thesis, including all those at CEP. Many thanks to all those who helped me conduct my fieldwork in Bangladesh, including everyone I interviewed as part of the research.

This thesis is dedicated entirely to my mum Hilary Wright who has been a constant source of inspiration, guidance and encouragement in everything I do.

xxx

Abstract

Climate change threatens food security and livelihoods throughout the world. Under the United Nations Framework Convention on Climate Change, developed countries have committed to providing additional resources for adaptation to climate change in developing countries. This thesis explores how this finance can be most effective. Importantly, a multi-level case study approach was adopted because this enabled institutional arrangements for adaptation finance to be explored at multiple scales (international, national and local-level). The national case study of Bangladesh was selected as a country highly vulnerable to climate change impacts including sea level rise and intense cyclones, whilst a local-level case study was also selected in coastal Kalapara. A criteria-based framework for analysis was adopted to analyse the three levels.

At the local-level, day labourers, many of whom owned no land, were found to be particularly vulnerable to food insecurity. There was evidence of climate-related poverty traps and many households found it extremely difficult to recover from severe cyclones. However, a recent community-based adaptation project had engaged with local government and built infrastructure to protect croplands. At national-level, priorities aligned well with those identified in the local case study, but concerns were expressed regarding national ownership and capacity. At international-level, concerns were expressed about the lack of transparency and stakeholder engagement in decision-making on climate finance. There seemed to be more progress against criteria of ownership and equity at local-level. A set of policy recommendations have been developed, including the need to mainstream gender into adaptation planning at all levels, and the need for climate funds to engage more fully with local government. Future research is required on how to strengthen synergies between adaptation and mitigation, whilst exploring a wider range of case studies could provide useful insights for the Green Climate Fund.

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List of Acronyms

ADB	Asian Development Bank
ADP	Annual Development Programme
AOSIS	Alliance of Small Island States
ASAP	Adaptation for Smallholder Agriculture Programme
AWD	Alternate Wetting and Drying
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
BCCRF	Bangladesh Climate Change Resilience Fund
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCCTF	Bangladesh Climate Change Trust Fund
BCR	Benefit-Cost Ratio
BFIs	Bilateral Finance Institutions
BMD	Bangladesh Meteorological Department
BRRI	Bangladesh Rice Research Institute
BSPCR	Bangladesh Strategic Programme for Climate Resilience
BWDB	Bangladesh Water Development Board
CA	Conservation Agriculture
CAN	Climate Action Network
CAP	Common Agricultural Policy
CBA	Community-Based Adaptation
CBD	Convention on Biological Diversity
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CCCP	Community Climate Change Project
CCU	Climate Change Unit
CCVI	Climate Change Vulnerability Index
CDM	Clean Development Mechanism

CDMP	Comprehensive Disaster Management Programme
CEIP	Coastal Embankment Improvement Project
CERs	Certified Emission Reductions
CGIAR	Consultative Group on International Agricultural Research
CGPS	Continuous Global Positioning System
CIFs	Climate Investment Funds
COP	Conference of Parties
CPEIR	Climate Public Expenditure and Institutional Review
CPP	Cyclone Preparedness Programme
CSA	Climate-Smart Agriculture
CTF	Clean Technology Fund
CVCA	Climate Vulnerability and Capacity Analysis
DAC	Development Co-operation Directorate
DAE	Department of Agricultural Extension
DEFRA	Department for Environment, Food and Rural Affairs
DFID	Department for International Development
DFIs	Development Finance Institutions
DRR	Disaster Risk Reduction
DSSAT	Decision Support System for Agrotechnology Transfer
EACC	Economics of Adaptation to Climate Change
EBA	Ecosystem-Based Adaptation
EC	European Commission
ECA	Economics of Climate Adaptation
ECRRP	Emergency 2007 Cyclone Recovery and Restoration Project
EIA	Environmental Impact Assessment
ENSO	El Niño-Southern Oscillation
ESSP	Earth System Science Partnership
EU	European Union
EVI	Environmental Vulnerability Index

EWS	Early Warning System
FAO	Food and Agriculture Organisation
FDI	Foreign Direct Investment
FGD	Focus Group Discussion
FSF	Fast Start Finance
GAIN	Global Adaptation Index
GCCA	Global Climate Change Alliance
GCF	Green Climate Fund
GCM	General Circulation Model
GDI	Gross Domestic Income
GDP	Gross Domestic Product
GEF	Global Environment Facility
GGD	Gonogobeshona Dol
GHG	Greenhouse Gas
GIS	Geographic Information System
GM	Genetically Modified
GNI	Gross National Income
GoB	Government of Bangladesh
HIES	Household Income and Expenditure Survey
HYV	High-Yielding Variety
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
ICAI	Independent Commission for Aid Impact
ICT	Information and Communication Technologies
ICTSD	International Centre for Trade and Sustainable Development
IDA	International Development Association
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFPRI	International Food Policy Research Institute

IGES	Institute for Global Environmental Strategies
IIED	International Institute for Environment and Development
IISD	International Institute for Sustainable Development
ILUC	Indirect Land Use Change
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPRs	Intellectual Property Rights
IWMI	International Water Management Institute
LAC	Local Adaptive Capacity
LACC	Livelihood Adaptation to Climate Change
LAPA	Local Adaptation Plan of Action
LCA	Life Cycle Analysis
LDC	Least Developed Country
LDCF	Least Developed Countries Fund
LGED	Local Government Engineering Department
MBF	Ministry Budget Framework
MCA	Multi-Criteria Analysis
MCDA	Multi-Criteria Decision Analysis
MDBs	Multilateral Development Banks
MDGs	Millennium Development Goals
MFIs	Microfinance Institutions
MIEs	Multilateral Implementing Entities
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
MRV	Monitoring, Reporting and Verification
MTBF	Medium Term Budget Framework
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NAPA	National Adaptation Programmes of Action

NDA	National Designated Authority
NGO	Non-Governmental Organisation
NIEs	National Implementing Entities
NUE	Nutrient-Use Efficiency
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PCMU	Project Coordination Monitoring Unit
PKSF	Palli Karma-Sahayak Foundation
PLA	Participatory Learning and Action
PPCR	Pilot Programme for Climate Resilience
PRA	Participatory Rural Appraisal
REDD	Reducing Emissions from Deforestation and Forest Degradation
RINGO	Research and Independent NGO
ROI	Return on Investment
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCCF	Special Climate Change Fund
SCF	Standing Committee on Finance
SDG	Sustainable Development Goal
SEA	Strategic Environmental Assessment
SEI	Stockholm Environment Institute
SES	Social-Ecological Systems
SGP	Small Grants Programme
SIDS	Small Island Developing States
SLA	Sustainable Livelihoods Approach
SLF	Sustainable Livelihoods Framework
SLR	Sea Level Rise
SME	Small and Medium-Sized Enterprises
SPA	Strategic Priority for Adaptation

SRDI	Soil Resources Development Institute
SREX	Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
SST	Sea Surface Temperature
STW	Shallow Tube Well
TEK	Traditional Ecological Knowledge
TFP	Total Factor Productivity
TIB	Transparency International Bangladesh
TNA	Technology Needs Assessment
TRIPs	Trade-Related Aspects of Intellectual Property Rights
UKCIP	UK Climate Impacts Programme
UNCDF	United Nations Capital Development Fund
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
UP	Union Parishad
URAA	Uruguay Round Agreement on Agriculture
VRA	Vulnerability Reduction Assessment
WEF	World Economic Forum
WFP	World Food Programme
WHO	World Health Organisation
WIPO	World Intellectual Property Organization
WRI	World Resources Institute
WTO	World Trade Organisation
WUE	Water-Use Efficiency

Introduction

1.1. Research Premise

Currently around 1 billion people around the world already suffer from food insecurity and malnutrition (WFP, 2012). Climate change poses great risks for food security globally, and will particularly affect developing countries. The effects of climate change on food production are already evident in several parts of the world (IPCC, 2014). Adaptation to climate change has now been recognised as a key priority in international climate negotiations. However, analysis of flows of climate finance point towards insufficient progress in scaling-up finance for adaptation (Buchner *et al.,* 2013; Nakhooda *et al.,* 2013).

At both international and national-level, there has been a particular emphasis on public adaptation finance, with commitments being made by developed countries under the United Framework Convention on Climate Change (UNFCCC) to support efforts to address climate change in developing countries. Due to limited availability of resources, it is necessary for the available financial resources to be used wisely and effectively. This thesis aims to contribute to this subject, by identifying whether and how climate finance can be effective in ensuring food security under climate change; and what kinds of frameworks can facilitate effective finance. The purpose of the research is to contribute to new human understanding of public adaptation finance with respect to a multi-level criteria-based approach using original case studies.

Importantly, this research adopts a multi-scalar approach, because vulnerability is determined at multiple scales (Smit and Wandel, 2006) and adaptation is therefore increasingly observed at different spatial and societal scales (Adger *et al.,* 2005) (see Section 2.1). Barrett (2012) argues a multi-scalar construct is required to appraise the distribution of finance for adaptation, in order to ascertain whether international finance flows are distributed to local actors.

1.2. Thesis Structure

The methodology chapter outlines the research questions (Section 2.2) and explains how the theoretical framework was developed during the research. The chapter also outlines the various methods that were applied in conducting fieldwork at the various scales of analysis. Interdisciplinary mixed-method research was undertaken at three levels. At local-level, a case study was selected in Kalapara, Bangladesh as it is a vulnerable coastal area and a target

of various adaptation interventions including a community-based adaptation project. At national-level, Bangladesh was identified as a case study as it is considered highly climate-vulnerable and has a range of emerging experience in utilising climate finance. At international-level, semi-structured expert interviews were undertaken with key informants and UNFCCC negotiations were observed as this is the primary forum for discussions relating to international climate finance.

The literature review in Chapter 3 provides background and theory on adaptation, mitigation and food security. The chapter defines several key terms and explores the interactions between adaptation, mitigation and sustainable development. The chapter also explains the interaction between climate change impacts and food security.

Chapter 4 gives an overview on the topic of community-based adaptation (CBA), providing the theoretical background to the analysis of the local-level case study. Subsequently, Chapter 5 provides an extensive review of literature and background relating to the national-level case study of Bangladesh, including reviewing the various projected climate impacts, and analysing climate finance and policy responses, using relevant policy documents. Chapter 6 provides an overview of literature relating to the international-level analysis.

In Chapter 7, an indicative framework of criteria to be taken into consideration for effective adaptation financing is developed, drawing on a comprehensive literature review. This is relevant for the first research question. The framework is used to inform the forthcoming fieldwork including semi-structured interviews with key informants, and an effort is made to assess climate adaptation finance against these criteria in the subsequent three chapters.

In Chapters 8 to 10 the results of the fieldwork undertaken at the three scales of analysis (local, national and international) are analysed and discussed using the framework of analysis (Chapter 7), informed by the literature review in preceding chapters. At local-level, methods include household-level interviews, focus group discussions, and semi-structured interviews with key informants including local officials. At national-level in Bangladesh, interview data has been used track progress against the framework, focusing on predominantly on the Bangladesh Climate Change Resilience Fund (BCCRF) and domestically-funded Bangladesh Climate Change Trust Fund (BCCTF). At international-level, climate finance negotiations under the Standing Committee on Finance (SCF) of the UNFCCC reveal the process by which decisions were taken on the criteria against which the financial mechanism is reviewed. Various multi-scalar linkages are observed between local and national-level but

also between national and international-levels. Finally, the concluding chapter summarises the research and highlights potential topics for further research as well as key recommendations which could be useful in informing future policy and practice.

2. Research Methodology

2.1. Introduction

This chapter describes the methodological approach adopted by this study for collection and analysis of data. The study aims to explore the primary research question: *In what ways can climate finance across scales (international, national, and local) effectively ensure food security under climate change?* The study explores and analyses the institutional settings and frameworks through which public climate finance is directed and prioritised at international, national and local-level, taking the national case of Bangladesh. This chapter outlines the research questions (Section 2.2.) and the methodological approaches adopted during the study, taking each level of analysis in turn.

2.1.1 Mixed Methods: A Multi-Level Multi-Case Study Approach

This research can be defined as mixed methods research which combines elements of qualitative and quantitative research approaches (Cresswell and Clark, 2011). The central premise of this approach is that the use of quantitative and qualitative data in combination provides better understanding than either approach alone (*ibid*). It has been argued that the methodological pluralism of mixed methods research frequently results in superior research compared to monomethod research, as it allows researchers to mix design components that offer the best chance of answering their specific research questions (Johnson and Onwuegbuzie, 2004). Furthermore, researchers adopting this approach can use all of the tools available to them rather than being restricted to a particular set of approaches (*ibid*).

The impacts of climate change are often cross-cutting and multi-sectoral, bridging social and environmental concerns, so this is ideally suited to a pragmatic multi-disciplinary approach. Qualitative research methods also manage to deal with ambiguity (Merriam, 2009) which will be valuable in dealing with many of the uncertainties surrounding climate change and its policy responses. It has been argued the distinction between qualitative and quantitative methods of research is based on the distinction between the sciences and humanities, but in fact it is still possible to be scientific without being quantitative (Potter, 1996). The research question has both qualitative and quantitative dimensions since it is necessary to look at both governance and distribution issues relating to climate finance.

Qualitative research methods are appropriate in the context of climate change adaptation and mitigation, because qualitative methods can be used to study "phenomena in terms of the

meanings people bring to them" (Denzin and Lincoln, 2005:p.3). Qualitative researchers are described as being interested in "how people interpret their experiences, how they construct their worlds, what meaning they attribute to their experienc*e*" and may draw from various philosophies including constructivism, phenomenology and symbolic interactionism (Merriam, 2009:p.14). Ethnographic approaches are drawn on in this study. Qualitative case study research is an empirical attempt to investigate a phenomenon in its real-life context (Merriam, 2009; Yin, 2008). Therefore, this type of research will be highly relevant for exploring climate change vulnerability. Direct observations will be made in the field setting during the case study, as well as incorporating semi-structured interviews (Yin, 2008). Overall, qualitative research methods are valuable in recognising the presence of multiple sources of evidence, and multiple opinions and perceptions of the same evidence, which sometimes involves conducting open-ended interviews in multiple settings (Yin, 2011). Ethical standards of conduct are vital for this approach in a field-based setting in order for the research to have integrity (Yin, 2011). Cresswell and Clark (2011) explain that where the qualitative and quantitative strands of research are separate initially, but connected, these may have to be brought together and merged at the end. Taking this into account, this mixed methods research also brings together different strands of the research at the end of the analysis.

Case study research has been described as being valuable for generating practical and expert knowledge, including "concrete, context-dependent experience" that is "more valuable than the vain search for predictive theories and universals" (Flyvbjerg, 2006:224). This is achieved due to proximity to the studied reality. Although it has previously been argued that it is difficult to generalise from a particular case, this is dependent largely upon the case one is speaking of, and how it is chosen, since the strategic choice of a case may add greatly to generalizability (*ibid*). Furthermore, case studies can be ideal for the 'falsification' of propositions as proposed by Karl Popper. On the identification of case studies, it has been observed; "atypical or extreme cases often reveal more information because they activate more actors and more basic mechanisms in the situation studied" (Flyvbjerg, 2006:229). In studying climate adaptation, the selection of a case study from a country or region that is considered particularly vulnerable to climate change could therefore reveal a range of useful insights in this regard (see 2.4.1). Drawing upon the insight; "good social science is problem driven and not methodology driven (Flyvbjerg, 2006:p242), this research seeks to overcome the restrictions of a particular discipline and embraces a combination of qualitative and

quantitative research methods. This study thus uses mixed methods including semi-structured key informant interviews and household-level survey data as described in following sections.

The research draws upon the concept of 'phronetic social science' because the point of departure is 'bottom-up', contextual and action-orientated knowledge (Flyvbjerg *et al.,* 2012). The term 'phronesis' comes from the Greek word in Aristotelian ethics which is sometimes translated as "practical wisdom" and which Aristotle pointed out facilitates 'sophia' (wisdom). It draws upon public deliberation in the public sphere, and this bottom-up approach can be useful in highlighting perspectives or policy responses that are neglected or marginalised in public policy-making (*ibid*). Furthermore, since this type of research is grounded in contextual policy decisions, it also supports the use of mixed-methods research. In relation to climate vulnerability and adaptation, the approach highlights the need to include and incorporate the perspectives of climate-vulnerable groups.

A theoretical underpinning of the research is systems thinking. A system is basically "an entity with certain properties that can be distinguished from its surrounding environment" (Halliday and Glaser, 2011:p.1). Fiksel (2006) suggests in sustainability research there is a need to understanding the dynamic, adaptive behaviour of complex systems and their resilience. Both global climate and food systems are integrated natural-human systems. Without an understanding of system implications, Fiksel (2006) points out there is a risk of unintended consequences. For instance, uptake of biofuels could affect agricultural productivity. This is, once again, highly relevant in the context of avoiding maladaptation. It is important to consider vulnerability at the whole-system level, where the influence of governance and institutions might be more relevant than it is at household-level (Adger, 2006). This research utilised systems thinking in the analysis of findings in order to identify how different factors link to each other.

Hence this research adopts a multi-disciplinary approach that analyses and recognises the inter-linkages between social, economy and natural systems. This is informed by the concept of 'resilience' in systems, which has emerged as a concept in ecology, as well as economics and risk management (see Fiksel, 2006). Applied to food security, this informs an understanding that the resilience of food systems under climate change will inherently require an understanding of the complexity of coupled natural-human systems.

2.1.2. Literature review

An extensive literature review was undertaken on the areas identified as relevant to the study. The literature review was used to identify the major issues and debates around the topic (Hart, 1998) including key concepts and theories, as well as the major impacts of climate change. Critical evaluation of the literature was linked to the research questions, including identifying various areas in which there were gaps in the literature (*ibid*). In particular, an in-depth literature review was undertaken to analyse articles relevant to the effectiveness of climate finance and specific issues relating to climate adaptation finance in Bangladesh. Policy documents and reports were analysed to gain a broad understanding of the subject, including various unpublished documents recommended in person by key informants. The thesis includes several appendices provided for the interest of the reader; these are relevant to the thesis but non-essential to understanding it.

During this stage, research questions were developed and various hypotheses were then developed which were investigated in the primary research. In particular, the literature review on climate finance was used to develop the indicative framework of principles (Chapter 7). The term 'framework' is used to describe the set of criteria that could be used to evaluate the effectiveness of climate finance. These issues were explored in semi-structured interviews with key informants during the case study research. Similarly, the case studies helped to confirm or disconfirm the theoretical propositions put forward in the literature review and evaluate the accuracy of that analysis.

2.1.3. Overview of the Methodological Approach

Since environmental research explores human-environment interactions, this supports the use of interdisciplinary approaches as discussed above. Furthermore, the focus on climate change lends itself to multi-scalar analysis for various reasons. Firstly, while climate change is a global phenomenon, the impacts manifest themselves at local-level. Vulnerability and adaptive capacity are both determined at multiple scales (Smit and Wandel, 2006). General Circulation Models (GCMs) are the means through which climate change projections have been developed, although these are only downscaled to local-level with higher levels of uncertainty. Hence, a local-level analysis provides valuable insights and perspectives on how climate variability manifests itself and is experienced.

Although there is a growing body of scholars who view scale as 'socially constructed', there is also a rich literature discussing the importance of scale as a fundamental concept in

describing the hierarchical organisation of the world (Moran, 2010). Multiple definitions of scale include institutional, spatial as well as temporal scale. It has been argued we live in a 'multilevel' world (Cash *et al.,* 2006) and environmental problems such as climate change require an understanding of how processes operate at different scales and might be related across scales (Moran, 2010). Gupta et al (2007) argue climate change is a 'glocal' problem with global impacts that are experienced locally, thus requiring a multi-level governance solution. It is also vital to understand how related policy processes at each level (global, national and local) feed into each other (*ibid*).

In studying climate finance in particular, international channels of public climate finance are based on commitments at international-level and involve financial transfers from developed to developing countries. Adaptation is increasingly being observed at different spatial and societal scales (Adger *et al.,* 2005) and therefore the effectiveness of adaptation may be judged at different scales. In terms of food security, globalisation of agricultural trade also means market or price shocks have implications across scales. Hence, this study aims to analyse the research question at three levels: incorporating an international, national and local-level analysis (see Figure 2.1). Analysis of case studies was undertaken to answer the research question at those levels.

In relating to climate justice, Paavola (2005) argues both distributive and procedural justice have cross-level dimensions. Barrett (2012) argues a multiscalar and interdisciplinary construct is required to appraise the distribution of climate finance for adaptation, and analysis of adaptation finance is particularly illuminating for analysing climate justice, in terms of analysing whether flows of finance are distributed to vulnerable actors. Barrett suggests utilising literature from international relations (global level), political economy (national-level) and political ecology (local-level), disciplines which were also used to inform this research.

It is recognised that in some sense the identification and definition of the scales at 'international', 'national' and 'local' level are social constructs, and the definition of 'local' is also a subjective decision, but it is considered that these levels of analysis will be revealing for analysis of climate finance. Refer to Figure 2.1 for a diagrammatic representation of the methodology. The term 'scale' is used synonymously with the term 'level' in this research. Jurisdictional (administrative) levels (Cash *et al.,* 2006) were identified as appropriate units of analysis due to the institutions at these levels. Regional or supra-national institutions were

not included due to the absence of adaptation funds at this scale, but may be identified in other localities. The findings and conclusions also enabled a consideration of the linkages between these scales.

The initial table (below) takes various steps of the methodology (outlined in Figure 2.1) and maps these steps against the research methods which are discussed in this chapter as executed. Sections 2.3-2.5 give an overview of the different methods at each stage.

Table 2.1 Steps of Methodology

Methodological Step of Thesis	Theoretical/practical underpinnings
Literature Review	International relations, political economy, political ecology, systems thinking
Fieldwork – Local (in Kalapara) (Chapter 8)	Semi-structured interviews with key informants, household survey questionnaire, focus group discussions, informed by political ecology literature and systems thinking
Fieldwork – National (Bangladesh) (Chapter 9)	Semi-structured interviews with key informants and analysis of secondary household survey dataset, informed by political economy literature and systems thinking
Fieldwork – International (UNFCCC) (Chapter 10)	Semi-structured interviews with key informants and participant observation, informed by international relations literature

As seen in the table above, some methods were used at several levels, for example, semi-structured interviews with key informants were undertaken at international, national and local level. Finally, the outcomes of the research were a set of findings and conclusions logically derived from the case studies and related fieldwork, as well as a set of policy-relevant recommendations.

2.2. Research Questions

As previously mentioned, the study aims to explore the primary research question: "*In what ways can climate finance across scales (international, national, and local) effectively ensure*

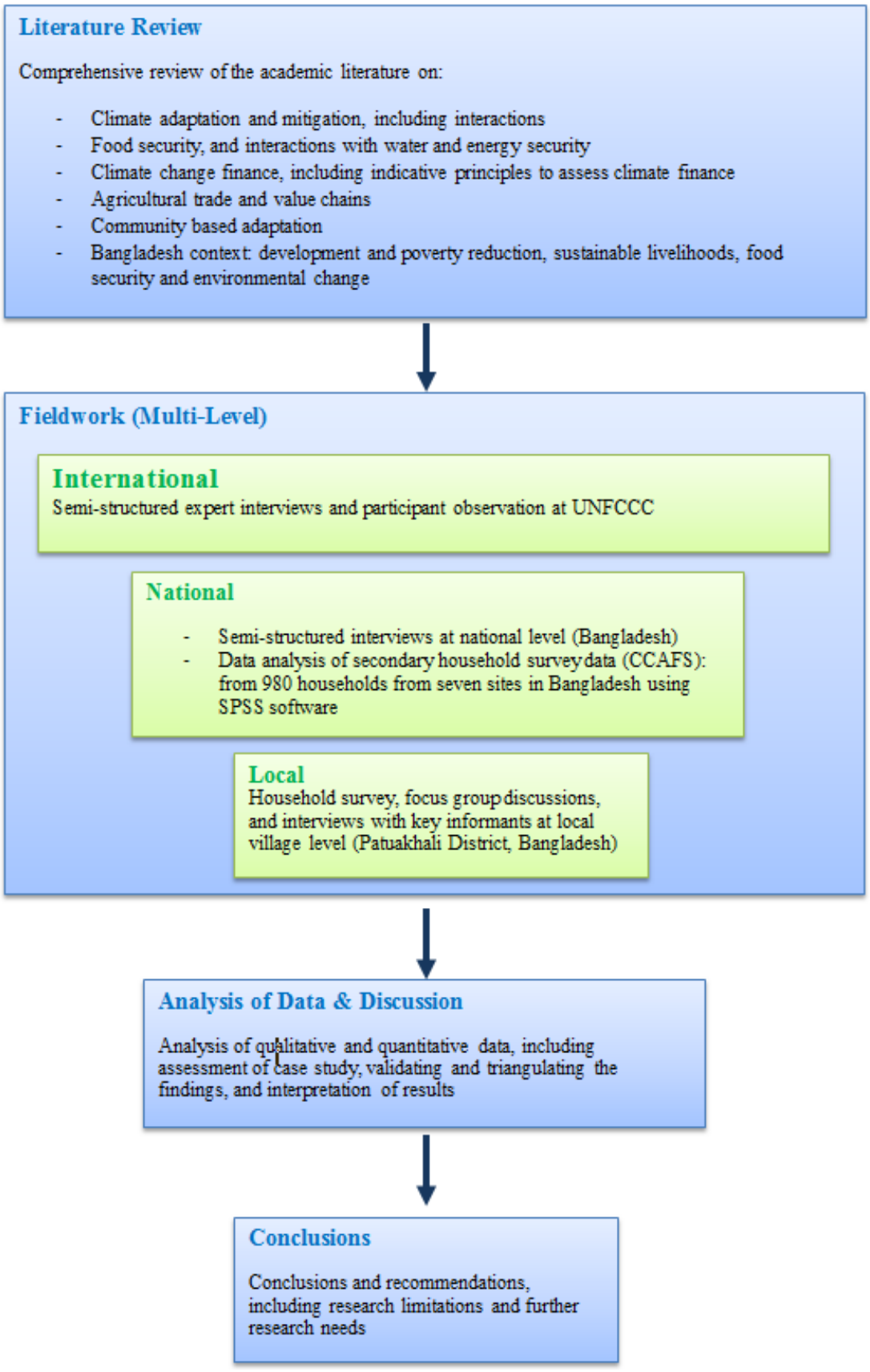
food security under climate change?" The study explores and analyses the institutional settings and frameworks through which public climate finance is directed and prioritised at international, national and local-level.

Sub-questions are:

- What issues should be taken into consideration in evaluating the effectiveness of adaptation finance?
- What progress has been made across scales (local, national, international) in effectively financing adaptation?
- What kinds of frameworks, institutions and policies are recommended to facilitate effective adaptation financing across scales?

Each of these research questions are answered explicitly or implicitly throughout the thesis at each level (local, national, international). At both international and national-scale, particular focus is placed on public adaptation finance as these are the climate finance flows available under UNFCCC mechanisms, but private finance is also explored in order to further understand how private adaptation action can be mobilised. Taking the national case of Bangladesh, institutional mechanisms and channels of publicly-provided climate finance are explored with the aim of exploring the key issues surrounding adaptation finance and identifying recommendations for the kind of frameworks, institutions and policies, which can facilitate effective finance. At the local-scale, the study explores local perceptions of climate change impacts from key stakeholders and analyses local efforts to adapt with the aim of drawing bottom-up insights into these research questions from on-the-ground experiences.

Figure 2.1 Outline of the methodology of the thesis



2.3. Local Level

2.3.1. Selecting a local case study

Kalapara, a sub-district within Patuakhali District is an area in a tidal floodplain in coastal Bangladesh that is highly vulnerable to climate change and food insecurity issues. One case study was identified because the aim was to conduct an in-depth analysis of the local issues, rather than to be representative of a particular area.

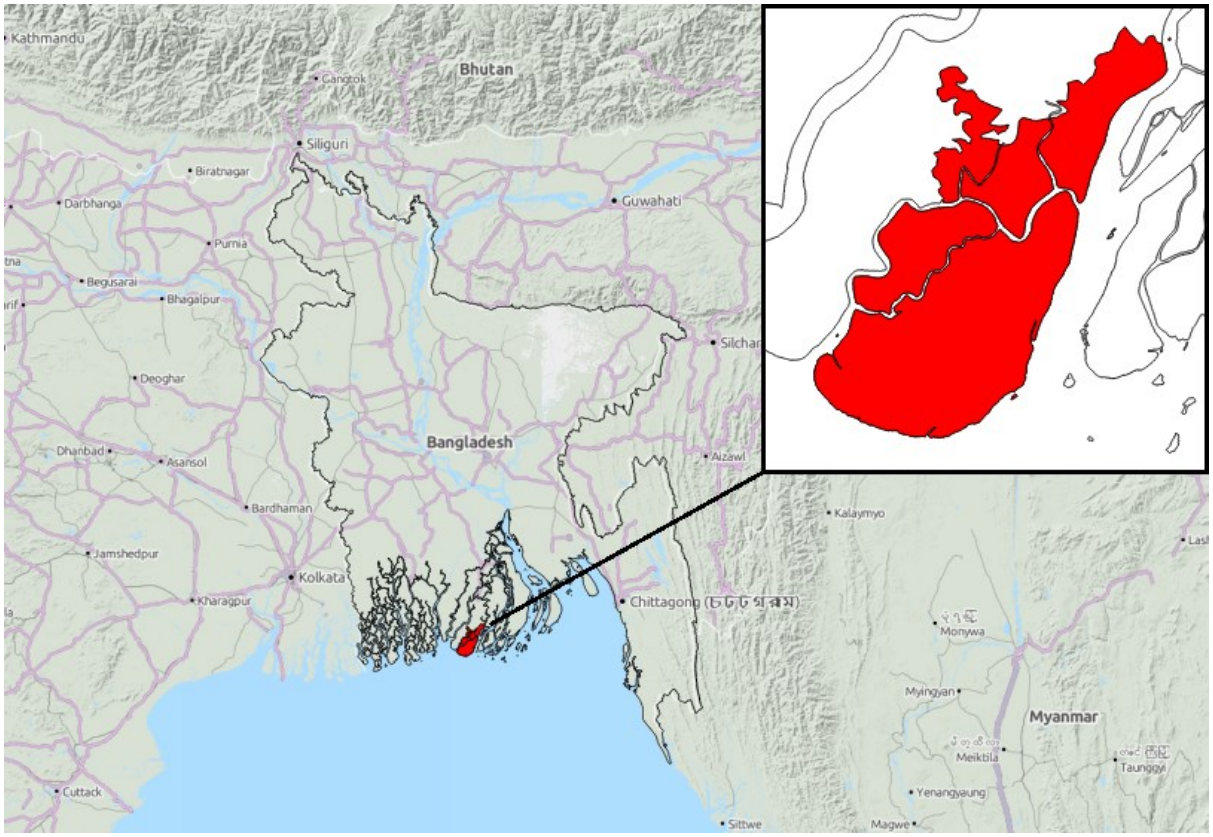


Figure 2.2 Map to show Kalapara Upazila (Sub-district), Patuakhali (Authors' own: produced using QGIS software)

The area was selected as an ideal study location due to various factors, including high likelihood of coastal climate change impacts (sea level rise, cyclones, and salinity intrusion), high incidence of poverty and food insecurity, feasibility, and availability of data. This area also suffers from geographical isolation from urban centres and markets, factors which may exacerbate vulnerability. Patuakhali is a target area for the Comprehensive Disaster Management Programme (CDMP) project to construct multi-purpose schools and cyclone shelters, which was the first project funded by the multi-lateral Bangladesh Climate Change Resilience Fund (BBCRF). Furthermore, the selected area of Kalapara also overlapped with

an area for which there was secondary household survey data already available from CCAFS (Climate Change Agriculture and Food Security), an international research project by CGIAR (Consultative Group on International Agricultural Research). CCAFS provided an existing survey dataset on household vulnerability from various sites across coastal Bangladesh which could be analysed, and one of these sites was Kalapara. Furthermore, ActionAid Bangladesh had been conducting a local-level community-based adaptation (CBA) project in the locality for several years and were selected as a local-level research partner for practical reasons as it provided an entry point to local organisations and facilitated introductions with key informants. The village of Poshurbania was targeted for the detailed household survey due to its location in the vulnerable Sidr-affected coastal belt, as the site of the CBA project, and as a target area for various government-linked adaptation interventions, including improvement of embankments and introduction of saline-tolerant rice varieties. Whilst Poshurbania was the unit of analysis for household interviews, it was important to understand the Upazila-level governance context (see below). Therefore, after deliberation on the choice of local case study, against a number of criteria (vulnerability, feasibility, and data availability), this was selected as the local-level case study.

2.3.2. Semi-structured interviews with key informants

At local-level, key stakeholders were identified for semi-structured interviews from relevant institutions, primarily those responsible for local government services in the selected case study village. In-depth interviews with a local non-governmental organisation (NGO) respondent informed the design of the household survey. The ten interviewees included the Union Parishad Chairman, Upazila Chairman, Local Government Engineering Department official, Water Development Board, and Department of Agriculture Extension. Presence of Upazila-level government institutions meant these interviews were primarily conducted in Kalapara. A Bengali-English interpreter was used where necessary, as for the household survey (see 2.3.4). Use of semi-structured interviews alongside focus group discussions also enabled a form of methodological triangulation to occur (see Denzin and Lincoln, 2005).

2.3.3. Participatory research tools

A range of approaches are used in the assessment of proposed adaptation interventions. The climate finance chapter (Chapter 7) explains these include multi-criteria analysis, cost-effectiveness analysis, and cost-benefit analysis (UNFCCC, 2011a). In cost-benefit analysis, the benefits of the proposed adaptation action can be compared to the costs to determine

whether it is worthwhile. Usually, market and non-market costs and benefits are expressed in terms of monetary terms and compared in this way. Relevant gains and losses are aggregated together, either across people or across time (Hanley and Barbier, 2009). Analysing the costs and benefits of adaptation could help answer the broad research question regarding how climate finance can be effective.

In local contexts, the social value disparate groups of individuals place on community assets poses challenges to a traditional cost-benefit approach. For example, in Morocco, stakeholders ranked the non-monetary benefits of irrigation more highly than monetary benefits (Chambwera *et al.,* 2011). There are challenges associated with monetising costs or benefits associated with environmental goods and services, social or cultural values, or common pool resources (UNFCCC, 2011a; Chambwera *et al.,* 2011). Furthermore, it is important to consider equity and distribution of costs and benefits, i.e. who benefits from adaptation interventions (UNFCCC, 2011a), especially since poorer groups are most vulnerable. For these reasons it was decided conventional cost-benefit analysis was not appropriate to the local context, but the study aimed to discuss costs and benefits of different adaptation strategies with stakeholders in a qualitative way, drawing on participatory cost-benefit analysis (Chambwera *et al.,* 2012).

Participatory cost-benefit analysis is a tool that has recently been used in the context of adaptation, drawing on participatory research appraisal methods to ensure all financial, social and environmental costs and benefits are identified. An example from Khulna, Bangladesh showed participatory cost-benefit analysis can be used to complement quantitative analyses and may even reduce the cost of adaptation by requiring a balancing of benefits across stakeholders (Haque, 2013). The value of adopting a stakeholder-focused approach also lies in facilitating dialogue among stakeholders who may not otherwise interact (Chambwera *et al.,* 2011). The focus is less upon solely economic and monetary costs and benefits, it incorporates social and environmental costs and benefits identified by stakeholders themselves (*ibid*). Participatory cost-benefit analysis draws from the established technique of rapid rural appraisal, developed by Robert Chambers and others. This technique is widely used by NGOs and international organisations, especially in agricultural development, and has transformed into participatory rural appraisal (PRA) and participatory learning and action (PLA). The approach can be adapted to local circumstances, overcoming literacy barriers, and aims to empower communities to engage effectively with researchers in influencing the direction of research. Important questions and issues emerge as information is collected.

These approaches are flexible and participatory to avoid the difficulties that emerge from rigid "top-down" application of fixed methods (FAO, 1997). PLA aims to be useful to participants themselves and involve mutually-beneficial shared learning.

However, participatory approaches have also been criticised for the potential to be 'hi-jacked' by the most influential or powerful members of the community, and therefore to ultimately legitimise existing structures of power. Part of this critique draws from utilisation of participation by powerful organisations like the World Bank (Cooke and Kothari, 2001). Further criticisms arise from the potential for research to be patronising in a post-colonial context, with a dichotomy between 'subjects' and 'objects' of research which is disguised but never really overcome, or for participatory research to ignore the role of the 'state' (*ibid*). In this research, such objections were carefully considered in research design, ensuring all discussions were inclusive of women as a marginalised group (Cannon, 2002), remaining cognizant of the key role of governance, and inviting participants to ask their own questions at the end of each survey.

The PRA approach was utilised to some extent, although due to resource constraints it was not possible to use a multi-disciplinary research team. However the household survey was checked by three academic staff from different discipline backgrounds (law, economics and engineering) as well as being cross-checked by a team of PhD colleagues, before piloting and adjustment during the actual fieldwork (see next section).

2.3.4. Local-level questionnaire design

The local-level household survey was designed with the following principles in mind; using simple, familiar language, avoiding 'leading' questions, avoiding double negatives, considering the types of response categories, ensuring the questionnaire was easy to use, and piloting the survey before use (Johnson and Turner, 2003). Household surveys undertaken at village-level were piloted by interviewing several community members in the initial days to field-test the survey and inform the final design of the survey. The pilot also ensured the survey was suitable to the local context and of suitable length.

Upon piloting the survey, several aspects had to be adapted because there were certain sections that were too extensive, irrelevant, or inappropriate. For example, it was found through Focus Group Discussions (FGDs) and the pilot survey that most participants experienced salinity as a consequence of cyclones, so there was no need to treat these

climatic impacts separately. When discussion began on the impacts of cyclones, participants quickly mentioned the salinity problem resulting from the cyclonic storm surge, which affected the crops. Therefore, these two sections of the survey were eventually merged, along with additional questions on salinity. Furthermore, although river erosion was not mentioned during the FGDs, which could be owing to the specific location of this village, this issue was brought up in the local government interviews, and hence river erosion was incorporated into the household survey. Furthermore, during adjustment and piloting of the survey it was necessary to focus the questionnaire on the social benefits of adaptation options and adopt more qualitative approach due to feedback from respondents that cyclone shelters and embankment primarily had non-monetary benefits. Thus a qualitative open-ended and semi-structured format was adopted, moving away from the initial focus on economic costs and benefits. This confirmed findings from the literature review that cautioned against use of conventional cost-benefit analysis.

In total, 32 household interviews were completed comprising around a third of the total population of Poshurbunia village. It was found important to retain the engagement of interviewees throughout the survey to avoid research fatigue by ensuring the interview did not take up too much time. Hence the survey was streamlined to be conducted as efficiently as possible to avoid research fatigue as far as possible. The survey questions also had to be culturally sensitive as well as sensitive to the fact many of the respondents were illiterate. Therefore, the household survey was simplified to include losses from previous disasters, ranking of issues and ranking of adaptation options. Refer to the limitations section, below, which discusses how issues of bias were avoided.

Since a list of households in the village was not available, household survey respondents were randomly sampled from the village. The household survey was undertaken by every third household encountered on foot. As previously mentioned, the sampling was stratified by gender: representation of women was ensured by encouraging female household members to respond on behalf of the household wherever possible, resulting in approximately half the responses from women. Use of mapping (both using Google Earth and the participatory village map) ensured the whole village had been surveyed. The response rate was high as every household asked to take part in the household survey accepted, and villagers felt comfortable discussing the environmental challenges they were facing. Since there was only one principal investigator and interpreter conducting the survey, there was no chance of duplication of responses.

2.4.5. Focus group discussions (FGDs)

Focus groups are useful in exploring ideas and concepts, as well as obtaining in-depth information about what people think about an issue (Johnson and Turner, 2003). The benefits of FGDs are that the discussion enables participants to have greater control over the issues raised, and spontaneous issues can arise that were unanticipated by the researcher (Hennick, 2007). FGDs were undertaken with the main livelihood groups identified in the locality of the village; farmers, fishermen and agricultural labourers. In addition, separate FGDs were conducted with women's research groups launched by Actionaid (GGDs known as Gonogobeshona Dol) which had previously developed community action plans. Separate FGDs were conducted with women to ensure their views and perspectives were fully considered as a marginalised group and ensure women felt able to speak openly. The use of FGDs alongside the local-level household survey and semi-structured interviews also enabled a degree of triangulation to occur (see Section 2.6.2). Group interviews through FGDs also enable "indefinite triangulation" whereby individual responses were put into context (Denzin and Lincoln, 2005).

FGDs with the community groups informed the design of the household survey as participants prioritised the main risks faced locally, including cyclones, salinity intrusion, and river erosion. This enabled the local population to input into the study, and enabled local perceptions and knowledge to be brought into the design of the survey itself.

2.4. National Level

2.4.1. Selection of country case study

Selection of the country case study was based on identification of a location considered highly vulnerable to climate change that also provided a rich source of emerging experience in international climate finance. Criteria used to select the country case study were; vulnerability to current and future climate change impacts, food insecurity issues, and emerging experiences with climate change finance. Bangladesh was identified as highly vulnerable to climate change. Under the Climate Change Vulnerability Index (CCVI), Bangladesh was ranked as most vulnerable country in the world to climate change in both 2011 and 2013 (Maplecroft, 2011; Maplecroft, 2013). The CCVI ranking is based on indicators for exposure, sensitivity and adaptive capacity (*ibid*). Bangladesh also suffers from a range of food insecurity and poverty issues, and some 40% of the population live below the food poverty line (WFP, 2014). The availability of relevant data and information

was also taken into consideration, including practical considerations, and the feasibility of conducting fieldwork. Following a process of deliberation, Bangladesh was selected as the case study country for the research.

Bangladesh is also an interesting case study for adaptation finance as it has established institutions for climate finance, the Bangladesh Climate Change Trust Fund (BCCTF) and the Bangladesh Climate Change Resilience Fund (BCCRF). There is broad awareness of the linkages between climate change and development in Bangladesh, and Bangladesh is also a significant player in the UNFCCC negotiations as a Least Developed Country (LDC) (Hedger, 2011). Furthermore, Bangladesh is also recognised as a leader in the field of community-based adaptation to climate change, having hosted a number of conferences on this subject. For all these reasons, Bangladesh was selected as the national case study for the research.

2.4.2. Analysis of household dataset

At national level, CCAFS household survey was designed with the intent of developing simple, comparable cross-site household-level indicators for food security, household assets, agricultural production diversity and other indicators across 980 households in total (see Kristjanson *et al.,* 2011; Wright et al., 2012 and Chapter 9). The open-access dataset provided a useful resource for statistical analysis with SPSS Software.

2.4.3 Semi-structured interviews with key informants

At national-level in Bangladesh, key informants were identified for interview including representatives of various institutions involved in the climate finance architecture. Similar to the international-scale interviews, a series of open-ended questions were asked based on the research questions, informed by the literature review. 24 key informants were selected for interview based upon their knowledge and expertise on adaptation finance, and the stakeholder groups represented included those from international organisations, government, NGOs, academia and media. It was more difficult to identify private sector stakeholders as it was noted in the literature review that private companies have not yet become involved in public adaptation finance in Bangladesh (except in the PPCR). Efforts were made to be sensitive to cultural differences and sensitivities, including dressing appropriately, as well as recognising the need to avoid ethnocentrism (Clifford *et al.,* 2010). As with international interviews, key informants were asked different questions depending on the relevant context and specific expertise of the individual.

The semi-structured interviews provided a degree of flexibility in exploring the research questions, while at the same time, making the most of the time available with the interviewee (Fife, 2005). This enabled the interview to unfold in a conservational manner offering the participants the chance to explore issues they felt were important (Clifford *et al.,* 2010). This flexibility was useful in order to explore and learn about new and emerging issues, particularly since climate change adaptation is an emerging and dynamic field. The semi-structured approach enabled "follow-up" questions to be asked where necessary to elicit further details about specific responses from interviewees (Wengraf, 2001). At the end of each interview, interviewees were asked to suggest any further literature or provide related documents, if possible, which in some cases enabled further information to be gathered. Following the interviews, the content of the interviews was transcribed, coded and analysed.

2.5. International Level

2.5.1. Participant observation

Drawing on ethnographic research methods, the international-level research at UNFCCC negotiations involved participant observation of the international discussions on climate finance. At the UNFCCC negotiations, attendance of the talks and registration as an 'Observer Delegate' offered various benefits, enabling a combination of involvement and detachment from the international negotiations under the umbrella constituency for researchers known as 'RINGO's (Research and independent NGOs). The following UNFCCC meetings were attended as an observer delegate:

- UNFCCC informal sessions at United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Bangkok, Thailand, 30 August-5 September 2012 followed by the first meeting of the Adaptation Committee, Bangkok, Thailand, 7-10 September 2012
- The eighteenth session of the Conference of the Parties (COP-18), in Doha, November-December 2012
- Bonn UNFCCC Intersessional Meeting of the UNFCCC, in Bonn, Germany, June 2013
- The nineteenth session of the Conference of the Parties (COP-19) in Warsaw, Poland in November 2013

As recommended by Merriam (2009), participant observation was undertaken in this research with the aim of avoiding subjectivity and remaining sensitive to any effect the research may

be having on the situation. Participant observation enabled first-hand experiential evidence (*ibid*) to be gathered of UNFCCC climate finance negotiations and decision-making processes. The UNFCCC is the primary forum for discussions relating to international climate finance. Accreditation at the talks enabled access to government officials and access to various discussions which were not available by any other means. Other benefits included being permitted to view documents relating to the negotiations in this dynamic and political context. Analysis of draft texts before and after the process of negotiation at Warsaw (COP-18), as well as observation of meetings, enabled observation-based learning with an actor-specific focus grounded in negotiations between human decision-makers (Hudson, 2005). Insights have thus been elicited drawing upon negotiation theory (Alfredson and Cungu, 2008). Other non-UNFCCC meetings which were attended included the 7th Annual Community Based Adaptation Conference (CBA7) held in Dhaka, Bangladesh in April 2013 and the 8th Annual Community Based Adaptation Conference (CBA8) in Nepal in April 2014.

2.5.2. Semi-structured interviews with key informants

In addition to participant observation, semi-structured interviews were undertaken with key informants. A series of open-ended questions were asked on the various key issues, informed by the literature review. UNFCCC meetings provided a forum for identifying stakeholders for interview as this is the single most important forum for international climate finance discussions. 18 key informants were selected based on their knowledge in the field, and purposive sampling (Tongco, 2007) was used to ensure representation of different stakeholder groups in these interviews, including international organisations, civil society (NGOs), and media, as well as maintaining balance between developing and developed-country government officials. By participating at relevant conferences, as well as using 'snowball sampling', it was possible to interview at least 1 high-level stakeholder involved with each of five major global institutions engaged in financing adaptation to climate change; the Kyoto Protocol's Adaptation Fund, the Pilot Programme for Climate Resilience (under the World Bank's Climate Investment Funds), the Global Environment Facility (GEF), the International Fund for Agricultural Development (IFAD), and the newly-launched Green Climate Fund (GCF).

This study utilised a purposive sampling technique due to the need to identify knowledgeable experts for interview (Tongco, 2007). This form of targeted sampling (Wilson, 2000) was identified as suitable for the case study research as key informants were identified based on

expertise and familiarity with the area of study. Within key institutions, in certain cases, snowball sampling (also known as chain referral) was utilised for practical reasons because this enabled further access to officials or experts who might have otherwise proven difficult to contact. Due to time constraints, at times the contact details of interviewees were taken and interviews were undertaken at a later date. Documents and materials from the UNFCCC were obtained during the interview process and provided a source of primary material. Semi-structured interviewing was selected as a research method as it enables sufficient flexibility to approach different respondents differently while still covering the same subject areas (Noor, 2008). Thus, key informants were asked different context-specific questions, and additional follow-up questions were asked where necessary.

2.6. Interpretation of Findings

All semi-structured interviews were transcribed verbatim from notes and audio to maintain the quality of data. The next step in the process of systematic analysis of the data was a process of manual "coding" of texts, which describes the attachment of codes to segments of texts which represent signposts or labels to the transcription. Drawing on Hay (2005), a two-step process was adopted in which basic coding was initially done in order to distinguish overall themes, followed by a more in-depth process in which more specific patterns were interpreted. According to Denzin and Lincoln (2005), the initial coding phase in grounded theory is the first step in an analytic stance towards the data, and this gives a researcher analytic scaffolding on which to build. A predominantly 'inductive' style of inquiry was adopted during the process of analysis, as this enabled new and emerging issues to be identified from the data rather than ascribing meaning based on preconceived hypotheses. This drew on 'grounded theory', which is often referred to as the "constant comparative method of analysis" (Glaser and Strauss, 1967:101).

In Strauss and Corbin (1990), categories can come from the pool of concepts drawn from the literature review, while others are drawn from other sources or from phrases used by key informants themselves. Hence, the pool of concepts for analysis was ultimately developed using a combination of both inductive and deductive approaches. Coding has a crucial role in analysing and making sense of data (Basit, 2010). Coding was done manually in this study, because although this process can take longer (*ibid*), it was felt manual coding was more appropriate than computer-assisted coding due to the 'open' style of inquiry in which it was important for the codes to be flexible and in which new themes could emerge spontaneously.

2.6.1. Validity of Findings

Yin (2009) argues case study research needs to be designed to maximise the quality of the research through four critical conditions; construct validity, internal validity, external validity and reliability. These are described as evaluative standards for conducting case study research. There are various ways to increase the reliability of case study research, including triangulation through using multiple sources of evidence, multiple cases or cross-case comparison. With regards to 'construct validity' investigators can use multiple sources of evidence during data collection, to encourage convergent lines of enquiry (Yin, 2009) and by maintaining a 'chain of evidence' which provides validity in reconstructing the study from the research questions to the conclusions. In this research, multiple sources of evidence were used throughout (for example, World Bank documents, stakeholder interviews, articles) while a cross-case syntheses was not done because a single case study country was used at national-level. Moreover, multiple methods were also used to provide 'methodological triangulation', as described below. Use of multiple sources in data collection improves the accuracy, quality and trustworthiness of the research.

Secondly, with regards to 'internal validity', it is suggested this can be achieved by pattern matching, explanation building, addressing rival explanations and using logic models (Yin, 2009). In pattern matching, the chain of evidence results in comparison of predicted (theoretical) patterns with observed (empirical) patterns, and in 'explanation building' the theoretical pattern is modified by several iterations. In analysis of the case of Bangladesh, explanations were built up as it was observed that in various areas, initial theoretical statements or propositions from literature review were confronted with observed findings. Furthermore, alternative explanations for the findings were taken into consideration. It was crucial to consider alternative explanations due to the complex nature of the research relating to adaptation finance governance.

Thirdly, 'external validity' is addressed by considering the extent to which results are generalizable beyond the immediate case study – an issue that will be addressed in the next section. Finally, 'reliability' is ensured by documenting the research procedures and methods that were used, to ensure that if these procedures were followed by another investigator, they would come to the same findings, including precise documentation of the data base (Yin, 2009). In particular, it was important to disclose when and how the evidence was collected and refer to any related circumstances. All of these standards are designed to mitigate bias in case study research, including the investigator bias.

2.6.2. Methodological Triangulation

The process of triangulation is generally considered to be a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation (Denzin and Lincoln, 2005). As described above, this research used a range of different qualitative and qualitative methods to explore the research questions at multiple scales, including at national-scale in the case of Bangladesh. Following Denzin's framework of triangulation (1978), this can be described as a form of "methodological triangulation", in which different methods are used to validate the findings. From a post-modern perspective, triangulation was originally regarded as an instrument of validation, but is now discussed as a technique leading to deeper and broader understanding by recognising a plurality of perspectives (Flick *et al.,* 2004).

2.6.3. Generalisability of case study research

The study does not assume the results obtained within the case study of Bangladesh are generalizable to other countries or contexts. A key disadvantage of the case study method relates to the limited external validity (Poteete *et al.,* 2010). On the other hand, the fine-grained observations support conceptual refinements and theory development, and enhance internal validity and concept validity (*ibid*). While other countries under similar conditions were taken into account and considered in the literature review, generalisation of the case study to other contexts is only possible to a certain degree and may depend upon context-specific socio-economic and political conditions, which differ from case-to-case. Therefore it is accepted that the application of these results to other contexts may not be possible. Similarly, the results and recommendations from the international-level analysis do not seek to pose a generic framework, but to offer insights into a specific snapshot at a specific time. It is recognised the field of climate finance is rapidly-changing and the climate finance institutions, and their conditions, exist in a dynamic environment.

2.7. Research Challenges and Limitations

2.7.1. Challenges of multi-scalar research

The heart of the challenge posed by multi-scale analysis lies in the difference between microscopic analysis (focusing on community interactions) and macroscopic analysis which focuses on structural conditions and institutions (Moran, 2010). In analysis, these scales are treated as largely distinct, while in reality there is interconnectivity between local-level process and larger scales, as well as between events in time and space (*ibid*). Higher-level

institutions have an impact on the ability of local-level institutions to manage their resources, including for adaptation. A challenge in this research was to recognise interconnectivity without drawing generalisations. Analysing the behaviour of coupled human–environment systems is difficult even where there is data available, due to the diversity of local conditions (Moran, 2010). To address this problem, insights were drawn from local observations without making the assumption that these were general in nature or could be applied elsewhere. The problem of comparing within and between cases was overcome by having only one case study from the national and local-level, avoiding the need to compare between cases that may be largely incomparable. Although mixed-level can be methodologically "messy" (Rousseau, 1985) arguably this reflects the reality of policy and decision-making on environmental issues, as policy questions are always difficult to answer. Adaptation occurs at multiple scales (Adger *et al.,* 2005) so while challenging, the multi-scalar research method was relevant in a context where international climate finance is used to tackle climate issues at local-scale.

2.7.2. Challenges during participant observation

One possible drawback of participant observation is that it resulted in the 'Hawthorne effect' (also known as the 'observer effect'). This is a psychological phenomenon whereby the subjects under study alter or modify their behaviour due to the fact they were being observed. The effect is not likely to have been significant because the UNFCCC climate change finance negotiations are already observed by multiple observers, except during closed meetings. Furthermore, researchers, as part of the RINGO constituency, are indistinguishable from other delegates at these meetings. However it is accepted the observer effect might have been an issue in the local-level household survey, as discussed below.

2.7.3. Challenges during field research

The fieldwork in Bangladesh encountered a range of difficulties including, inter alia, challenges relating to translation, security, health issues and political uncertainties. The onset of field research (February 2013) coincided with the sentencing of various officials under the International Crimes Tribunal, which triggered political demonstrations. Travel around Bangladesh was limited during the 'hartals' (strikes) and fieldwork had to adapt to these circumstances. Accessibility to the rural field sites in Patuakhali was also hindered by the lack of paved roads and frequent river-crossings. Other limitations to the study included available resources, time constraints, and attention to personal safety as a lone researcher. Another limitation was the language barrier, which necessitated the use of an interpreter for the duration of the fieldwork, raising the risk of mistranslation.

Every effort was made to reduce this risk by hiring of experienced and qualified interpreters, who were trained and given an orientation to the research. A trained interpreter was particularly important for FGDs, where it is vital to have good facilitation (Hennick, 2007). Furthermore, having a basic working knowledge of Bengali vocabulary also enabled the general topics of conversation to be followed during interviews and FGDs.

An additional concern arose from the lack of availability of a local map in Kalapara. This limitation was overcome through the use of Google Earth to map the vicinity as well as the help of NGO representatives (as key informants) in identifying key landmarks (buildings, sluice gates and community boundaries) on the aerial map. GIS software was used to produce a local map (Figure 1.2). In addition, community members pointed out the location of relevant landmarks. Thus, visual documentation was a part of the process of research triangulation (Denzin and Lincoln, 2005).

2.7.4. Challenges during focus group discussions

As described above, FGDs were conducted with the main livelihood groups in the local-level case study. Drawbacks included possible reactive or investigator effects if participants feel they are being watched, as well as the difficulty of generalising if small unrepresentative samples are used (Johnson and Turner, 2003). Other drawbacks are that FGDs are time-consuming. To reduce possible observer effects, participants were fully informed the FGD was for independent research. Good moderation and facilitation was important, including development of a permissive, non-threatening environment where participants felt comfortable to share their views and experiences without fear of judgement (Hennick, 2007). Other challenges include potential domination of the discussion by the most vocal group members (Johnson and Turner, 2003). This was avoided by encouraging all participants to have their say and contribute to the dialogue. Elite capture of FGDs was also avoided by ensuring the representation of marginalised groups, and inviting less-vocal participants to speak. Bias was also avoided through careful facilitation, alongside the trained interpreter. As noted previously, holding FGDs also enabled a form of methodological triangulation to occur (Denzin and Lincoln, 2005.)

2.7.5. Reliability and validity of household surveys

A potential response bias could have occurred if respondents had an expectation the research would result in activities by donors. Response bias occurs when respondents respond strategically to the questions to maximise their gains or minimise losses (FAO, 2003). Thus,

it was explained at the outset that the survey was for independent research purposes. Social desirability issues arise if poor households try to downplay their poverty, and cognitive bias can occur if respondents fail to understand the questions (*ibid*). Response bias (including the risk of social desirability bias and acquiescence bias) were avoided through carefully wording questions, and not using leading questions.

There was a risk of 'gender bias' as the survey was targeted at households, and some households might have felt the husband should speak on behalf of the family. Gender bias is a particular risk in Bangladesh, which was avoided by deliberately encouraging women to take part wherever possible. 40% of the final respondents were women and two separate FGDs were undertaken with women. At certain times throughout the day, representation of women was facilitated by the fact men were working. However, whilst efforts were made to avoid gender bias in the household survey, it was not possible to avoid a gender bias in interviews with local government because there were few women working in these positions.

Other potential weaknesses include the risk of open-ended questions resulting in vague answers, and the problem of missing data (Johnson and Turner, 2003). 'Non-response bias' can occur if the answers of respondents differ from potential answers by non-respondents. Households were approached directly to take part, but it is possible a few household members were absent, for example, due to ill-health or poverty, or if they had temporarily migrated for work. In these cases, a possible non-response bias occurred. This bias was avoided as far as possible by asking respondents whether it was a convenient time to take part, and offering to return at a time more suitable for them. It is accepted the risk of a non-response bias could not be removed entirely.

2.8. Summary

This chapter has outlined the methodological approaches used in this thesis, including the means of data elicitation, and analysis and interpretation of findings. Recognising that climate change is a problem that occurs at multiple scales, the study adopts a multi-scalar analysis to analyse the research questions at international, national and local-level. Bangladesh is taken as the national-level case study. A case study approach has been described as being valuable for generating practical and expert knowledge (Flyvbjerg, 2006) and was used because this research question is grounded in contextual policy decisions.

Mixed methods were used combining elements of qualitative and quantitative research approaches, enabling flexibility in the design and selection of research methods. Furthermore the research drew on systems thinking, built on an understanding of the integration between natural and human systems. The methods used for data elicitation included semi-structured interviews, participant observation, focus groups, and analysis of household survey data, as well as a comprehensive literature review. The findings and conclusions have been logically derived from the case studies and related fieldwork.

The greatest methodological challenges were in the use of household surveys and focus groups at local-level, as these interviews were largely reliant on translation from Bengali to English. Efforts were made to minimise issues relating to mistranslation by using experienced interpreters. Furthermore there were practical challenges during the fieldwork due to poor transport links and challenging political circumstances at times. Despite these challenges, the local case study provided valuable and practical insights into access and governance of adaptation resources in a local community that was highly vulnerable to climate-related hazards.

3. Adaptation, Mitigation and Food Security: Theory and Background

3.1 Introduction to Adaptation and Mitigation

Under the United Nations Framework Convention on Climate Change (UNFCCC), which was adopted in 1992 as the basis for a global response to climate change, adaptation and mitigation are identified as two distinct policy responses to climate change. Hence Article 4.2 of the UNFCCC Convention states the developed-country Parties to the Convention will adopt measures on the mitigation of climate change by limiting "anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs" (UNFCCC, 1992) whilst Article 4.4 states that developed-country Parties shall assist developing-country Parties in meeting the costs of adaptation to adverse effects of climate change.

Implicit in the UNFCCC Convention is the separation of adaptation and mitigation. Article 3.1 states that "on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities" the "developed country Parties should take the lead in combating climate change" (UNFCCC, 1992). Thus, it is implied developed countries should take the lead in reducing emissions on the basis of their historical responsibilities for greenhouse gas (GHG) emissions since the start of the Industrial Revolution. The separation of adaptation and mitigation in international policy and negotiations is reinforced in the IPCC (Intergovernmental Panel on Climate Change) Reports, where WGII (Working Group II) addresses adaptation and WGIII (Working Group III) addresses mitigation (Ayers and Huq, 2009; Ravindranath, 2007).

At COP-16 in Cancun, Mexico in 2010, Parties agreed to establish the Green Climate Fund (GCF) to distribute $100Bn of climate finance per annum by 2020, to support both adaptation and mitigation actions. Article IV(A) of the Cancun Agreements takes note of the promise for $30Bn USD in new and additional financial resources for the period 2010-12 with a "balanced allocation between adaptation and mitigation" whilst "funding for adaptation will be prioritised for the most vulnerable developing countries" (UNFCCC, 2010). The Cancun Agreements (1/CP.16, Appendix III) also state the GCF should address the objective of "achieving a balanced allocation between adaptation and mitigation" (*ibid*). Whilst the need for balancing adaptation and mitigation is recognised, integration and coordination between adaptation and mitigation has not been fully considered or implemented.

Box 3.1: Definitions of Key Terms (Source: IPCC, 2014)	
Adaptation	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects.
Mitigation	A human intervention to reduce the sources or enhance the sinks of greenhouse gases.
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.
Adaptive Capacity	The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.
Resilience	The capacity of a social-ecological system to cope with a hazardous event or disturbance, responding or reorganizing in ways that maintain its essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Adaptation can be anticipatory or reactive, and can be either autonomous or planned (IPCC, 2007). Whilst autonomous adaptation may take place by private individuals, public intervention can also be important in "providing the proper environment for adaptation… by stimulating research and development, diffusing information and making markets and policy conditions conducive" (OECD, 2008:44). It is argued anticipatory, planned adaptation deserves particular attention from the international community (Klein and Tol, 1997).

For mitigation, there are a range of policy measures that policy-makers can take including encouraging energy-efficiency, encouraging low-carbon and renewable energy sources, reducing fossil fuel emissions from transport, and reducing deforestation. Moreover, it is recognised that energy access is a key priority to enable developing countries to develop and renewable sources will enable sustainable access to energy in the long-term, which can arguably strengthen adaptive capacity. The UNDP-WHO report recognises that almost two billion people need modern energy services by 2015 to achieve the Millennium Development

Goals (UNDP-WHO, 2009). Nearly 2 million deaths occur globally from indoor air pollution resulting from solid fuel use (*ibid*). Use of traditional biomass such as firewood also contributes to deforestation and this can make poor communities even more vulnerable to flooding. Therefore, it seems appropriate adaptation, mitigation and sustainable development should be seen together in an integrated approach that explores linkages and trade-offs between these priorities. In terms of equity, there is a strong possibility that if developing countries insist upon a "right to catch up" in terms of emissions then this may push the world into "dangerous" climate change (Schneider and Lane, 2006:42) which demonstrates the need for mitigation and emissions-avoidance in developing countries. Participation of all countries to some extent is therefore essential for emissions stabilisation.

It is also recognised in the IPCC that adaptation faces significant limitations and barriers, especially in vulnerable nations and communities. For example, in the worst case roughly 400 million people (or about 8% of global population) are threatened by a 5-m rise in sea level, based on 1995 data (Nicholls *et al.,* 2008). Even if global warming is limited to 2°C, global-mean sea level could continue to rise, reaching between 1.5 and 4 metres above 2000 levels by 2300, with the best estimate being at 2.7 metres (Schaeffer *et al.,* 2012). Such rises would be difficult to adapt to. Other extreme possibilities include the existence of climatic 'tipping points' at which the climate system will at some point cross a critical threshold and transition rapidly into a new state with some degree of irreversibility or non-linearity (Scheffer *et al.,* 2009; Lenton *et al.,* 2008). This could happen due to positive feedbacks such as rapid sea-ice melt which causes further warming due to the 'albedo' effect. Lenton et al (2008:1789) argue "a critical threshold for summer Arctic sea-ice loss may exist" and for the Greenland Ice Sheet it is suggested a critical threshold beyond which it eventually disappears lies at 3°C of local warming above preindustrial levels, a level possible this century, whilst die-back of the Amazon rainforest is predicted at 3-4°C of warming (*ibid*). Drought and forest dieback in the Amazon would further amplify the drying which caused it and release CO2, though the threshold is uncertain (Cox *et al.,* 2004). Feedbacks in the climate system might make emissions reduction both more urgent, and more expensive than previously assumed.

Adaptation is linked to several related concepts; vulnerability, resilience and adaptive capacity (see Box 3.1). Vulnerability is influenced by factors such as the development pathway, physical exposure, distribution of resources, prior stresses and social and government institutions (IPCC, 2007). Poor, underdeveloped countries therefore have been recognised as more at risk to the impacts of climate change, with marginalised communities

within those countries particularly at risk. Key factors that increase vulnerability include geographical vulnerability due to prevalence of pre-existing climate extremes such as susceptibility to flooding or drought, dependence upon agriculture or natural resources, and low political capacity. Overall developing countries have a higher share of assets tied up in natural resources, since around 75% of people in developing countries live in rural areas and are dependent on agriculture for their livelihood (WFP, 2010). Additionally, many developing countries are SIDS (Small Island Developing States).

In the academic literature, both 'community-based adaptation' (CBA) and 'ecosystem-based' adaptation (EbA) are discussed; with CBA focusing on empowering vulnerable communities to increase their own resilience, whilst EbA recognises ecosystems as the basis of life-support systems. Both approaches may be mutually reinforcing (Wright, 2010) particularly where communities' livelihoods are based on ecosystem services. Climate change results in rapid changes to ecosystems and biodiversity, which is already subject to other anthropogenic and biological pressures, so conservation efforts may have to provide biological corridors within habitats for wildlife at the landscape-level so that biodiversity can be protected in a changing climate (RCEP, 2010).

Climate hazards can either be sudden unpredictable rapid-onset shocks, like cyclones and storm surges, or slow-onset changes like temperature change or glacial melting that may build up to a critical point. Even changes that appear to be slow-onset can be too rapid for ecosystems to withstand. In relation to disasters, resilience is often determined by the extent to which "the degree to which the social system is capable of organising itself...learning from past disasters for better future protection and to improve risk reduction measures" (HFA, 2005:4). This applies to both man-made and natural disasters.

With regards to preparedness and resilience to climate changes, uncertainty in projected and expected climate changes make adaptation much more difficult. Whilst countries agreed in the Copenhagen Accord to keep the increase in global temperature rise to below 2°C above pre-industrial levels (UNFCCC, 2009), so far the international community has not reached an agreement that would limit the temperature rise to 2°C. More recent analysis shows current government pledges put the world on track for 3.7^{o}C of warming (Hare *et al.,* 2013). The target of stabilising global greenhouse gases at 450ppm CO2eq in the atmosphere would itself only yield roughly a 26-78% (mean of 47%) risk of overshooting 2°C; still a significant risk (Meinhausen, 2005). It is argued "mitigation and adaptation are not alternatives"

because even if rapid and deep cuts of emissions take place, the science suggests the planet is locked into a further 1.4^{o}C rise (RCEP, 2010:3). Thus, we face the challenge of adaptation even if mitigation is successful. Only at levels around 400ppm (parts per million per volume) CO2eq are the risks of achieving the 2 degree target termed "likely" (*ibid*). Others argue 350ppm is a more suitable target, and if the present overshoot of 350ppm is not brief, there is the possibility of irreversible catastrophic consequences (Hansen *et al.,* 2008).

Rockstrom et al (2009) argue humanity has already crossed over the 'planetary boundary' when it comes to climate change. The authors also recommend the upper boundary of atmospheric carbon dioxide levels on earth should be kept at 350ppm. However the current status of the annual mean is currently upwards of 396ppm (NOAA, 2013). Furthermore the change in radiative forcing has been found to have reached 1.5 watts per metre squared, whilst the proposed boundary is 1 W/M2 (*ibid*). Global biodiversity loss is currently estimated at over 100 extinctions per million species years - 10 times the proposed 'safe' boundary level (Rockstrom et al, 2009). Boundaries for the nitrogen cycle, stratospheric ozone depletion and ocean acidification have also been overreached (*ibid*) which are all influenced by global food systems.

There is also a level of uncertainty in the climate models projecting the changes, making adaptation more difficult. The IPCC 4th Assessment Report (AR4) recognised the scarcity of data and lack of evidence of observed changes in Africa, Latin America, South-East Asia, the Indian Ocean and Pacific, which is possibly due to lack of access to data, lack of research and published studies, or lag effects in responses (IPCC, 2007). The report recommended an improvement in observation networks and enhanced research capability in regions with sparse data (*ibid*). There is particularly sparse local weather data in central Africa. Where forecasts are given, these "give only probabilities not certainties" and more distant forecasts are even less likely to be accurate (IASC, 2009:19). Tropical convention currents, monsoons and the ENSO (El Niño-Southern Oscillation) phenomenon are not well understood. Current models do not agree on the nature of changes in frequency or intensity of El Nino (Conway & Waage, 2010). Furthermore, climate models have a low resolution making it more difficult to assess local impacts, for example when the resolution is 25-50km. Downscaling GCMs to the finer scale of local areas, for example using the PRECIS model, amplifies uncertainties (*ibid*). There is a need for better, fine-grained models and better ground data. All these

factors make adaptation more difficult. There is a need to plan adaptation measures to cope with high levels of uncertainty.

It is argued that even if rapid emission reductions take place, current concentrations of GHG emissions mean the climate will continue to change for decades to come. Lowe et al (2006) found by modelling the Greenland ice sheet and thermal expansion that sea levels are likely to continue rising for more than 1000 years after greenhouse gas levels have stabilised. Furthermore, four-fifths of the energy-related CO2 emissions permissible by 2035 are already 'locked-in' by existing infrastructure and capital stock, meaning that if stringent action is not forthcoming by 2017, there will be no room for additional power plants unless they are zero-carbon (IEA, 2011).

3.2. Adaptation, Mitigation and Sustainable Development: Interactions and Theory

It is recognised economic development raises the capacity to adapt to climate change. This is recognised under Article 3.4 of the UNFCCC Convention, which states " economic development is essential for adopting measures to address climate change" and thus policies to protect the climate system should be "integrated with national development programmes" (UNFCCC, 1992). It is argued "if people are better fed and in better health, and have access to education, jobs and markets" they will have capacity to be more resilient (Conway & Waage, 2010). However, the path of economic development so far has also increased GHG emissions, thus creating a certain tension and complex relationships between adaptation, mitigation and sustainable development. However, development may also increase the potential for 'mitigative capacity' - the capacity to mitigate.

It is argued emissions reductions that hamper development could increase vulnerability to the impacts of climate change (Tol and Yohe, 2006, IPCC 2007). Thus Goklany (2000) argues "aggressive mitigation would fall foul of the precautionary principle" (in IPCC, 2007:755). The economic impacts of mitigation could particularly impact on countries that are exporters of fossil-fuels, like Nigeria. This became the basis for the '"response measures' negotiations under the UNFCCC Convention as Article 4.8 specifies the impact of response measures should be taken into account, including on economies "highly dependent" on fossil fuels (UNFCCC, 1992) . Under Article 1(b) of the Bali Action Plan (decision 1.CP/13) countries also agreed to consider the "economic and social consequences of response measures"

(UNFCCC, 2007). This has become a contentious issue as some countries have opposed the inclusion of focusing on response measures or regarded it as inequitable. Moreover, AOSIS (Alliance of Small Island States) argued in 2011 there is the need to explore the "potential positive impacts of response measures… taking into account the growing literature on green growth" (AWG-LCA, 2011:1).

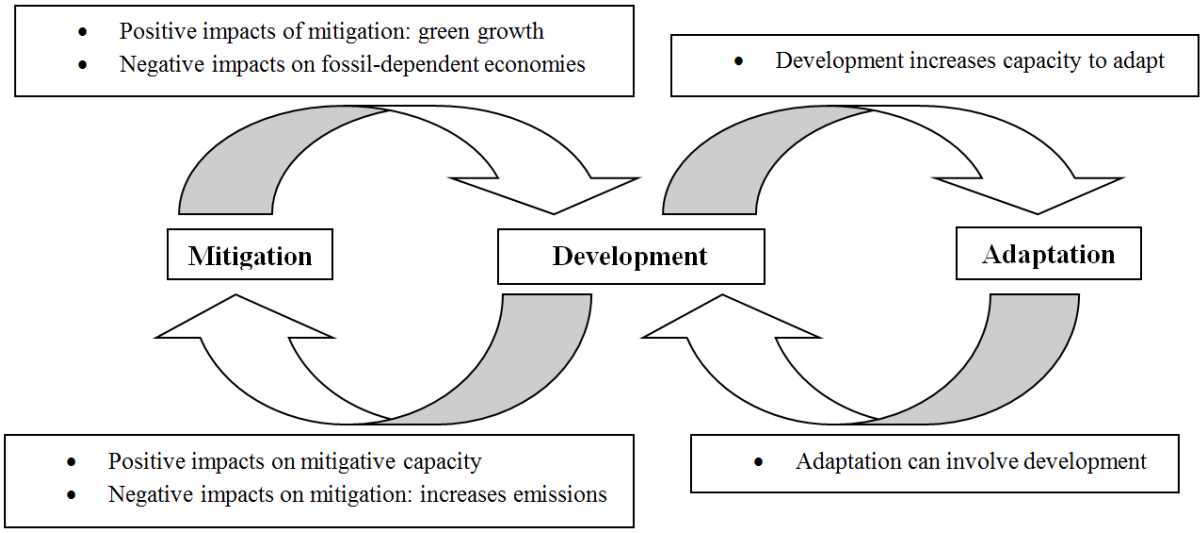


Figure 3.1 Interactions between adaptation, mitigation and development

The diagram above indicates it is possible for mitigation and development to conflict, where mitigation increases emissions or where a country's economy is dependent upon fossil fuels and is undiversified. However this tension between mitigation and development depends upon the type of development pathway under consideration. 'Synergies' are possible where mitigation has positive effects for economic development under a "green growth" pathway. It is also possible for sustainable development to increase capacity to mitigate and it is this elusive 'sustainable development' pathway that is the target of policy-makers. Climate change and sustainable development also have to be understood in a 'place-based context' where we must appreciate there are multiple stresses apart from climate change, including population growth, economic and institutional changes (Wilbanks, 2003).

Commentators have also argued it is inequitable for developing countries to make deep cuts in emissions when developed countries, with greater capacity, are not showing leadership. This is the crux of the North-South division in the climate negotiations, which recurred again at the COP-17 negotiations in Durban in 2011, where countries cautioned against any weakening of the principle of 'common but differentiated responsibilities' (IISD, 2011). It is therefore argued developing countries ought to be compensated for taking a greener

development pathway and given the means, technical assistance and technology in order to do so. Provision of climate finance for mitigation and adaptation may thus offer the way out of this conundrum.

In the IPCC-AR4 chapter on inter-relationships between adaptation and mitigation (Klein *et al.,* 2007) the authors question whether adaptation and mitigation are substitutes or complements, and whether there can be synergies (or trade-offs) between them. Synergies between adaptation and mitigation are "greater in some sectors (e.g. agriculture and forestry, buildings and urban infrastructure)" but limited in others such as coastal systems, energy and health (Klein *et al.,* 2007:747). This research will focus primarily on the food and agriculture sector, where synergies have already been identified as possible and practical. There is a lack of "both conceptual and empirical information that explicitly considers both adaptation and mitigation" making it difficult to assess the need for and potential of synergies in climate policy (Klein *et al.,* 2007:747).

Whilst mitigation has hard, quantifiable outcomes, adaptation is necessarily qualitative in nature and it has been difficult to establish metrics for adaptation. Since it is related to processes on development and disaster risk reduction, adaptation is "complex and messy, context-specific, and difficult to quantify" (Ayers and Huq, 2009:755). Adaptation is less clear cut because it involves actions such as policy-based institutional arrangements, land tenure policies, infrastructure, irrigation, and also livelihood-based approaches (*ibid*). Furthermore it has been argued while mitigation efforts are effective at global level, adaptation is "primarily local" (RCEP, 2010:3). Thus, adaptation and mitigation have been distinguished as distinct spatially, temporally and socioeconomically. Mitigation benefits are usually perceived at global-level at long time scales, compared to adaptation actions which often occur at local-level over shorter time scales.

Taking a 'systems' approach may enable us to highlight some key areas of inconsistency and incoherence in policy-making on climate change planning and finance. It is clear that the realms of 'adaptation' and 'mitigation' are based on distinctions under the UNFCCC framework but that both of these ultimately remain part of the complex socio-economic and environmental system. Fiksel (2006) argues a comprehensive systems approach is essential for decision-making with regards to sustainability, since industrial, ecological and social systems are closely coupled. To address this inherent complexity, Fiksel (2006:20) recommends development of modeling and decision-making approaches that support

"dynamic, adaptive management", multi-objective decision-making involving trade-offs among conflicting goals, and simultaneous use of models that reflect different system interpretations or stakeholder perspectives.

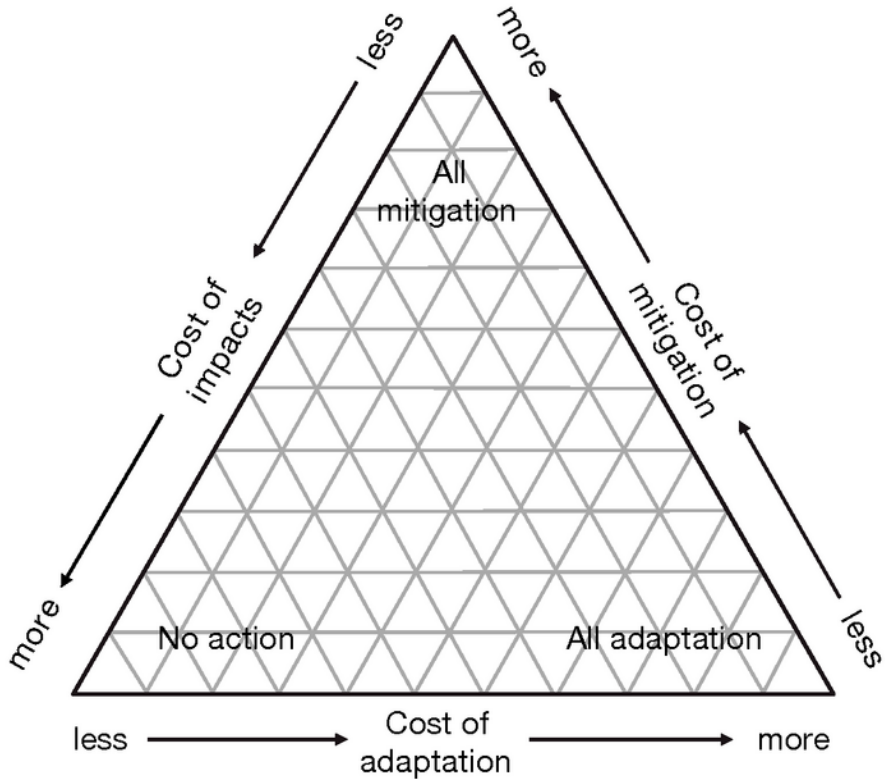


Figure 3.2 Schematic overview of inter-relationships between adaptation, mitigation and impacts. Based on Holdridge's life-zone classification scheme (Holdridge, 1947, 1967; M.L. Parry, personal communication, Source: Klein et al., 2007

In the diagram above, it is clear 'no action' on mitigation and adaptation leads to increased costs of climate change impacts. This links us to the recent policy debates on 'loss and damage' that have emerged in the UNFCCC as a response to the perceived risk of insufficient action on both adaptation and mitigation of climate change.

This discussion also links to climate finance allocation. Some have argued the spatial prioritisation of adaptation and mitigation should be different. For instance, in African countries, the impacts of climate change are so high that money might be better spent on vulnerability reduction than emission abatement (Tol, 2005). However, mitigation finance may also be better spent in developing countries where it will go further. Ravindranath (2007) suggests the costs of addressing climate change can be reduced by exploring synergies between adaptation and mitigation, because co-benefits are created. Yet, there are risks in creating synergies between adaptation and mitigation, because greater institutional

complexity could limit efficacy *(ibid*). Thus the net effect of investing in synergistic measures, with regards to finance, may be smaller than when half the money is invested in mitigation and half in adaptation (Klein *et al.,* 2003). Further research would be needed to determine whether this is true. The IPCC states "large scale modelling of adaptation-mitigation feedbacks is needed but still lacking" (Klein *et al.,* 2007:756). Modelling interactions is difficult and the complexity and inter-disciplinary nature of climate change explains why it has been described as a "super wicked" problem (Lazarus, 2008; Levin *et al.,* 2010). Overall, Klein et al (2003) argue it is contrived to identify synergies, and instead the focus ought to be upon integration of adaptation and mitigation with development.

There has been effort also towards "mainstreaming" adaptation and mitigation into official development assistance (ODA), despite some concerns this would divert money from ODA away from more pressing challenges (Klein *et al.,* 2007:768). Klein et al (2003) argue mainstreaming is a more effective and efficient use of finance and resources than implementation of climate policy separate from ongoing activities. Yet, since development and the components of mitigative and adaptive capacity must also consider equity; equity is another important consideration, as well as efficacy.

The term 'mainstreaming' has emerged to describe integration of climate adaptation and mitigation into national or sectoral development planning, to build efficiency. This term emerged from development literature which sought to mainstream gender into development (Klein *et al.,* 2003) through 'gender mainstreaming'. Later, the term 'environmental mainstreaming' evolved, promoting inclusion of environmental concerns into decision-making of institutions that drive national and sectoral development policy, including, investment and finance (Dalal-Clayton and Bass, 2009). Mainstreaming has been held to include 'climate-proofing' of development portfolios and investments (Tanner, 2008). However, a more holistic approach would also involve 'adaptation as development' which means addressing the underlying drivers of vulnerability (Ayers and Dodman, 2010). This may also mean mainstreaming adaptation into national development "policies, programmes and projects," as well as external aid (Gupta and Van Der Grijp, 2010:77). In terms of simply 'climate-proofing' development aid, there is concern this could undermine progress made in integrating the OECD-DAC principles of national ownership and participation (Klein, 2008). There is also a danger mitigation has been somewhat sidelined in this discussion of adaptation mainstreaming. This mainstreaming of climate change in food security policies and provision may need to be addressed in further depth.

3.2.1. Trade-offs and Synergies between Adaptation and Mitigation

As noted above, achieving synergies between adaptation and mitigation may develop co-benefits that reduce the costs of policy action. Ravindranath (2007) explores the co-benefits achievable in the forestry sector through combining adaptation and mitigation. Forestry mitigation projects often have benefits for increasing the resilience and adaptive capacity of ecosystems, biodiversity and endangered species. Agroforestry also has potential to sequester carbon whilst reducing vulnerability of crops to climate change, whilst in other places forests and trees may act as buffer to increased cyclones, rising temperatures or extreme weather conditions. Yet it has also been pointed out that where there are synergies, these may not be complete synergies. For instance, the tree species preferred for carbon sequestration may not be the preferred species for watershed management and biodiversity protection (Dang *et al.,* 2003).

In Vietnam, it was found feasible Clean Development Mechanism (CDM) options exist that have co-benefits for climate resilience, including water management for reducing methane in rice fields, protection of forests, forest nursing and regeneration, and small-scale hydropower (Dang *et al.,* 2003). However some adaptation options, such as improving sea dyke systems, can lead to increased emissions or energy demand. Thus it is recommended that policy-makers adopt a comprehensive national climate policy to strike a rational balance between mitigation and adaptation that maximises potential synergies through 'mainstreaming' into national policy (*ibid*).

In supplementary material in Chapter 18, IPCC-AR4 (2007), authors provided a matrix of 70 examples of adaptation-mitigation linkages. Of the 40 studies analysed for their impacts on poverty, 43% had neutral or ambiguous effects on poverty while 40% were consistent with poverty reduction (*ibid*). While this list of examples was clearly non-exhaustive, it does indicate that a large number of mitigation projects do have potential for increasing adaptive capacity by reducing poverty. Please refer to Annex II for a table of theoretical examples of conflicts and synergies between adaptation and mitigation.

3.3. Costing and Equity in Climate Adaptation and Mitigation

The 2007 Stern Review offered a comprehensive assessment of the costs of mitigation compared to the costs of inaction. It found that without any action on climate change, the costs of climate change could be equivalent to 5% of global GDP (Gross Domestic Product)

each year which could increase to 20% or more. By contrast, stabilising climate change at 500-550ppm could cost just 1% of GDP by 2050 which is "significant but manageable" (Stern, 2007:644). Further recommendations were that adaptation needs to be integrated into development policy and planning.

The Stern Review was criticised for having a low discount rate, which was combated by commentators, like Nordhaus and Dasgupta (Nordhaus, 2007; Dasgupta, 2006). Stern used a rate of 1.4% similar to that previously used by Cline in 1992 (Dasgupta 2006, Cline, 1992). Stern justifies the low discount rate on grounds of intergenerational equity. Furthermore, it could be argued that reducing consumption does not actually lower well-being. Therefore, when economists argue that we would have to make 'sacrifices' to lower emissions, some of these may not actually impact on well-being. This is evident in recent debates and discussions on GDP and happiness. Frequently we find economic models are ineffective in capturing true value of lives and ecosystem services. It has been suggested that a pure cost-benefit analysis must not be applied over and above a common sense approach.

Biodiversity and ecosystem services are also not valued in the conventional cost-benefit analysis approach, meaning climate impact estimates are underestimates. Neumayer argues the real issue is non-substitutable loss of natural capital; that is to what extent climate change inflicts irreversible and non-substitutable damage to and loss of natural capital (Neumayer, 2007). Arguably, the loss of natural capital cannot be substituted by growth in consumption. In many of the Integrated Assessment Models, the monetary valuation of health and ecosystems is not included because their monetary valuation is "speculative and uncertain" (Dietz *et al.,* 2007). Dasgupta (2008) also admits his viewpoint is anthropocentric and natural capital is not considered because the models do not consider it.

The balance between adaptation and mitigation has been a source of tension and controversy in UN climate negotiations, where the use of aggregated market damages has been challenged by members of the South (Schneider and Lane, 2006). This is because if the impacts of climate change were predicted to have a monetary gain in the North due to extending growing periods and yet a monetary loss of the same amount in the South, this could hardly be regarding as a 'neutral' outcome (*ibid*). Cost-benefit analyses are therefore, conventionally devoid of equity considerations. Under the "market-aggregation-only" analysis, the loss of 80% of the GDP of Bangladesh amounts to 0.1% of global GDP. The same criticisms could be applied to integrated analyses that compare adaptation and

mitigation as in conflict with one another, because models that show the 'mitigation only' scenario as being more economically efficient may not be considering the distribution of impacts.

The IPCC states that cost-benefit models have been criticised for "ignoring the sectoral (economic and social), spatial and temporal distances between those who need to mitigate versus those who need to adapt to climate change" (Klein *et al.,* 2007:754). The IPCC-AR4 concluded it is difficult to operationalise the notion of an "optimal mix" of adaptation and mitigation, because this would require the "reconciliation of welfare impact on people living in different places and at different points in time into a global aggregate measure of well-being" (Klein *et al.,* 2007:747).

3.4. Planning Under Uncertainty

As discussed previously, there are levels of uncertainty in adaptation to climate change which must be dealt with by decision-makers. Uncertainty can be due to the inherent uncertainty in the complex climatic system, lack of data availability in areas with few meteorological stations, and also due to the low resolution of existing climate models. If these uncertainties are not considered there is a risk of 'maladaptation' for instance 'under-adaptation', 'over-adaptation' (where investments were made that are unnecessary) or 'incorrect adaptation'. Consideration of uncertainty, therefore, will be crucial in the effectiveness of climate adaptation finance (Ranger and Garbett-Shiels, 2011).

Hence, experts argue it is logical to start with the adaptation problem on the ground itself rather than climate models in order to reduce the data and resources needed. Under the PPCR (Pilot Programme for Climate Resilience) there were efforts to integrate adaptation processes with existing programmes in order to improve coordination whilst exploiting synergies and co-benefits (Ranger and Garbett-Shiels, 2011). Decision-makers will also have to resolve trade-offs with other policy goals. This supports the view adaptation must address core development objectives as a driver of underlying vulnerability (McGray *et al.,* 2007) like poverty alleviation and sanitation. Furthermore, risk reduction to existing disasters should be strengthened. For example, disaster preparedness efforts in Bangladesh have arguably paid off since Cyclone Sidr (2007) had a lower mortality than an equivalent cyclone in Myanmar in 2008 (IPCC, 2014).

In terms of selecting adaptation options, decision-makers can weigh up the costs and benefits of different options and calculate a cost-benefit ratio using existing decision tools. However, other factors may be crucial to consider such as equity and distribution of benefits, environmental co-impacts, and robustness to uncertainty. Measures that are highly robust to uncertainty are known as 'no-regrets measures' (Ranger and Garbett-Shiels, 2011). Yet it is clear that low-regrets measures may not be adequate (*ibid*); adaptation options may be non-substitutable and in many cases may be complementary. Adaptation processes can therefore be designed with built-in flexibility to address long-term uncertainty; for example, a sea wall with larger foundations could be adjusted later if impacts increase (*ibid*). Inflexible options should be avoided which could 'lock-in' future risk. For example, according to the typology developed by UKCIP (UK Climate Impacts Programme) adaptation is divided into four categories of options; low-regrets, no-regrets, win-win and flexible (UKCIP, 2011).

3.5. Emerging Risks of Loss and Damage

As discussed previously with reference to the costs of adaptation, mitigation and no action (see Klein *et al.,* 2007) there is a growing debate on the implications of minimal action on adaptation and mitigation on the potential for 'loss and damage' resulting from climate change. Under the UNFCCC framework, this has led to calls by developing countries for a compensatory mechanism to address the residual damages caused by climate change, as some of these impacts cannot be addressed due to the 'limits of adaptation'.

However, UNFCCC negotiations have been fraught with tension and developed countries Parties have made it clear that any discussion of implications for additional finance is not under discussion. Although the Bali Action Plan (2007) contained an entire section on risk management and loss and damage associated with climate change, any association or mention of compensation or liability for loss and damage caused discomfort for industrialized countries (Warner and Zakieldeen, 2012). COP-16 established a work programme to consider approaches to address loss and damage associated with climate impacts in developing countries as part of the Cancun Adaptation Framework in COP decision 1/CP.16. Thematic areas were agreed under the Subsidiary Body for Implementation (SBI), including a literature review and a technical paper on the impacts of 'slow onset' events (FCCC/TP/2012/7). At SBI-34 in Bonn, 2011, the work programme was structured into three thematic areas: assessing the risk of loss and damage, approaches to address loss and damage;

and the role of the Convention in enhancing implementation. In COP-18, Parties agreed to continue the work programme to improve understanding of several key issues, including non-economic losses and slow-onset climatic processes like sea-level rise (Huq *et al.,* 2013). The work programme on loss and damage includes discussion on risk assessment and risk management as a key component, including disaster preparedness, risk reduction, emergency response and rehabilitation (covering the whole disaster risk management cycle) (Warner and Zakieldeen, 2012). It has also been recognised that there is an opportunity for learning from good practices in the private sector - including the insurance industry.

It is possible this discussion could reinvigorate existing efforts on adaptation and mitigation; but there is also a need for further research on important issues like the 'limits' to adaptation (Huq *et al.,* 2013). The topic is of key relevance to this research thesis, since any understanding of the effectiveness of adaptation will have to come to terms with the issue of limits to adaptation. Drawing on the IPCC (2014), the following theoretical framework was drawn to illustrate the concept of loss and damage.

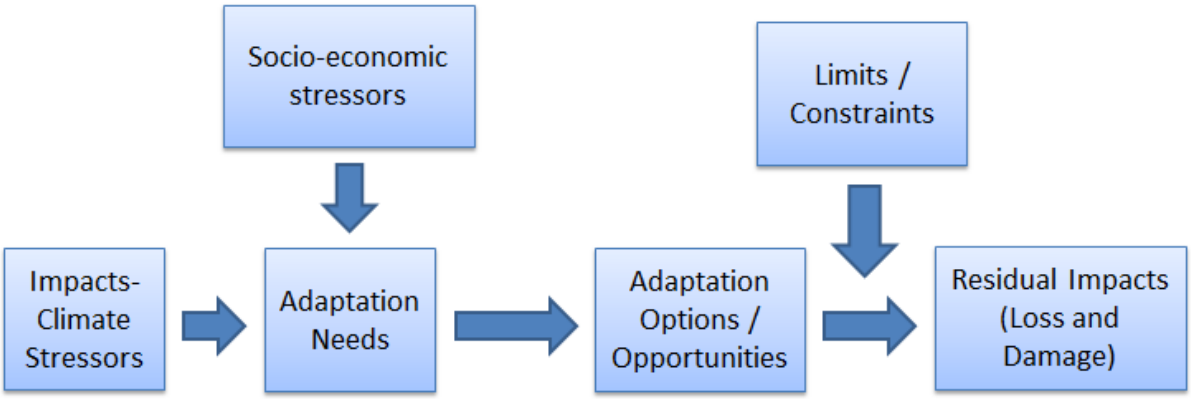


Figure 3.3 Theoretical framework to illustrate the concept of loss and damage (Authors' own)

The issue of residual damage further emphasises the need for mitigation, as it can reduce the level of adaptation needs by reducing climate stressors (see Figure 3.3).

3.6. Impacts of Climate Change on Food Systems

Projections of population growth and consumption patterns have shown agricultural production will need to increase by 70% by 2050 to meet demand for food (FAO, 2010). More recent projections forecast a 100-110% increase in global crop demand from 2005-2050 (Tilman *et al.,* 2011). World population is expected to grow to 9 billion by 2050, as well as

growing household incomes and demand. Meanwhile, climate change is likely to reduce agricultural productivity and poses a particular threat to areas already suffering from food insecurity. The effect is particularly severe when we consider almost 1 billion people globally are already suffering from food insecurity and malnutrition, with hunger being categorised as the greatest global risk to human health (WFP, 2012) and undernutrition the leading underlying cause of death in children (Bryce *et al.,* 2005). Climate change is projected to add another 10-20% to the world's hungry by 2050 (WFP, 2009). Considerable research has already been conducted on how climate change is likely to affect future food production, particularly focusing on mitigation potential, and crop yields under different climate scenarios (Rosenzweig & Parry, 1994; Lobell *et al.,* 2008). Climate impacts include long-term changes to temperature and precipitation patterns, production seasons, pests and diseases (FAO, 2010) as well as extreme events. This demonstrates the need for further investment, research and institutional support to tackle these problems in coming decades, as well as research on adaptation policies and finance.

In the meantime, global demand for increased food production, resulting from increased per capita calorific or protein content and increased per capita income, is forecasted to result in increasing trends of land clearing for agriculture (Tilman *et al.,* 2011). Consumption trends such as the rise of meat and dairy consumption associated with rising incomes are known to affect global food security and the demand for agricultural production (Godfray *et al.,* 2010). Future food security is threatened also by the depletion of rock phosphate that is used for NPK fertiliser, as phosphate deposits are projected to peak in production in 2030 and be depleted in 50-100 years (Cordell *et al.,* 2009). A further threat is the rising oil prices. Loss of soil fertility poses a major threat to agriculture and global mismanagement of soils may already cost €1 trillion/year (EC, 2009b). On top of this, loss of insect pollinators such as bees is looming as these pollinators have been affected by pesticide use (Whitehorn *et al.,* 2012), and yet are responsible for pollinating 84% of EU crop species (Williams, 2002). Rosegrant (2008) argues the world food economy now has to meet increased demand for food, feed and fuel. If trends of greater agricultural intensification in rich nations and greater land-clearing in poorer nations continue, there will be a ~3Gt y-1 (Gigaton/year) increase in CO2e emissions (Tilman *et al.,* 2011). Therefore, there could be a positive feedback loop as increased demand results in increased land clearing and therefore increased rates of climate change. A more sustainable pathway would involve sustainable intensification, moderate intensification focused on existing croplands, efficient management practices and

technological improvements (*ibid*). Attaining high yields on existing croplands is important in this scenario. However, the achievement of high yields may be threatened and impacted by climate change itself, emphasising the need for an integrated approach to both adapt to and mitigate the impacts of climate change in agriculture.

Thus, climatic impacts are additional to the other existing threats to food security, such as population, increased consumption and demand, soil erosion, and depletion of resources such as oil and phosphate. The various aspects of climate change include temperature impacts, precipitation changes, and extreme weather events. The EACC (Economics of Adaptation to Climate Change) study by the World Bank found that changes in temperature in precipitation under both climate scenarios (the NCAR wetter scenario and CSIRO drier scenario) would result in decreased crop yields and production, with irrigated and rainfed wheat and irrigated rice hardest hit (Narain *et al.,* 2011). It was also found that South Asia shoulders the biggest losses in production (*ibid*).

Food security is defined by the Food and Agriculture Organisation of the United Nations (FAO) as; "*a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" (FAO, 2002:49). Four factors influence the food supply: **availability, access, stability and utilization.** Major attention has been concentrated so far on the impacts of climate change on the first factor, food availability, which is directly connected to food production (Ziervogel & Ericksen, 2010; Schmidhuber & Tubiello, 2007). These effects can be both positive and negative. However, this might not be the most important factor in the way climate change affects food security. Schmidhuber and Tubiello (2007) assessed the impacts of climate change across the four elements of food security; availability, stability utilisation and access. They found that almost all quantitative assessments find that climate change impacts significantly on food security.

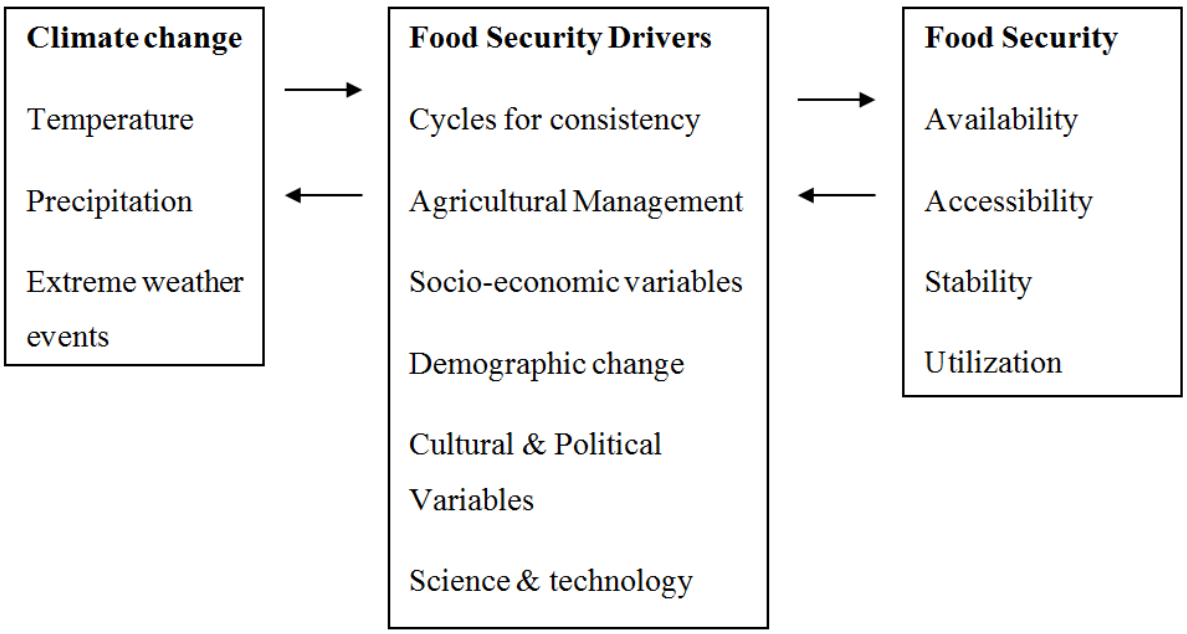


Figure 3.4 Linkages between climate change and food security (Source: Ziervogel & Ericksen, 2010).

The diagram above demonstrates there are multiple pathways by which climate change can impact on food security, through the various drivers. These pathways can theoretically be subdivided into positive and negative impacts, direct and indirect impacts, as well as into short-term and long-term effects.

In terms of availability, climate change has a direct effect on agricultural productivity and thus food availability through changes to temperature, precipitation and weather patterns, as well as extreme weather. In terms of access to food, extreme events such as droughts or floods can damage infrastructure and limit access to food supplies. Distribution of food to the marketplace is affected if roads and transportation are impacted by flooding, for example. Climate variability in the form of drought can also reduce the need for seasonal agricultural work and thus reduce the income of these daily labourers and their purchasing power in obtaining food. These are all indirect ways in which climate change can affect food security, which can be difficult to quantify due to the inherent complexity. Positive impacts are also possible, such as increased water availability. Particular attention must be paid to the work of Amartya Sen, who showed that food insecurity and famine is often linked to political and institutional factors including rights and entitlements (Sen, 1981; Sen, 1984). Income distribution and inequality are important in this regard.

On the third factor, food stability, food security is impacted by the volatility of food prices. Droughts, flooding and lost productivity all lead to increased food prices. Other factors such as competition with biofuels, speculation, and export bans or protectionist reactions to food crises can promote the fluctuation of food prices. Price instability may mean producers do not have the confidence to invest in increased production. Increasing food prices may also impact on the nutritional quality of dietary intake (Lake *et al.,* 2012).

Lastly, food utilisation can be impacted by changes to the nutritional value or quality of food produce, as well as food safety, caused by climate change. For instance, farmers might change their cropping systems to include new varieties that are more adaptable to climate change. This can cause impacts on the nutritional value of the diet. Elevated CO2 levels have been directly linked to lower nutritional quality of food (DaMatta *et al.,* 2010) and new pests and pathogens also have impacts on food safety. Food-related health problems like diarrhoea, which can be triggered by flooding and spread of water-borne disease, can affect food utilisation irrespective of food availability. Increased malnutrition has been found by the IPCC to be a likely and significant impact of climate change on human health (IPCC, 2007). In fact, the term 'ecological public health' has arisen in recognition of the key links between environmental and human health underpinned by our food system (Lang, 2009).

Food systems have been conceived of as a system ranging from production (field) to consumption (fork). There are marked differences between 'traditional' food systems with a local supply chain and 'modern' food systems which have many food miles (Ericksen, 2008). Availability, accessibility, stability and utilization may all be affected by the impacts of climate change. Globalised food systems can also be vulnerable to "income shocks leading to food poverty" (Ericksen, 2008:2). As well as the severe impact on producers, there are also impacts of climate change all the way down the supply chain. For instance, taking as an example the food and beverage sector in Asia, one study found that climate impacts can raise agricultural commodity prices, increase price volatility by decreasing yields, impact on availability, quality and price of key commodity inputs, with food commodity prices being particularly vulnerable to shocks from unpredictable extreme weather events (WRI, 2010). One case study of a sugar producer in India found that a 1% increase in agricultural input cost leads to a 3-10% decline in profits (*ibid*).

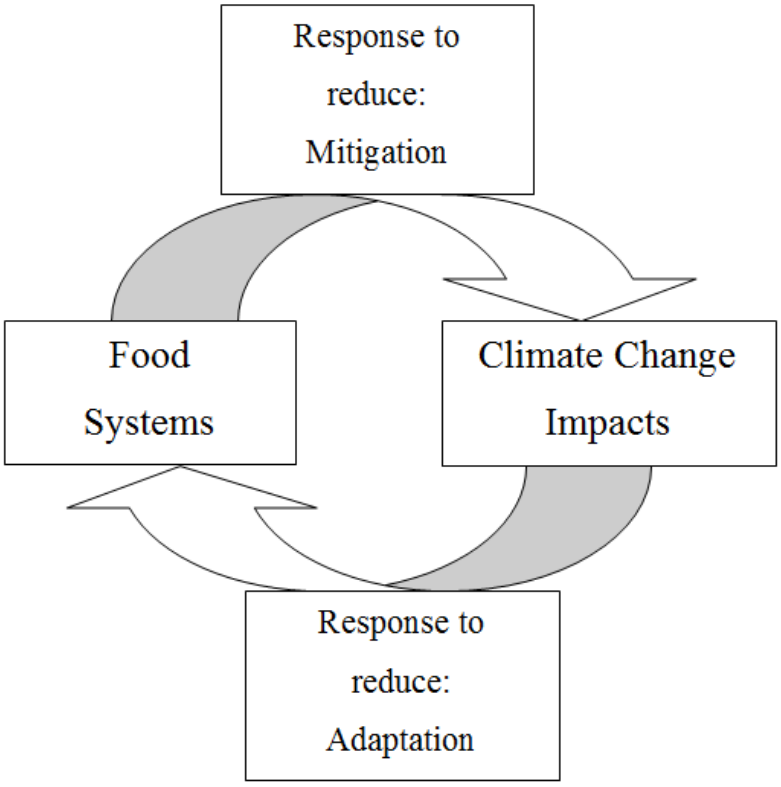


Figure 3.5 Conceptual Diagram to show the interactions between climate change and food systems, and appropriate responses

There are potential impacts on food safety at all stages of the food chain, which have associated effects for food security (FAO, 2008) by preventing the utilisation of safe food. This includes the impact of wastage due to moulds and toxins. The Hazard Analysis and Critical Control Point system could perhaps be taken as a model to look at climate impacts down the food value chain. The benefits of this approach have been in enhancing food safety and preventing many cases of foodborne diseases, primarily in preventing human health risks (FAO, 2004), but the same could be applied to tackling adaptation and mitigation in a 'life-cycle' approach. There has been some attempt to integrate climate adaptation into life-cycle costing and planning, where the costs of climate change can be seen under the 'triple bottom line' which includes financial, social and environmental costs (Allbee, 2009). Although previously life-cycle approaches have been used primarily to look at mitigation, life-cycle approaches can also be used for adaptation, for example identification of climate risks down the food supply chain (Koehler, 2012). Feedback loops can also occur, for instance, adaptating the food sector may result in increased emissions from application of fertiliser (Bows *et al.,* 2012). Synergies can also occur for example managing soil organic carbon, increasing water-use efficiency (WUE) and nutrient-use efficiency (NUE).

Overall, climate change has been identified as one of the greatest threats to the global economy and sustainable development in the decades ahead, and it is possible to identify many pathways through which this threatens food security. The triple food, fuel and financial crisis of 2008 may be a precursor for the future. Climate change is projected to alter patterns of water availability by intensifying the water cycle (Stern, 2007), increasing rainfall intensity and variability, and increasing the risks of extreme events like flooding and drought in many areas (IPCC, 2008). A rise in the sea surface temperature of 2-4°C is projected to lead to an increase of 10-20% in tropical cyclone intensities (Knutson and Tuleya, 2004). Impacts of sea-level rise include permanent inundation of low-lying deltas and estuaries, salinity intrusion and retreat of shorelines (IPCC, 2001). Salinisation and flooding particularly threaten agricultural systems in coastal areas (Hosterman *et al.,* 2009). However, in some cases increased evapotranspiration might be offset by the CO2 fertilisation effect (*ibid*).

Climate change will affect different crops differently. C3 crops like wheat and rice can experience a CO2-fertilisation effect under experimental conditions, but C4 crops like maize do not (Schmidhuber and Tubiello, 2007). C3 crops respond to higher CO2 levels and increase photosynthesis while C4 plants do not. However, adaptation also depends on habitat changes and rates of movement. C3 crops make up the majority of species globally, especially in cooler wet climates, and include rice, wheat, barley, cassava and potato (and trees), while C4 crops include maize, sugar cane, sorghum and millet, important for many developing countries. Conversely, C4 crops are more water-efficient and respond better to water stress. C4 plants account for 20-30% of global terrestrial carbon fixation, even though under 5% of plant species use the C4 pathways (Osborne and Beerling 2006). This illustrates a possible trade-off between adaptation and mitigation, as C3 crops may be more adaptable under higher CO2 but less beneficial for carbon sequestration.

Changes have already been observed, for example, in South-East Asia, extreme weather events associated with El Niño have reportedly become more frequent and intense in the last 20 years (IPCC, 2007). Agricultural productivity is sensitive to changes in hydrological regimes, as well as temperature increase (*ibid*), so farmers may have to adapt by changing crops. Higher temperatures can also raise crop water demand and alter susceptibility to crop pests and diseases. Changes in temperature, sea level, ocean chemistry and circulation can also affect fisheries and marine ecosystems (Roessig *et al.,* 2004; Harley *et al.,* 2006), and several tropical Asian countries, including Bangladesh have been found to be particularly vulnerable due to higher reliance on fisheries for national economies and diets (Allison *et al.,*

2009). It is also possible climate change could lead to 'hypoxia' or dead zones in the oceans (Gewin, 2010). Thus climate change threatens fish resources, making it more difficult to increase productivity to meet growing demand. Changes to water resources are expected to affect agriculture and food security, since 70% of all freshwater is used to produce food, and thus the crucial interactions between food security, water security and energy security require consideration.

3.7. Impacts of Food Systems on Climate Change

Food and agriculture constitutes a major GHG-emitting sector worldwide. Agriculture in its strict sense contributes around 10-14% of global emissions (IPCC, 2007a). In addition, emissions from land use change in the tropics, including logging and conversion of forests to croplands and pastures, were estimated at around 15-35% of global fossil fuel emissions during the 1990s (Jorgensen and Fath, 2014). Land use change and deforestation are driven by demand for agricultural products such as beef and maize, as well as logging. For instance, in 1999 in Brazil, increased world prices for beef, soya, beans and pig iron increased the incentive for deforestation by 33% over the following five years (Stern, 2007). In fact, four-fifths of EU soymeal imports come from Brazil and Argentina, where the demand has been a key driver of deforestation of 44.5 million acres of rainforest (FWW, 2011). Furthermore, the bulk of emissions from deforestation occur when land is converted to agricultural production since mature forests like dense tropical forests have high carbon stocks (Stern, 2007). Conversion to agricultural land often occurs by burning, a cheap way of clearing land. Clearly, deforestation also makes species' more vulnerable to climate impacts as habitat is destroyed. In South America, the main drivers are farming enterprises selling beef and soya (primarily for animal feed) for export, whilst in South Asia oil palm, coffee, and timber are produced. Logging in certain areas (high value trees) also leads to road-building which make forests more vulnerable to conversion to agricultural production (*ibid*). Global drivers include population, income, agricultural prices and subsidies.

Agricultural emissions totaling 5.1–6.1 GtCO2e y-1 are basically made up of 3.3GtCO2e methane (CH4) emissions and nitrous oxide (N20) emissions of 2.8GtCO2e (IPCC, 2007a). Agriculture accounted for about 60% of global N20 and 50% of CH4 (*ibid*). The net flux of CO2 was minimal and described as "approximately balanced" with net of 0.04Gt, not including CO2 from electricity and fuel of agriculture or associated transportation. However, high uncertainty remains about CH4 and N20 emissions in particular. The IPCC states the error margin for CH4 and N20 is in the order of 30-50%, with CO2 emissions from

agriculture and forestry having an even higher error margin (IPCC, 2007a). Thus, uncertainty about global agricultural emissions is very high, emphasizing the need for further research. CH4 emissions are 34times as potent as CO2, and N2O is 298 times more potent than CO2 over 100 years (including climate-carbon feedbacks) (IPCC, 2013), making emissions reductions from this sector potentially cost-effective.

Hence it is possible that agriculture may amount to more than 30% of global emissions, which exceeds the amount coming from the supply of energy and electricity, or global transport. Moreover, as recognized by the IPCC, transport emissions contain a certain percentage of food transport emissions. For example, UK food transport emissions accounted for 1.8% of total UK CO2 emissions in 2002 (DEFRA, 2005) and accounted for 25% of journeys of heavy goods vehicles, but these would have been counted in the 'transport' sector. Other sectors (energy, transport) may thus contain a certain percentage that is associated with food electricity and fuel use. Oil accounts for between 30-75% of energy inputs in UK agriculture, depending on the cropping system (Woods *et al.,* 2010).

Please refer to the Annex III for further discussion of emissions and mitigation in agriculture. Stern (2007:Annex 7G) argues compared to other sectors, "relatively little work" has been done on how to cut agricultural emissions. Livestock emissions can be altered by factors such as the feeding schedule and feed additives. Ironically, switching the diet for ruminants in the EU from roughage to concentrates was originally proposed as a cost-effective way to reduce GHG emissions in the EU (Bates, 2002) but this did not consider the life-cycle emissions of animal feed. Reforming subsidies has not been effectively tackled as a way of reducing agricultural emissions and the EU still subsidizes agriculture, much of which ends up going towards intensive livestock farming (FOE, 2009; Westhoek *et al.,* 2012). There is more on this in Chapter 6.

Box 3.2: Mitigation and food security conflicts: Case of EU Biofuels

Biofuel production as a low-carbon energy source may have resulted in negative impacts on food security in some places due to conflicts with land for food production. Indirect Land Use Change (ILUC) can occur when energy crops are grown on agricultural land, resulting in higher food prices and forest conversion to agricultural land elsewhere (Searchinger et al, 2008). This can also increase GHG emissions (ibid). Biofuels may have contributed to the 2007-8 food price rises. Rosegrant (2008) estimated that over 2000–2007, biofuel demand made up 30% of the average grain price rise; including 39% of the maize price rise, 21% of the rice price rise and 22% of the wheat price rise. Thus, there may be conflicts between adaptation (including food security) and mitigation, demonstrating that negatives consequences can arise from insufficient policy integration.

The EU Renewable Energy Directive (2009/28/EC) included a mandatory 10 % minimum target for the share of biofuels in transport petrol and diesel consumption by 2020 (EC, 2009). The Directive originally mandated a minimum of 35% GHG saving from biofuel consumed in 2009, rising to 50% in 2017 and 60% in 2018, compared to fossil fuels (ibid). This did not include emissions from ILUC. Social sustainability criteria were also not set. Article 17(3) states the biofuel should not come from land with high biodiversity value, including "primary forest", protected areas, or "highly biodiverse grassland" or, in Article 17(4), lands with high carbon stocks including wetlands, forested areas with a canopy cover of over 30%, and drained peatlands. However, critics noted a lack of verification and implementation measures. The EU Fuel Quality Directive (FQD) (2009/30/EC) mandates a lifecycle reduction of GHG emissions in EU fuels of 6% by 2020 (EC, 2009a). Carre et al (2010) developed guidelines by which operators can determine changes in land carbon stocks based on IPCC guidelines, but there is uncertainty in many estimates, including uncertainty of +/- 100% for figures for conversion of degraded forests.

According to the GTAP model, the EU biofuel mandate caused world cropland to increase by 0.07% (IFPRI, 2010). Food prices rises caused an estimated loss of real income in Sub-Saharan Africa of -0.12%. Another study found biodiesel production from Malaysia and Indonesia would be increased by 24% and 23% respectively (Fonseca et al, 2010). These countries are biodiversity hotspots (Melillo et al 2009) with high conversion of forests to palm oil. Non-ruminant animal production would benefit from lower feed costs; which may cause another indirect impact on emissions. Andriana et al (2011) found biofuel plantations in Malaysia and Indonesia have led to water pollution, flooding, and conflict with indigenous communities, but created jobs. Biofuel from palm oil may be responsible for over 6.5% of deforestation in Indonesia and 2.8% in Malaysia (Gao et al 2011). Hence, this could affect the adaptive capacity of ecosystems. Under Article 2.4 of EC (2010), biofuel sustainability standards are harmonised at EU-level, meaning individual States cannot set stronger standards. Standards come under Article 95 (internal market) of the EC Treaty. The justification for this is that differing standards could lead to trade distortions. If standards were adopted under Article 193 (Formerly Article 176) of the EC Treaty, it would be possible for Member States to adopt more stringent sustainability standards (Douma, 2005).

In response to these concerns, the Commission published on 17 October 2012 a proposal to limit ILUC and promote the use of advanced biofuels (such as wastes and algae) (EC, 2012a). Advanced biofuels can provide high GHG savings with low risk of ILUC, that do not compete directly for land with food or feed markets. ILUC emissions are now included in the reporting of GHG emissions (EC, 2012a). Under Article 7(b), the GHG saving shall be "at least 60% for biofuels produced in installations starting operation after 1st July 2014" (ibid). Installations in operation before this date do not have to meet this target. Their GHG savings are set at 35% until 31st December 2017.

Overall, the food sector currently accounts for around 30% of the world's total energy consumption and over 20% of global GHG emissions (FAO, 2011). Mechanized farming and fertilizer production both require energy. Thus rising energy prices can impact on food prices.



Figure 3.6 FAO Food price index against Brent crude oil price. (Authors Own, Data: FAO, EIA).

Figure 3.6 shows the prices of food oils and cereals are particularly well linked to the crude oil price. This could be occurring partly due to the fact that the oil price index includes palm oil and soybean oil, used as feedstocks for biodiesel. Certain forms of biofuels can increase interdependencies between food and energy, since feed commodities are used for biofuels, and higher oil prices increase biofuel demand (Nellemann *et al.,* 2009). Biofuel demand also feeds back into increased water demand. Thus, there is an emerging 'water-food-energy nexus' and a nexus-orientated approach, informed by systems thinking, may be required to identify mutually beneficial solutions without compromising sustainability (WEF, 2011). There are trade-offs to be made between technology options and solutions, for example drip irrigation is more water-efficient than flood irrigation, but more energy-intensive as the water is pressurized. Inefficiency in one area can also lead to problems in another, for instance, in India it is common to leave irrigation pumps on all the time because of lack of energy security which contributes to inefficient water use (Hoff, 2011). Arguably, understanding these inter-linkages could be vital to managing trade-offs and ensuring efficient resource use.

3.8. Adapting and Mitigating through Climate-Smart Agriculture

FAO argues potential losses due to climate change can be avoided by 'climate-smart agriculture' (CSA) (FAO, 2010), a term coined to demonstrate the fact that addressing the climate change impacts on agriculture will require both adaptation and mitigation. Ensuring

food security, adaptation and mitigation has been described as a 'triple-dividend' or 'triple-win' solution and methods for 'sustainable intensification' such as drip irrigation or inter-cropping have been examined (Murphy, 2011). Suggested improvements include soil and nutrient management, improved soil nutrient content (intercropping with leguminous plants), water harvesting and use, pest and disease control, preservation of genetic resources and seeds and reduction of post-harvest losses (FAO, 2011a).

Soil carbon sequestration contributes to around 90% of the technical mitigation potential of agriculture (IPCC, 2007a) which can also promote climate-resilient growth in agricultural production. Finance needs to be targeted to agriculture in order to capture these multiple benefits, reward synergistic action and leverage investment for up-scaling (FAO, 2009a). Based on experience with land-based carbon finance, it is estimated carbon finance revenues of $30Bn may incentivise US$150Bn of climate-smart agricultural investments in developing countries (*ibid*). However, CSA has come under fire from some civil society groups who oppose the inclusion of agriculture under the UNFCCC based on uncertainty in soil carbon sequestration science and suspicion about extension of carbon markets (Anderson, 2012). At COP-17, text referring to agriculture under the UNFCCC was controversial since the text was under the 'enhanced action on mitigation' section (II.D, Art.75, Decision 2/CP.17) rather than adaptation section (UNFCCC, 2012).

Box 3.3: The Case of Conservation Agriculture in Lesotho: Climate-Smart?
'Conservation Agriculture' (CA) is a farming method that involves three key characteristics; (1) minimal mechanical soil disturbance (2) maintaining carbon-rich mulch (3) crop rotation including nitrogen-fixing plants. About 8% of global arable cropland is currently covered by these systems, ranging from small to large farms (FAO, 2010). In Lesotho, conservation farming practices have transformed agriculture and made food systems much more resilient. A planting basin system known locally as 'likoti' (Sesotho word for "holes") has been adopted widely (Silici, 2010). In dry conditions, the layer of mulch reduces evaporation of water, reducing crop water requirements and preventing soil erosion. Studies in Lesotho found human capital (education and literacy) and social capital (trust and networks) were both important in the adoption of CA; confirming the relevance of education in adoption and diffusion of innovations generally (Silico, 2010). In some areas, maize yields by CA farmers were more than three times the district average yield for that growing season, and food security level were higher for the CA sample (ibid). The human workload was found to be higher in the initial stages, requiring use of available labour, but this could also be spread out over time.

Adaptation technologies include sustainable water use and management (including efficient irrigation), soil management (including conversation tillage) and sustainable crop management (e.g. crop diversification and grain storage) (see Clements *et al.,* 2011; based primarily on the concept of agro-ecology). However while there has been an emphasis on 'hard' technologies under the 'technology needs assessments' (TNA's) under the UNFCCC framework (Wright, 2010), it is clear that both 'hard' technologies (infrastructure and hardware) as well as 'soft' technologies (practices and information) will be needed to ensure food security under the changing climate.

3.9. Summary

This chapter introduces key issues and terms. In summary, we can observe various interactions between adaptation and mitigation, including trade-offs and synergies, although these objectives have been distinguished markedly under the UNFCCC. Cost estimates have been used to compare the two, even though there are issues relating to equity. There have been recent efforts towards mainstreaming both adaptation and mitigation into development.

Furthermore, adaptation and mitigation both interact with food systems. There are various direct and indirect impacts of climate change on food security. The literature emphasises the impacts of climate change on food availability, but more attention may be needed to food access, stability and utilisation. Utilising a whole system perspective we can observe this issue as part of a water-food-energy nexus, in which the climate change impacts often manifest themselves through water resources. Understanding these interactions can enable identification of integrated solutions for effective responses to climate change.

4. Community-Based Adaptation

In the previous chapters we noted how adaptation to expected climate changes can occur through either anticipatory or reactive actions, and be either autonomous or planned. In this chapter we will focus on anticipatory, planned adaptation that can be initiated and supported by organisations or local government. This chapter provides background to the local-scale case study analysis. Community-based adaptation (CBA) is an approach which has emerged to guide and support the adaptation actions of local communities in the face of climate change.

CBA can be defined as a bottom-up approach whereby a community is the main entity to implement adaptation (Sekine *et al.,* 2009). It is a process which focuses on communities most vulnerable to climate change and is based on understanding how climate change will affect a community's capacities and assets (Huq and Reid, 2007). CBA generates adaptation strategies through participatory processes including local stakeholders and development and disaster risk–reduction practitioners (Ayers and Forsyth, 2009). Community-based approaches have been found to be highly effective in agricultural development, where participatory approaches "have higher initial costs, but improved efficiency in technology development, capacity strengthening and learning" (IAASTD, 2009:204). In Malawi and Zimbabwe, it was found that participatory approaches improved efficiency and impact both in terms of technology development and "building farmers' capacity for experimentation and collective learning" (Rusike *et al.,* 2006:176).

Indigenous knowledge, social capital and local context are important in determining local adaptation options (Sekine *et al.,* 2009). The literature on development and natural resource management posited that local participation and engagement are essential for success. Reid et al (2009) argue that until relatively recently, adaptation efforts were 'top-down' with little attention paid to the experiences of local communities. However, marginalised and indigenous systems, including local rice varieties, have been found to provide solutions for adapting to changing conditions like salinity changes (Berger *et al.,* 2009). Yet there is evidence that indigenous systems for predicting the weather, for example the 'litha' system in Sri Lanka, may be falling out of use (*ibid*). It is unclear whether this is because climate change is making such systems less reliable, or because modern forecasting methods are becoming more widespread since they are preferred by the younger generation (*ibid*).

CBA is seen as a process undertaken by people at community-level based on the principles of participation, empowerment, and consideration of local priorities, needs and capacities (Reid *et al.,* 2009). In that sense there is a downward accountability of projects to stakeholders. As described above, there is a need to integrate traditional knowledge with scientific knowledge and technology. CBA draws on participatory disaster risk reduction (DRR) frameworks and community development work, as well as sectoral-specific approaches such as farmer participatory research and 'Farmer Field Schools' (Reid *et al.,* 2009). The CBA approach recognises communities are facing many hazards and risks, including food and energy prices, market exclusion, unemployment, conflict and health hazards, and climate change is only one amongst these risks. Integrating scientific and local knowledge is challenging since, for example, climate models are often uncertain or unavailable at appropriate resolutions.

Often a community-risk assessment is used for grassroots adaptation assessment, focused on people's vulnerability, livelihood, coping and adaptive capacity; for example the vulnerability and capacity assessment adopted by the Red Cross (Aalst *et al.,* 2007). This built upon the work of Sen which highlighted the significance of entitlements, as well as 'access' to resources as a determinant of vulnerability (Blaikie *et al.,* 1994), and thirdly, the sustainable livelihoods approach (Aalst *et al.,* 2007). Tools and methods, such as risk mapping and hazard calendars have therefore been adapted from the realm of community-based disaster preparedness (*ibid*). Ebi and Semenza (2008) argue the theoretical underpinnings of CBA lie in the concept of 'social capital', in which the social relationships of a community enable it to achieve shared goals such as increasing resilience. Social capital can be; *structural* (through social networks), *cognitive* (consisting of norms and values), *bonding* (through homogenous groupings), *bridging* (connecting heterogenous groups), or *linking* (connecting different levels of power) (*ibid*). It is also important to consider the specific role of culture (Ensor and Berger, 2009) which can have a productive role in defining opportunities for adaptation.

However, the term 'community' is multi-functional and can have various meanings depending on the context, so it may not be possible to devise a comprehensive definition (Sekine *et al.,* 2009). Moreover, communities can have different objectives and can come into conflict either internally or externally. Therefore, it must not be assumed there is one single overarching decision or preferential option for adaptation to benefit all actors and stakeholders. Instead, there may be a series of trade-offs that must be made in terms of costs and benefits for different actors.

4.1. Understanding Community-Based Adaptation

4.1.1.Vulnerability and Local Adaptive Capacity: A Theoretical Framework

Indicators have been developed for vulnerability and adaptive capacity (Adger *et al.,* 2004) and under the NAPA's (National Adaptation Programmes of Action), support materials were made available for identification of vulnerable sectors and stresses. A 'formal framework' has been suggested as necessary for vulnerability (Ionescu *et al.,* 2009). Understanding vulnerability and adaptive capacity will help policy-makers understand how climate finance and policies can be best targeted to protect communities against the impacts of climate change. Chapter 3 included definitions of vulnerability and adaptive capacity. Adaptive capacity can be seen as the inverse of vulnerability, since the lower the adaptive capacity, the higher vulnerability will be. Determinants of adaptive capacity include not only economic development, technology and innovation, but also social factors such as human capital and governance structures, and community organisations (*ibid).* Please refer to Annex IV for further details on measuring risk and adaptive capacity.

The tradition of sustainable livelihoods research has been applied in the context of climate change, and within this entitlements are an important variable. This research evolved as a result of the need to explain phenomenon such as food insecurity, for example, Sen showed vulnerability to food insecurity and famine is often linked to political, institutional factors and entitlements (Sen, 1981; Sen, 1984). Livelihoods are conceptualised as stemming from capital assets that include ecosystem services (natural capital), as well as physical and ecological dynamics of risk (see Annex V).

The goal of CBA is primarily to reduce vulnerability and increase the adaptive capacity of vulnerable groups. Adaptive capacity can also be conceptualised as being made up of components of assets or resources, building upon the conceptual 'sustainable livelihoods approach' (SLA) (see Annex V; DFID, 1999). In the SLA, communities' assets are made up of both tangible and intangible assets, including rights and entitlements. Therefore a combination of qualitative and quantitative indicators could be used to capture 'adaptive capacity'. Knutsson and Ostwald (2006) argue the different types of capitals can either be seen as substitutable with each other (for example, financial capital is used to buy physical assets), or they can be complementary; and the degree to which they are transferrable may depend on the context. Knutsson and Ostwald (2006) argue there is more flexibility for an asset to support a livelihood system when it can be transferred, because the actor can react to

changes in value. McDowell and Hess (2012) support the argument the asset base is the foundation of adaptation; and vulnerability can be seen as a function of lack of access to assets or resources. Furthermore, the asset base must be seen as dynamic and fluid, since the process of adaption can erode future resources or reallocate resources which may increase future vulnerability.

It is argued that asset-orientated approaches which use assets and capitals as indicators, such as the SLA typically mask the role of process and functions in supporting adaptive capacity (Jones *et al.,* 2010). Thus the 'Local Adaptive Capacity (LAC)' Framework which developed out of the Africa Climate Change Resilience Alliance tried to incorporate intangible and tangible dimensions of adaptive capacity (*ibid*) into a more holistic conception. The LAC incorporates institutions and entitlements, governance, innovation and knowledge as well as assets (Jones *et al.,* 2010). Indicators are not yet available for each of the above features in the framework, but might be developed in due course. Further analysis of empirical data drawing on the SLA is shown in Chapter 9.

It is argued the different determinants of adaptive capacity, as well as strategies to reduce them, should not be viewed independently. Paavola (2008) argues that complementary strategies are needed, including governance, since a single strategy, for example enhancing market participation, is not only about physical access to markets but also about institutions. Furthermore, ability to participate in markets depends on human capital in both tangible and intangible respects, such as health, nutrition, education and skills (*ibid*). Focusing exclusively on market access might actually increase the vulnerability of the most vulnerable groups who rely upon the natural resource base (*ibid*) leading to the importance of holistic strategies recognising social, economic and environmental considerations.

Pelling and High (2005) argue social capital offers a useful lens with which to examine adaptive capacity. Within this framework, the types of social relationships which make up social capital are defined as "bonding, bridging and linking" relationships, and "trust and reciprocity" are important elements (*ibid*:p.310). Social capital may help communities to adapt to changes in the environment because they can draw on others for support or to take collective action to access resources, including financial or social support. Within the Bangladesh dataset (see Chapter 9), this may be one reason why larger households were found to be marginally more food secure, compared to those in smaller households. This

lends support to the view that having a large family is a 'coping strategy' for poor families, including substituting for a pension.

Eriksen et al (2005) show that smallholder farmers use livelihood diversification as a coping strategy to respond to drought in Kenya and Tanzania. However, Eriksen et al (2005) differentiate between households with a 'principal' or specialisation coping strategy, and households without a principal strategy who adopt a multitude of less-favoured activities categorised as opportunistic and often irregular. The Bangladesh survey (see Chapter 9) did not differentiate between principal and complementary activities but still found association between production diversification and food security. Diversification is arguably a positive strategy for adaptation as it reduces dependence on risky agriculture (Paavola, 2008).

Adger (2006:274) also notes that equity is an important consideration in vulnerability and adaptive capacity, since "unequal distribution of vulnerability to climate change is therefore exacerbated by pre-existing inequalities". This demonstrates why equity considerations must be a key element for effective adaptation finance distribution and policies. The literature review on vulnerability shows there is a close interdependence between environmental risk, resilience of systems, and the political economy of development (*ibid*).

Overall, vulnerability to climate change, like adaptive capacity, is not easily reduced to simple metrics and not easily quantifiable. Critics argue that statistical analysis fails to capture the social differentiation of local conditions that mediate capacity to adapt (Cutter *et al.,* 2003). However, statistical analysis does show us there are common elements across multiple dimensions and conditions. In this context, Rawlsian principles of justice, as well as rights-based justice rules, may play an important role in guiding action for climate change adaptation (Adger, 2006). In this case, both equity within decision-making, as well as equity in outcomes will be crucial in reducing vulnerability, leading to the notion of 'fair' adaptation which reduces the vulnerability of the most vulnerable.

4.1.2. The Adaptation Continuum

McGray et al (2007) indicate it is useful to distinguish between adaptation and development, since there is in fact a continuum of approaches from 'pure' development at one end to explicit adaptation measures on the other. At the development end, activities often reduce poverty and therefore address drivers of vulnerability, including efforts to improve literacy and improve women's rights. At the other end, actions may focus exclusively on addressing

climate impacts, with a broad spectrum of activities in between. Overall, efforts to draw a distinct line between adaptation and development could prove counterproductive (*ibid*).

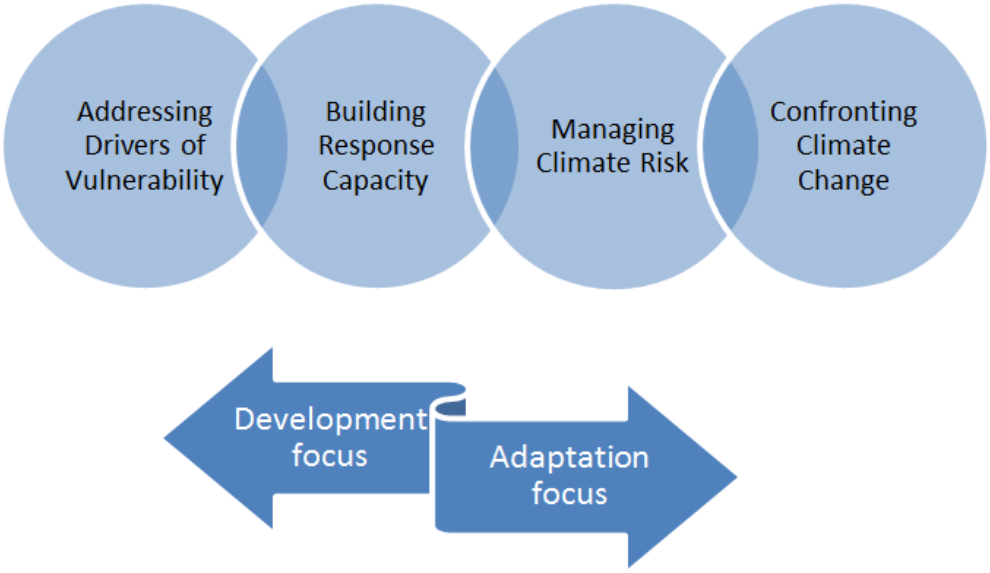


Figure 4.1 Development and Adaptation. Adapted from McGray et al., 2007

However, this continuum also poses a severe dilemma when it comes to adaptation finance: how can adaptation be determined as "new and additional" when it is so difficult to distinguish between adaptation and development? One answer could be to ensure funding streams are additional in volume whilst recognising that many of the activities at ground-level look like development activities. The question has relevance for CBA, because while policies proliferate at national-level (e.g. on climate and desertification), which can lead to duplication, households tend to adapt to multiple stresses in an integrated way (Stringer *et al.,* 2010).

4.1.3. Adapting to Multiple Stressors

Yohe and Tol (2002) argue adaptive capacity must be broadly defined not just as adaptation to climate change but to adaptive capacity to a range of stresses (*ibid*). There is clear evidence smallholder farmers must confront multiple stressors, of which climate change is only one of the environmental stressors that necessitate livelihood changes. For example, McDowell and Hess (2012) argue limited access to assets amongst Bolivian smallholders leads to greater exposure and sensitivity to stressors and hence limits capacity to adapt. The multiple stressors faced by smallholder farmers include land scarcity, since land is a limited resource under the category of natural capital which limits householders' flexibility and adaptive capacity to the stressors they face *(ibid*). The multiple stressors also include market

risks created by globalisation (O'Brien et al 2004). In this context, the onus of vulnerability is on the social and institutional frameworks that produce the underlying causes of vulnerability.

The asset-based perspective on adaptation (*ibid*) can therefore be seen as the process of broadening access to assets, both tangible and intangible. Overall, since multiple stressors include factors such as climate stress, market stress and land scarcity, policy-makers must explore ways to tackle these root causes of vulnerability in the context of adaptation to climate change. This will allow a process of adaptive development that expands food security by strengthening livelihood opportunities in the context of access to resources, including strengthening social and human capital and enabling institutions.

4.2. Frameworks for Assessing and Prioritising Adaptation Options and Projects

Various frameworks have been proposed for implementing CBA, including steps such as situation analysis, asset mapping and resource mobilisation (see Ebi and Semenza, 2008). Please refer to Ju Hui et al (2008) for description of the application of UKCIP's 'Adaptation Framework' in Ningxia, China. The UKCIP framework was developed based on standard decision-making and risk principles, and includes steps for appraising options and evaluating outcomes (IPCC, 2014). Consultation and understanding the local context were vital for ranking adaptation options (Conway, 2012a) but this local specificity may be a barrier to application of regional responses or comparisons across regions.

4.2.1. Assessing and Evaluating Adaptation Options for CBA Projects

Monitoring and evaluation (M&E) for CBA is a relatively new field and there is much work to be done to evaluate the success of locally-driven adaptation. Projects may need a series of performance indicators and to outline their means of verification. It can involve a process of "learning-by-doing" known as adaptive management. The IPCC-AR4 called on researchers to provide "effective approaches for identifying and evaluating both existing and prospective adaptation measures and strategies" (IPCC, 2007:161). As previously mentioned, there is an overlap between adaptation and development so indicators for adaptation could in some circumstances be similar to those developed for monitoring success in development projects; in other cases different or new indicators may have to be developed. Fussel and Klein (2008) argue M&E of adaptation is more difficult than for mitigation. Moreover, assessing projects is essential for developing and recording lessons learnt so these can be translated to other regions. For instance, UNDP's 'Adaptation Learning Framework' hopes to capture and

disseminate lessons learnt in a global learning platform (AdaptationLearning, 2010). Monitoring is essential, because where experiences are not recorded or evaluated, lessons on what works are lost (RIU, 2008). It is impossible to up-scale projects without M&E; and you cannot explore the impact or learn from mistakes without establishing baselines (*ibid*).

McGray and Spearman (2011) suggest an approach based on an 'adaptive learning cycle', where the project is implemented by various steps, including vulnerability assessment, adaptation hypotheses, a theory of change, indicators and baselines are set, and then an M&E system is used which incorporates flexibility. CARE (2010) argues M&E should be an integral part of the project cycle at each stage, not just at the end. In practice, there has also been an attempt to bring an actor-orientated perspective to adaptation actions and evaluation, including multi-criteria assessment (Downing *et al.,* 2004).

Overall, effective indicators and some new indicators will be needed to identify the success or otherwise of CBA. The community-based approach means there may have to be flexibility in design of M&E frameworks to avoid an overly constrained or bureaucratic approach, and for tools to be practical. There may be a trade-off between the simplicity of top-down approaches versus the complexity and realism of bottom-up approaches that incorporate socio-economic drivers of risk (Jones and Preston, 2010). Developing frameworks for assessing projects will be essential for improving the efficiency of projects, saving time, guiding prioritisation of donor funding (which applies to either public or public finance), as well as dissemination of lessons learnt that can be scaled-up and applied to other settings. These frameworks for assessment also encourages the building of trust and confidence to enable policy-makers in developed countries to convince the electorate climate finance is being well-spent. Hence this will contribute to the necessary scaling-up of adaptation finance.

4.2.2. Participatory Approaches and Tools

There are several participatory tools used in CBA including seasonal calendars, timelines to assess trends, community mapping and modelling, transect walks, stakeholder analysis and participatory video (see Reid *et al.,* 2009; CARE, 2009). For example, in Climate Vulnerability and Capacity Analysis (CVCA), communities fill out a 'vulnerability matrix' in which they identify their most important livelihood resources and then rank the hazards that most threaten these resources (CARE, 2009). This is based on the formula for risk management (Risk = Likelihood x Impact). The discussion is then taken forward to identify coping strategies for the most serious hazards. By getting communities to assess existing

hazards themselves, it indicates these hazards have a likelihood of affecting them, and the relative impact of these risks can be assessed.

Vulnerability Reduction Assessment (VRA) is a form of participatory impact assessment that takes a semi-structured and context-informed approach, based on community perceptions of vulnerability to climate change. VRA is a community-based tool involving stakeholder meetings with the affected population to assess vulnerability to existing and future climate variability and identify barriers to adaptation, as well as community's willingness to maintain the project. VRA can provide information to guide adaptive management, as well as holding projects accountable to communities (UNDP, 2008). The indication of relative change in vulnerability is assessed through the "degree of change in the VRA scores relative to baseline values established prior to commencement of project activities" (UNDP, 2008:2). There are limitations due to a possible response bias. UNDP recommends ensuring a representative composition of groups in VRA meetings (gender, age and livelihood groups); and avoiding leading questions (*ibid*), but some other sources of substantial bias have not been addressed; for example courtesy bias (FAO, 1997) or social desirability bias. VRA produces quantitative outputs from qualitative information, and relies on participants perceptions of vulnerability; and therefore is a somewhat subjective analysis. However, other indicators may be needed if a project does not reduce participants' perceptions of vulnerability, but does have other positive outcomes, e.g. long-term adaptability of ecosystems.

4.2.3. Emerging Indicators and Metrics for CBA

CARE suggests projects assess improvements in adaptive capacity in areas of climate-resilient livelihoods, DRR, local capacity development and addressing underlying causes of vulnerability (CARE, 2010). Project-level indicators may be process-orientated as well as result-orientated, and there may be a combination of both quantitative and qualitative indicators, often disaggregated by gender or other determinants of vulnerability (*ibid*). A framework of milestones and indicators at each level is suggested, including household and individual level, local government and community-level, and national-level (CARE, 2011). Household-level tools will be particularly useful in designing a baseline survey.

In designing goals and objectives, it is suggested in the literature these should be SMART – "simple, measurable, achievable, realistic and time-bound" (CARE, 2010:55) but some add the term "area-specific" (Candwell, 2002). In selecting indicators and metrics, Candwell (2002) argues ideal indicators should be measurable, technically feasible, reliable, valid,

relevant, sensitive, cost-effective and timely. Some indicators describe the input of the project, others describe outputs or document activities, whilst others measure impacts or effects. Most indicators require a "standard against which to measure" (*ibid*:p.108), thus there is a need for a baseline survey or study with important data. Moreover, there is a distinction between aggregate (broad) indicators and more specific 'operational' indicators which may be a subset of the aggregate indicators. Many organisations develop a logical framework which is then turned into an M&E plan. In "action research", research tends to be participative, qualitative and reflective (*ibid*:p.130) allowing for reflection on unanticipated effects and learning from mistakes (Candwell, 2002).

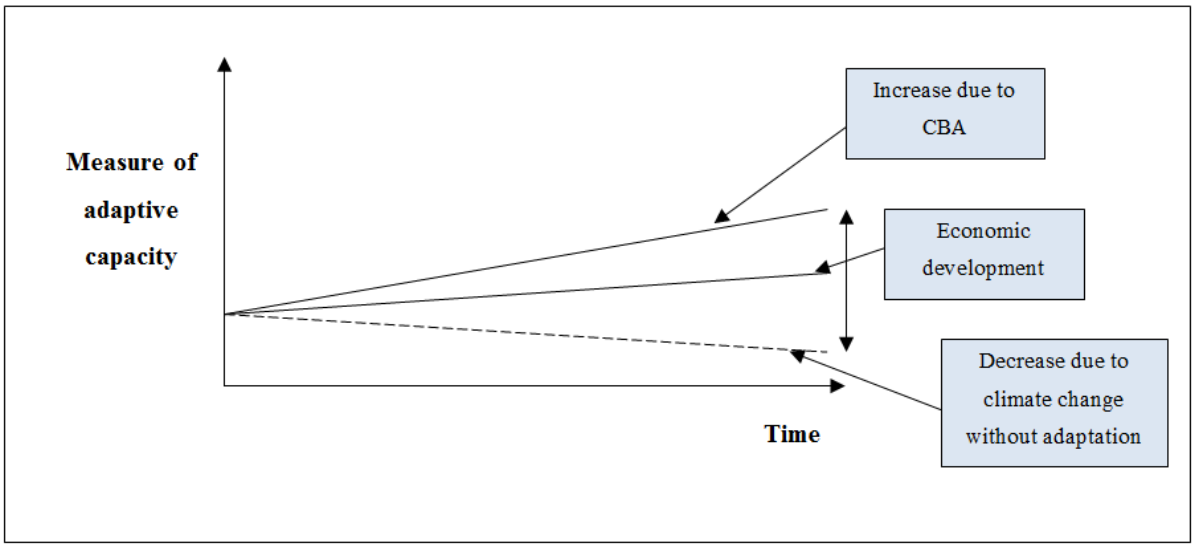


Figure 4.2 Dynamic and Shifting Baselines (Source: Authors' Own)

As shown above, climate change poses a challenge for development and project-based initiatives due to the problem of shifting and dynamic baselines. This means that the pressures of climate change (along with other pressures) may change the baseline over time. Therefore, projects will have to counteract negative impacts, although some impacts can also be positive. CBA exists in a dynamic situation and external pressures and forces must be understood. These challenges confirm it may be difficult to develop a set of generic indicators or metrics for local-level adaptation. We need to understand the counterfactuals and existing socio-economic changes already taking place, so it may be necessary to integrate adaptation into existing development planning.

4.3. Local and Traditional Knowledge in CBA

Traditional Ecological Knowledge (TEK) has been recognised as crucially important in adaptation, particularly in ecological resilience and conservation of biodiversity (Berkes *et*

al., 2000) although it is recognised not all traditional knowledge is ecologically wise (*ibid*). Practices may include monitoring the state of the resource, agroforestry, crop rotations, watershed management, buffer reserves, or types of social institutions (*ibid*). There is a need to integrate and bridge the gap between local and scientific knowledge to build enhanced resilience (Blanco, 2006). For instance, in the Canadian Arctic, traditional knowledge can be seen as local-scale expertise; a source of climate history and baseline data; in formulating research questions; as insights into impacts and adaptation… and for "long-term community-based monitoring" (Riedlinger and Berkes, 2000:315). It has been suggested the term 'traditional' is not helpful as it implies knowledge is old and static, while it can be dynamic (WIPO, 2008a). As noted above, TEK can be threatened as well as supported by external forces. Combining local and scientific knowledge can provide results that are greater than the sum of both, but this may require institutional reforms to strengthen 'common property management' regimes (Reed *et al.,* 2007). Building synergies amongst knowledge systems may enhance equity and effectiveness in environmental governance (UNESCO, 2012).

TEK is protected to different extents by international treaties and law. This is important because of the international finance which is supposed to benefit these communities, for instance for resilient seed varieties, and the verification processes that must follow. For instance, under the Convention on Biological Diversity (CBD), Article 8(j) each Party is required to "respect, preserve and maintain knowledge, innovations and practices or indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity" and "encourage the equitable sharing of the benefits arising from the utilisation of such knowledge innovations and practices" (CBD, 2012).

The CBD has also resulted in the 'Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from the Utilisation of Generic Resources' adopted in October 2010. The Protocol has 92 signatories including the US and UK. Parties must ensure the 'prior informed consent' of communities as well as fair 'access and benefit-sharing'. National focal points were established to ensure information, grant access or cooperate on compliance (CBD, 2012a).

However various 'gaps' remain where communities are not eligible to be protected, for instance where collective knowledge is not recognised (WIPO, 2008). TEK can be difficult to protect under intellectual property regimes because it often fails to meet the criteria to quality

for protection of being "new, original innovative or distinctive" (Simeone, 2004:5) and IPRs (Intellectual Property Rights) may also rely on individual property ownership. Since negotiating Parties at the UNFCCC are countries rather than communities, traditional knowledge often gets marginalised (Swiderska *et al.,* 2011) including the role of ecosystems in economic evaluation of adaptation.

TEK is particularly important for food security under climate change, because with the potential for climatic change to change the range at which crops are adapted to grow, the genetic diversity of traditional varieties sustained by farmers is valuable (Swiderska *et al.,* 2011). Specific examples of TEK include knowledge relevant to sustainable use of biodiversity, plant genetic resources for food and agriculture, and animal breeding and production (WIPO, 2008). Traditional varieties are genetically diverse so may be better able than modern varieties to withstand environmental stresses (Swiderska *et al.,* 2011). Furthermore, biodiversity may well provide a valuable source of germplasm for species that tolerate extreme conditions (*ibid*). Communities may well be able to identify resilient practices as well as varieties. Community seed banks for traditional varieties have therefore been suggested for adaptation. CGIAR holds the worlds' most important ex-situ collections of germplasm for major food crops, and CGIAR centres agreed in 1994 to hold designated germplasm "in trust for the benefit of the international community… not to claim ownership, or seek intellectual property rights" (WIPO, 2008a:9). Furthermore, customary laws often protect traditional ecological diversity, and the recognition and integration of customary laws with statutory governance systems is suggested, for example for non-timber forest products (Laird *et al.,* 2009).

The Nagoya Protocol is also relevant because biotechnology has been suggested as an opportunity for scientists and plant breeders to develop new climate-resilient varieties. The Protocol requires countries to support development of community protocols - charters of rules and responsibilities where communities set out their procedures for access and benefit-sharing, as well as legally-recognised and customary rights to natural resources and land (Swiderska, 2012). It requires countries to avoid 'bio-piracy' by taking measures to ensure communities give their 'free, prior informed consent' over use of knowledge or genetic resources (*ibid*). This could apply to measures to use TEK for adaptation, and to ensure climate-resilient seed programmes benefit communities. However, rather than protecting communities, critics argue the Nagoya Protocol legalises biopiracy as it treats utilisation as "for research and commerce" and enables transfer of genetic material from communities to

corporations (Shiva, 2012). The Nagoya Protocol has so far not come into effect as it has 29 signatories (as of 2014) out of the 50 required for it to go into effect, and the US is not yet a signatory.

Under the Aarhus Convention, otherwise known as the Convention on Access to Information, Public Participation in Decision-Making and Access to justice in Environmental Matters the public are granted rights to access to information and participation in environmental decision-making. However the Convention, which entered into force in 2001, has not been signed by many Least Developed Countries (LDC's). As of 2014 it had 39 signatories including the EU and UK (UN, 2014a). There is also a differentiation between public participation in decision-making and community engagement in national strategies and technological development. Processes for public participation and freedom of information offer a potential means to uncover information relating to climate finance.

4.4. Gender in CBA

Climate change has gender-specific implications in terms of vulnerability and adaptive capacity (IPCC, 2007). Therefore it will be important to consider gender issues in CBA. For further details please refer to the co-authored book chapter on this topic (Wright and Chandani, 2014) from which this section is adapted. Women play a unique role in managing natural resources globally including being involved in agriculture, and collecting water and fuel (*ibid*). Overall, poor women live on the frontlines of climate change, but also possess knowledge that may hold the key to adaptation in certain places (UNDP, 2010 in Wright and Chandani, 2014). It is therefore vital gender considerations, and men's and women's different needs, knowledge and skills are considered when planning CBA.

Cannon (2002) argues there are specific gender attributes which increase women's vulnerabilities. For example, drinking saline water in Bangladesh increases maternal health risks during pregnancy (Khan *et al.,* 2011). According to GTZ (2010), globally, women and children are 14 times more likely to lose their lives in a natural disaster. During the 1991 cyclone in Bangladesh, for example, 90% of fatalities were women (UNDP, 2010). Girls are often excluded from activities such as tree-climbing that reduce risks from floods (Plan International, 2011). In many countries, women lack land rights or lack the capacity to access finance, technology, training and information to cope with climate-related disasters (see Wright and Chandani, 2014).

It is therefore argued gender issues need to be mainstreamed into CBA. Gender mainstreaming can be defined as the "*process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in all areas and at all levels*" and is arguably the most crucial step towards scaling-up CBA projects in a way beneficial for both men and women (Wright and Chandani, 2014:227). Rooke et al. (2009) argue: "there will be no climate justice without gender justice" (cited in Wright and Chandani, 2014:228).

Furthermore, there is evidence linking gender mainstreaming to efficient project development. Investing in adaptation that specifically targets women may lower financial risks (see Wright and Chandani, 2014). In Bangladesh, women have been pioneers in microfinance (*ibid*). Furthermore, it has even been suggested meeting unmet demand for family planning could slow population growth, which could alleviate climate-related challenges, so there could be lessons to learn from population-health-environment (PHE) projects (see Wright and Chandani, 2014).

UNDP (2010) recommends integrating gender considerations in all the stages of the CBA project cycle, right from problem identification to M&E (below). Refer to Wright and Chandani (2014) for further discussion on this topic.



Figure 4.3 Project Cycle. Source: UNDP, 2010 (in Wright and Chandani, 2014)

4.5. Mainstreaming CBA in agriculture in Bangladesh

At present it is not clear to what extent CBA has been mainstreamed into agriculture, including funding agencies across different levels. Mainstreaming has been highlighted as a more effective approach than stand-alone climate interventions, and practical guidance now exists for policy-makers to mainstream adaptation into development, including in agriculture (FAO, 2012). Yet most guidance fails to clarify whether 'mainstreaming' is a bottom-up process through which successful CBA actions are replicated or scaled-up, or a top-down process in which government plans deliver pre-determined adaptation benefits. For further understanding on this issue, refer to the journal article on this topic (Wright *et al.,* 2014) from which this section is adapted.

Multilateral funds are in the early stages of integrating mechanisms for managing climate risks. The World Bank has guidelines for mainstreaming of adaptation into agriculture (World Bank, 2010) while the International Fund for Agricultural Development (IFAD) recently established a fund for smallholder adaptation. IFAD's new Adaptation for Smallholder Agriculture Programme (ASAP) provides a new source of grant co-financing to scale up and integrate adaptation across IFAD's approximately US$1billion annual new investments (IFAD, 2012). This includes a range of CBA components; participatory mapping and vulnerability assessment, delegation of priority-setting for spending of adaptation funds to community groups, and mechanisms for community-to-community learning across administrative and geographic boundaries (*ibid*). These experiences have implications for international climate finance institutions like the Green Climate Fund (GCF), which recognised food security as a key priority in its initial results management framework (GCF, 2014a).

In Bangladesh, initial steps have been taken to mainstream processes and lessons from CBA, but there are various institutional and market barriers. Bangladesh is at risk of increasing flooding, more intense cyclones and sea level rise in a warmer climate (Huq *et al.,* 2003). The 'Livelihood Adaptation to Climate Change' (LACC) project, under the Comprehensive Disaster Management Programme (CDMP), promoted livelihood adaptation among Bangladesh's most vulnerable communities, implemented jointly by the Department of Agricultural Extension (DAE) and FAO (Baas and Ramasamy, 2008). Project outputs included learning lessons from CBA. The project assessed existing locally-specific risk-coping strategies, and downscaled climate scenarios (*ibid*), intending to link local and

scientific knowledge. As reliable downscaled climate data was lacking, pilot projects focused on 'no regrets' options (Baas and Ramasamy, 2008).

An independent CDMP evaluation found LACC was successful and proposed further embedding climate-related knowledge in forthcoming projects, but argued gender require further attention (Russell *et al.,* 2009). A programme review cited information and communication gaps, including illiteracy, bias towards production of printed materials, the absence of a communications plan, and underuse of information and communication technologies (ICT) (FAO, 2010a). To overcome this, a deliberate effort was proposed to mainstream adaptation in national planning (*ibid*). Collaboration with the Agricultural Information Service was recommended (FAO, 2010a). The limited reach of extension services remained a barrier (*ibid*). General lessons were that integrating DRR and adaptation into operational local-level frameworks is crucial - not establishing separate institutions (FAO, 2010b).

A further project under the BCCRF (see Chapter 5) builds on lessons from LACC, including collaboration with farmer field schools, as well as improving community-based EWS (BCCRF, 2014). The project seeks to focus on community-based adaptive research and participatory extension approaches, drawing on local knowledge to develop community-based DRR plans (DAE, 2013). There is nascent evidence of mainstreaming of lessons from CBA. However, while CBA approaches are articulated in project documents, it is too early to explore whether this will be effective. Mainstreaming of adaptation in agriculture is on-going. Scaling-up CBA in agriculture faces social, institutional, policy, market and financial barriers (Wright *et al.,* 2014). Communication and literacy gaps were also highlighted in other studies (Spires et al 2014). Proposed solutions that may be cost-effective and institutionally feasible include better use of communications media; and tackling market barriers through trade reform. However, channels for scaling-up local adaptation are constrained by the reach of extension services. Addressing the existing 'development deficit' will therefore be crucial (Parry *et al.,* 2009).

4.6. Adaptive governance and CBA

Based on extensive analysis of large numbers of case studies of common property regimes in the 1980s, Ostrom suggests that bottom-up locally-managed systems are more likely to design governance rules to suit local resources than top-down systems (Ostrom, 1999; Ostrom, 2007). This observation has relevance for CBA.

Other scholars have used concepts like social-ecological systems (SES) to emphasise human society are nature are integrated in complex adaptive systems, and that delineation between the two is artificial and arbitrary (Folke *et al.,* 2005). The term 'adaptive governance' is used to describe systems with a capacity to reorganise or renew themselves during periods of abrupt change or turbulence (*ibid*). However, this tends to assume the 'system' requires stability rather than change. Recognizing the inter-dependence of political and ecological systems, a 'political ecology' framing could be useful for analysing CBA in agriculture, where people are reliant on ecosystem services. In the political ecology discourse, Adger et al (2001a) argue there is often a global 'managerial' discourse that argues institutional and policy failure are the ultimate cause of problems, and a 'populist' discourse that portrays local actors as disempowered victims. However, CBA narratives tend to diverge with these dominant discourses, emphasising the role of bottom-up governance and the importance of local knowledge for adaptation.

As noted above, social capital may be a useful lens through which to view adaptive capacity. In CBA, we can consider both NGOs and local government as 'bridging organisations' that bridge local actors with other scales of knowledge on adaptation, as well as link to climate finance. This forms a conceptual basis that may help us to understand the cross-scale dynamics in the case studies.

The IPCC introduces the concept of 'transformational adaptation' - defining this as adaptation that changes the fundamental attributes of a system in response to climate and its effects (IPCC, 2014). Pelling and Manuel-Navarrete (2011) propose a stylised 'adaptive cycle' in which social systems pass through four transitional states of institutionalised, scattered, mobilised and then polarised (which can then tend towards scatter). Dow et al (2013) argue 'transformation' may be needed to facilitate adaptation in the face of its limits, but recognise this can also be negative, for example, tolerating lower yields, or having to migrate. By contrast, adopting a vulnerability perspective, this study argues 'transformational' adaptation includes changes towards more inclusive governance that reduces vulnerability and enables CBA.

4.7. In-Depth Local Study: Kalapara

The area of Kalapara Upazila, Patuakhali District, Bangladesh has been selected for the in-depth local fieldwork study. This area was selected for detailed study due to various factors, including the high likelihood of climate change impacts (sea level rise, cyclone, and salinity

intrusion), high incidence of poverty and food insecurity, and availability of data, and presence of adaptation interventions. Furthermore, access to community organisations and officials and data access were facilitated by organisations working in the area including the NGO (non-governmental organisation) ActionAid. Various projects are also being implemented in the area by a variety of agencies, including the Comprehensive Disaster Management Programme (CDMP) cyclone preparedness programme and a CBA project in Poshurbunia village. Furthermore, the Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP) was ongoing to improve polders (embankments) and construct multipurpose cyclone shelters: the first project funded by the BCCRF donor fund. As described in Chapter 2, a household-level questionnaire was undertaken. The literature review in this section informs the local-level results and analysis (Chapter 8).

4.7.1. Vulnerability in Kalapara Upazila, Patuakhali District

According to the 1991 Bangladesh census, Kalapara Upazila has a population of 174,921. By 2012 this reportedly increased slightly to 212,835 according to the Kalapara Upazila Health Complex bulletin (MoHFW, 2012).The observed climate change data is found in Annex VI, which appears to show a gradually increasing trend in observed annual mean temperature, but no observable trend in precipitation. Kalapara is in Barisal Division, an area with high poverty. The poverty level in 2010 was between 21-27%. Malnutrition levels were also high at 10.2-11% in 2011.

Salinity

Salinity intrusion is an additional problem in this area, affecting freshwater supplies. Figure 4.4 shows soil salinity levels in this area, using ArcGIS data from the Soil Resources Development Institute (SRDI). The salinity boundaries have moved inland since 1973. The green area in the bottom left of the map is the Sunderbans forest.

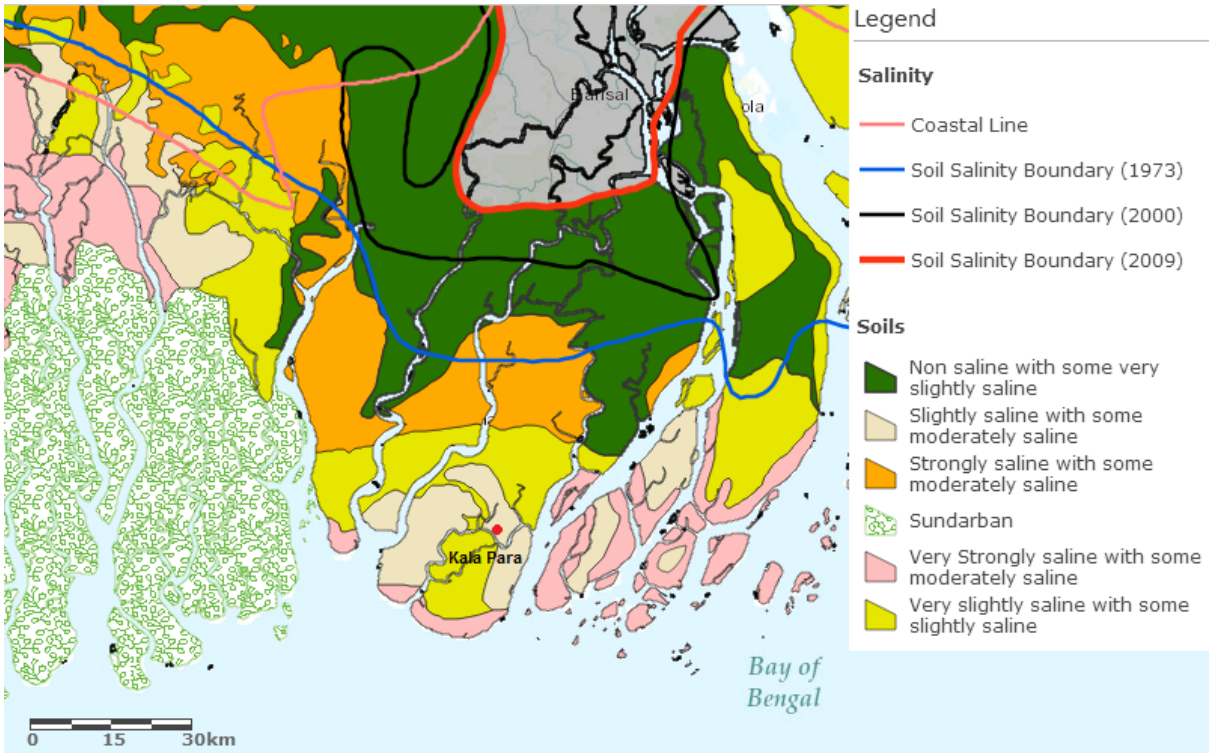


Figure 4.4 Soil salinity levels in this coastal area of Bangladesh (Source: Authors Own, with data from SRDI, 2010)

Cyclones

Patuakhali was affected by cyclone 9 times between 1970-2007 and 34.41% of households were involved in agriculture and so were expected to be exposed to cyclones (UNDP, 2009). After Cyclone Sidr in November 2007, 98 primary schools in Patuakhali were fully destroyed by the cyclone and 550 were partially destroyed, with most affected buildings made from corrugated iron roofing and wooden pillars (*ibid*). Therefore the plan to build multipurpose cyclone shelters has been welcomed.

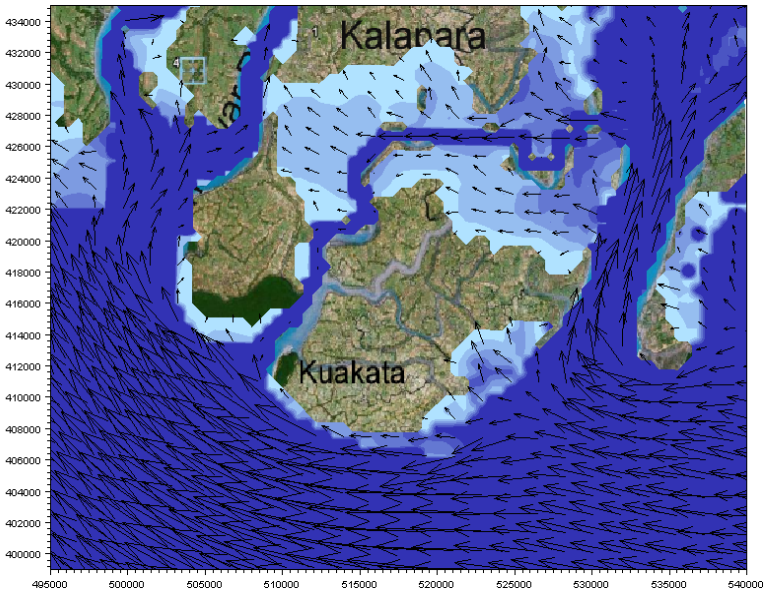


Figure 4.5 Figure to show the surge water intrusion in Kalapara due to breaching of the embankment during cyclone Sidr (from Choudhury, 2008)

During Cyclone Sidr, an estimated 611,125 people were affected in Patuakhali (CDMP, 2008a), one of the worst-affected regions in Bangladesh. In May 2009, the area was again ravaged by cyclone Aila, reportedly affecting almost 800,000 people in Patuakhali alone, according to the Ministry of Food and Disaster Management (MoFDM), including 93,695 people in Kalapara (DMIC, 2009), nearly half the population.

According to the district administration, 54,006 families became shelterless due to cyclone Sidr but only 23,639 of these families got new houses from government or donor agencies (Dailystar, 2012). According to the Water Development Board, at least 816km out of 1209km of embankment and 355 out of 412 sluice gates were damaged by Sidr (*ibid*). More than 300km of flood control embankment and 33 sluice gates had yet to be repaired in 2012 (*ibid*) meaning 300,000ha of agricultural land were under threat.

After the 1970 cyclone, shelters were built in Patuakhali. However, only around 7.3% of the coastal population are protected with usable shelters (World Bank, 2010a). 'Pucca' (solid) houses remain structurally intact during a cyclone and this can effectively substitute for cyclone shelters in areas with flooding less than 1 metre. Economic development may result in increasing numbers of these houses being built (*ibid*), since census data found those with annual incomes of $470 and above live in such houses.

The multipurpose shelters constructed in the World Bank ECRRP project in the aftermath of Cyclone Sidr are highly economically effective with a capacity to shelter 1,600 people, costing around $214,000 (about $134 per person accommodated) (World Bank, 2010a). Focus groups have found people are more willing to access these shelters when they are closer, accessible, less crowded and have separate facilities for women and sanitation facilities (*ibid*).

The mapping of vulnerable infrastructure in Kalapara, completed under the CDMP, is shown in Annex VII. The CDMP surveyed a number of buildings in the area including 34 cyclone shelters, 109 schools, 4 colleges and 1 hospital (CDMPR, 2008) within data collection areas based upon the Risk Zone and High Risk Area zones as defined by the Multipurpose Cyclone Shelter programme and Sidr-affected areas. 37% of Kalapara is vulnerable to storm surges between 3-6 metres high and 38% is vulnerable to surges between 1-3 metres (CDMPR,

2008). However it is important to note this report was based upon vulnerability to tsunami rather than long-term climate change trends or risks.

Food security is a problem in this area, for example a study in 2010 in nearby Mirjagonj Upazila found 56% of marginal farmers were food-insecure and only 13% were food-secure (Uddin, 2012). There was limited economic access to food and poor utilisation capacity due to lack of knowledge on human nutrition, as well as unhygienic water and sanitation. Farmers cultivated mainly rain-fed Aman rice and Aus rice, but were reluctant to use high-yield Boro because of lack of fresh irrigation water and lack of salt-tolerant rice varieties (*ibid*). The Aman rice period (July-November) is susceptible to flood, cyclone and storm surges. In terms of the vulnerability of different livelihoods in the region, crop farming was found to be most vulnerable to storm surges, followed by fishing, livestock and day labouring.

Self-coping and assisted coping strategies to address storm surge were also summarised by Uddin (2012) who found all farmers coped with storm surges by decreasing meal sizes and number of meals, half of marginal farmers took a new loan at a high interest rate, and half would consume uncultivated food from wild sources like water lily, leafy weeds, and banana. Additionally, 40% would sell their fixed and moveable assets, while a few (20%) would sell their day labour at a low rate, and some would cultivate short duration crops like red amaranth, amaranth, and radish (*ibid*). In terms of assisted strategies, the majority took relief food (76%) while half got food from communities and relatives in their social network, and a few resorted to begging. However, Bala and Hossain (2012) estimate the overall food security and ecological status was generally good in Kalapara compared to nearby regions, but environmental and social sustainability was hindered by shrimp aquaculture.

4.7.2. Local Adaptation Activities

The NGO Actionaid has been working on community-based adaptation in four villages in Patuakhali District in a project from 2008-2010 entitled 'Assistance to Local Communities on Climate Change Adaptation and Disaster Risk Reduction in Bangladesh' with assistance from the Embassy of Denmark in Bangladesh (Raihan *et al.,* 2010). The project focused on local government annual plans and budgets, development governance, and the main hazards (cyclones, river erosion, saline intrusion and tidal surge). Researchers found adaptation can only happen through addressing poverty and basic needs first, concluding; "people cannot worry about their future when their stomachs are empty right now" (Raihan *et al.,* 2010:9).

The project built on the emerging principles of CBA and helped communities to organise community research groups known as Gonogobeshona Dol (People's Research Teams or 'GGD') which worked with local government to produce Community Adaptation Plans (CAPs) (Christensen *et al.,* 2012). This community-led research was based on the premise that communities are most suited to articulate their adaptation needs in a changing climate, and utilised a range of PRA tools (Faulkner and Ali, 2012).

It was found saline water intrusion was causing uncertainty for farmers, putting traditional practices in peril, threatening water supplies through tube wells, and threatening the sanitation system (Actionaid, 2009) causing health hazards. This may force people to take out high-interest loans from NGO and banks which can increase vulnerability (*ibid*). There was reportedly migration into Charipara village due to river erosion, again causing migrants to take out loans (*ibid*). Rice cultivation is threatened and people reported salinity intrusion occurs when the winter starts, compounded by broken sluice gates and embankments, shrimp culture and insufficient irrigation, making fields more saline in the winter and part of the summer (*ibid*). Climatic hazards that threaten food security in this particular area have been mapped out in Chapter 8.

The research by the GGD highlighted that crop activities generate more income opportunities for the poor than shrimp activities. Thus, along with advocacy, the government closed sluice gates to reserve sweet water (pani) in 16 canals to support Boro (winter crop) cultivation, piloting the use of saline-tolerant Boro rice using improved seeds from BRRI (Bangladesh Rice Research Institute) (Actionaid, 2009). The project highlights the need for enabling factors to enable adaptation to occur. Project initiatives included homestead gardening with the Agricultural Department, climate-resilient latrines, raising pond banks to save sweet water, and provision of ducks and goats for alternative livelihoods (*ibid*). During Cyclone Aila (2009) there was provision of emergency relief and advocacy work, but farmers in Poshurbunia and Charipara villages were particularly vulnerable having lost all crops (*ibid*). Recent developments in the area involved tidal waters washing away coastal flood-defence river embankments, compounding flooding and saline intrusion which caused damages to crops and homes (Dailystar, 2012a; Dailystar, 2012b). There were allegations regarding corruption in scheduled embankment repair works in Kalapara (Independentbd, 2012).

4.7.3. Local Flood and Salinity Management

Flood and salinity management in Kalapara has historically been done through a system of embankments (polders and sluice gates). Embankment (polder) building in the coastal area has a controversial history in Bangladesh, with most being built in the 1950s and 60s by the water development board intending to protect agricultural land from saltwater. This process has been reversed with many polders being willingly opening to allow shrimp cultivation (Banglapedia, 2012) with environmental and social consequences for the population. A 'gher' is a small piece of land surrounded by a raised dyke.

Between 1959-1988, 6,130km of embankment, 4,521 hydraulic structures and 985 river closures were constructed all over the country, but due to lack of maintenance most are in poor repair (Salahuddin, 1995). There was a focus on construction and technical aspects but according to Salahuddin (1995) there was lack of resources, staff, and facilities allocated to operations and maintenance (O&M).

Polders have a high return on investment, with the internal rate of return of an LGED polder at 38% at prevailing market prices (Chowdhury *et al.,* 2010), aiming to support rice production by reducing salinity, enabling 'aman' rice to be grown. However, it is clear when polders and associated structures (including sluice gates) fall into disrepair, these advantages are not available. Under the ECRRP, various polders (embankments) are being improved in Kalapara with multilateral finance under the BCCRF (see Chapter 5).

4.8. Summary

This chapter explores frameworks for planned local-level adaptation to climate change under the process of community-based adaptation (CBA). Various theoretical frameworks were explored which may facilitate understanding of local-level adaptation including concepts of adaptive capacity, the sustainable livelihoods approach, and the recognition of multiple stressors affecting vulnerability. Various frameworks have been used by researchers and NGOs to evaluate adaptation options at local-level, including participatory tools. Overall it was noted it may be difficult to develop a set of generic indicators or metrics to evaluate the effectiveness of CBA since vulnerability to climate change tends to be context-specific and because the baseline is shifting as development takes place. Therefore it was decided a generic set of indicators for CBA effectiveness would not be developed; instead this chapter provides insights into a number of issues that were valuable in analysing the local-level case study.

In particular, the chapter explored two themes that emerge in literature on CBA; the role of traditional ecological knowledge (TEK), and the importance of gender sensitivity. TEK has huge potential for adaptation since local communities often have experience in adapting to changing climatic conditions, but this knowledge is often not recognised by institutions higher up, and without adequate legal protection it can also be misappropriated. Gender equity is another crucial issue for climate vulnerability, yet problems relating to gender might be difficult to tackle if they are related to social barriers to climate change (both cultural and cognitive).

Taking the case of Bangladesh, secondary literature was used to explore whether lessons from CBA projects have been incorporated in national agricultural planning. There is nascent evidence that experience with projects on livelihood adaptation have influenced policy-making as recent projects have tried to mainstream participatory adaptation mechanisms. However challenges remain, including communication and literacy barriers to disseminating information.

Finally, the chapter provides background to the local-level case study, where existing and projected climate-related challenges include salinity intrusion, cyclonic activity, and regular flooding. It will be useful to find out if one impact is experienced more than another by local people. The literature review reveals various emerging challenges relating to adaptation in this region, as well as for water management, which will be explored in greater detail in the local-level analysis (see Chapter 8). The locality is also highly vulnerable to food insecurity. Various interventions and projects already exist in this area to tackle these emerging issues, making this an interesting case study.

5. Case Study: Background to Climate and Food Security in Bangladesh

5.1 Introduction

Bangladesh has been recognised as one of the countries most at risk of dangerous climate change (Ali, 1999; World Bank, 2010a). In the list of the most vulnerable countries compiled by Maplecroft, Bangladesh tops the list (ADB, 2012). Bangladesh is a densely populated country with a population of around 154 million (UN, 2014). As the largest LDC (Least Developed Country) Bangladesh has had a period of significant economic development. Around 65% of Bangladesh is located in the Ganges-Brahmaputra Delta (Alam, 1996) - the largest megadelta in the world by population with 111 million people and the second most densely populated delta with 1,280 people per km^2 (IPCC, 2007; Ericson *et al.,* 2006). Deltaic regions, which are densely populated and low-lying, have long been recognised as sensitive to sea level rise and as 'hotspots' for vulnerability to climate change (IPCC, 2007).

The delta suffers from a range of factors which increase vulnerability to additional climate impacts, including population pressure, tropical cyclones, flooding and the effects of coastal erosion. Every 3-5 years, two-thirds of Bangladesh is inundated by floods, and around every 3 years a cyclone hits which causes storm surges in excess of 10m (World Bank, 2010a). Climate change is expected to lead to sea level rise (SLR) and sea surface temperature (SST) increases, increasing the frequency and intensity of tropical cyclones (Khan *et al.,* 2000). Salinity ingress and sea encroachment under SLR, compounded by high intensity cyclonic activity, could also affect freshwater supplies (Agrawala *et al.,* 2003). Flooding, salinity intrusion and soil erosion also have severe impacts for agricultural lands and rice yields which could affect food security (*ibid*). 1m SLR could inundate 17.5% of the country (Salwar and Khan, 2007) with the regions of Patuakhali, Khulna and Barisal most affected. Agriculture is the single largest sector of the economy, making up 18.4% of GDP and employing 45% of the population (CIA, 2012), with rice as the most important crop. Bangladesh is the fourth largest rice-producing country in the world (FAO, 2010c). Hence, agricultural development is important for reducing poverty and hunger, and the impacts of climate change in coming decades are recognised by the Government of Bangladesh (GoB) as a threat to economic development (BCCSAP, 2008). Climate change will reinforce many of the baseline stresses which already impede economic development (Agrawala *et al.,* 2003). CIF (2010) indicates that climate impacts include; sea level rise, cyclone and storm surges, flooding, drought, riverbank erosion, salinity and extreme events. This chapter takes the

various climate change impacts in turn and analyses the existing observable baseline changes, as well as projections into the future, before looking at adaptation finance and policy responses.

5.2 Poverty and Food Security in Bangladesh

Forty percent of the population in Bangladesh lived below the poverty line in 2005, which decreased from 48.9% in 2000, demonstrating development is occurring rapidly (World Bank, 2011). Poverty also decreased dramatically to 31.5% in 2010 (HIES, 2010). Yet many coastal districts in particular, including Barisal, still suffer from extreme poverty. Barisal has one of the highest incidences of poverty with 39.4% of households falling under the poverty line according to the incidence of poverty (head count rate) by cost of basic needs method (BBS, 2010).

Literacy in Bangladesh was 56% in 2009, which also increased from 47% in 2001 (World Bank, 2011). Despite recent gains, Bangladesh still suffers from food insecurity. 45% of the population suffer from food insecurity (consuming <2122 kcals/person/day) and 23.9% suffer from severe food insecurity (consuming <1805 kcals/person/day) (WFP, 2014). Average calorie intake per day in 2010 was 2,318kcal, which increased only slightly from 2,254 in 1996 (BBS, 2010) and 37% of children under-five were underweight from 2005-2009 (World Bank, 2011). Research has cast light on issues about the reliability and validity of such household survey and food security data (FAO, 2003). Yet clearly Bangladesh has made many recent gains: despite having less than half India's per-capita income, Bangladesh has overtaken India on many indicators such as life expectancy and child survival (Dreze and Sen, 2013).

Between 1999-2000, it was found 45% of children under five-years suffered from malnutrition (Rayhan and Khan, 2006) with the incidence 1.44 times higher in girls than boys (Choudhury *et al.,* 2000). Between 2006-2010, some 41% of children were underweight and 43% under-fives suffered from stunting (defined as being below minus two standard deviations from median height for age) (UNICEF, 2013). South Asian parents also show strong cultural preferences for firstborn sons (Nuwer, 2014) with impacts on malnutrition. With regards to nutrition, nearly one-third of women are undernourished (Ahmed *et al.,* 2012).

Governance issues remain a challenge in overcoming poverty and food security, with recent political turmoil characterised by frequent strikes known as 'hartals' as well as conflicts

between the main parties over on-going war crimes trials. Lewis (2012) argues that the extensive NGO sector in Bangladesh, including well-known home-grown NGOs such as Grameen and BRAC, have become comparable in size and influence to some government departments, and some argue NGOs' power further weakens the ability of the state to serve its' citizens.

Rice is the staple food in Bangladesh, contributing 63% of calorific intake for urban consumers and over 71% for the rural population, while food expenditure accounts for nearly 54% of average total expenditure (60% in rural areas) (WFP, 2014). Thus food prices are linked to poverty and malnutrition, as people spend a large proportion of their income on food. Therefore, as well as climate change, people are also vulnerable to changes in food prices. Bangladesh is the top of the Nomura Food Vulnerability Index (Nomura, 2010) due to the large percentage of income spent on food, amongst other factors. Rice prices are known to be associated with the prevalence of children being underweight, which may have been exacerbated by the financial crisis (Thorne-Lyman *et al.,* 2010). Rice is important for the most vulnerable. Lower rice prices improve households' ability to purchase more non-rice foods and therefore have nutritional diversity (*ibid*). Rising rice prices put an intolerable pressure on poor urban and rural households, forcing them to lower consumption of protein-rich foodstuffs and in 2008, FAO estimated the food crisis had increased the number of 'absolute poor' by 7.5 million people and raised the prevalence of undernourishment by 45% (FAO, 2008a).The major cereal crops are rice and wheat, although the main focus is on rice production, covering 79.4% of the cultivatable land area (*ibid*). There are three main varieties of rice; the rainfed 'Aus' crop with 10% of the area, rainfed 'Aman' crop with 51% of the area, and the increasingly important 'Boro' variety with 39% of the area (*ibid*). These rice crops are grown at different times of the year, with 'aman' rice grown during the rainy season between July and November.

Agriculture grew from 1991-2005, with rice production increasing by 5.9% from 2006-7 to 2007-8, as well as increased livestock and fisheries production (WFP, 2014). The Bangladeshi economy has seen steady growth overall, with GDP annual growth averaging 4% in the 1990's (FAO, 2008a). The main increase in rice production from 2006/7 to 2007/8 has been in Boro production whereas Aman rice production fell, with wheat and Aus production remaining level (WFP, 2014). Boro rice is produced during the 'rabi' (Winter) season from November to March (*ibid*). Most areas allow three crops a year with the

exception of Sylhet, the western drought-prone areas and coastal areas. Since work for agricultural labourers is seasonal, the income and food security status of the poorest groups often varies on a seasonal basis as well, and is highly dependent on agricultural production.

Oilseeds, pulses, fruits and vegetables are all nutritionally important, but there is evidence pulse production has declined over recent years. In 2008, production of pulses reportedly declined from 523,000 to 279,000 tonnes in the eleven years to 2005-6 (*ibid*). Lentils make up 40.17% of pulses, with Khesari an additional 38.8% (WFP, 2014). The main oilseeds are rape and mustard (FAO, 2008a). Oilseed area also declined during this period, though production increased.

Child food insecurity in Bangladesh has been shown to be seasonal, as well as being affected by climate-related disasters such as flooding. Research to monitor the effect of the 1998 floods, above, found that child wasting more than doubled from the surplus season to the lean season (IFPRI, 2013). After the floods, the percentage of households that borrowed money to cope with a shock increased from just over 10% to more than 55% of households in affected districts. Reducing the harmful effects of seasonal events will be crucial to build resilience (*ibid*). Thus it is found that hunger and agricultural livelihoods are both seasonal in Bangladesh.

5.3 Climate Change Impacts on Bangladesh

This section analyses each of the projected climate impacts in turn and analyses the observed and projected changes in terms of: temperature, precipitation, ocean acidification, glacier melt, sea level rise, flooding, intense cyclones and storm surges, and salinity intrusion. These all have direct or indirect impacts upon the agricultural sector and food security, as well as for health, development, freshwater, and livelihoods.

Table 5.1, below, highlights the observed and projected climate change for a range of factors. Further details on these climate change impacts can be found in Annexes VIII-X.

Table 5.1 Impacts of climate change on Bangladesh

Impact	Observed Change and Current Observations	Projected Changes Under Climate Change
Temperature	• Average monsoon-season maximum and minimum temperatures are increasing by 0.05°C and 0.03°C/year (WB, 2012) • A SST increase of about 1°C in May and 0.5°C in November has been observed during the 14-year period from 1985-1998 (WB, 2012) • 0.3 ºC rise since 1960 ºC in June-August (0.07ºC/decade) and a 0.5ºC rise in the Sept-Nov period (0.12ºC/decade) (Karmalkar et al, 2010). Between June-Aug there has been a 32% increase in average number of hot days (ibid).	• Temperature rise expands the range of many agricultural pests and livestock diseases (Schmidhuber and Tubiello, 2007) . Increased drought is possible in the North-east (Ahmed et al, 2006) • Most GCM models show increases of 2-3°C by 2080-2099 compared to 1960-99 (WB, 2012). Projections includes a 0.9-2.6ºC rise by the 2060's and 1.3 -4.1ºC by the 2090's (Karmalkar et al, 2010) • Rising global temperatures impact on SLR, both directly through direct ocean warming causing thermal expansion, and also indirectly through melting ice sheets.
Precipitation	• Recent trends have seen increasingly variable and erratic rainfall (WB, 2012). Decadal rain anomalies have been above long-term averages since the 1960's (IPCC, 2007).	• Most GCM models show increases in monsoon rain (WB, 2012). Increases in precipitation are most evident in the wet seasons (June-Nov), when the 5-day maxima projects increases by the 2090's of 0-62mm in June-Aug and between -7-49mm in Sept-Nov (Karmalkar et al, 2010).
Ocean acidification and coral bleaching	• Average pH in the Bay of Bengal has fallen by 0.2 units from 1994-2012 (to 7.95) (Rashid et al, 2013). Average Ca composition of calcifying organisms in the Bay of Bengal was 80%, 17% lower than the standard composition of those species; the lower pH might have made molluscs vulnerable which may be why less were present (ibid). Vulnerability of molluscs may have impacts on the next trophic level (small squids) and higher trophic levels like fish and marine mammals. • Acidification trends are found in the east Indian Sunderbans (close to Bangladesh), equivalent to trends in other oceans and estuaries (Chakraborty et al., 2013). However, in the Bay of Bengal, mangroves exert a regulatory role on water pH as halophytes absorb CO_2 for photosynthesis and shift the equilibrium towards alkalinity (ibid).	• Rising SST and ocean acidification from higher CO_2 are likely to affect coastal ecosystems and marine ecosystem services like aquaculture and fisheries (IPCC, 2007) with impacts on food security. Increased atmospheric CO2 leads to decreased ocean pH which decreases availability of carbonate ions (CO-3) in the water, important for organisms like molluscs for calcification (Cooley et al, 2009). Molluscs and corals build hard shells and skeletons using carbonate ions and thus exhibit negative responses to calcification (Cooley et al, 2012). • Ocean acidification and increased SST is expected to affect survival of coral reefs due to bleaching (IPCC, 2007). Coral reefs can be found around St Martin's Island (Rajasuriya et al, 2004), a tourist hotspot, and it is likely these coral species would vanish.
Glacier melt	• The 9 Himalayan glaciers listed in IPCC (2007) are receding at 5.1-135.2 metres/year. Himalayan glaciers are the source of water for the Ganga and Brahmaputra rivers which supply freshwater for Bangladesh (as well as India, Nepal and Bhutan) and these glaciers hold the largest body of ice outside the polar caps	• The IPCC's claim the Himalayan glaciers were under threat of melting by 2035 was erroneous (Raina, 2010). Fastest degeneration of glaciers was in Jammu & Kashmir whilst the lowest was in Sikkim (Raina, 2010). The Siachen glacier, the largest glacier, has shown little change; it is thought larger glaciers take longer to respond to temperature (ibid). It's premature to say glaciers are retreating abnormally; mass balance is primarily determined by annual snow precipitation (ibid).
Sea level rise (SLR)	• Mean tide level at Hiron Point (Sunderbans region) has shown a trend of 2.5mm/year increase in May and 8.5mm/yr increase in Nov whilst in Cox Bazar there has been a positive trend of 4.3mm/yr in May and 10.9mm/yr in Nov (Khan, 2000) . During the cyclone months of May and November, there is an increase in the sea level increment. • SLR in South Asia (Pakistan and India) is reported to be about 1mm/year in long term trends (Ali, 1996). • Shum and Kuo (2011), using multiple-mission satellite radar altimetry, estimate observed SLR as 1.8-2.2mm/ year since 1900. Contributors included glacial isostatic adjustment and anthropogenic effects from dams. • Hazipur Well subsides by 2.2cm/year (past 10,000 years) while the Hatiya Trough, Faridpur Trough and Sylhet Trough subsided at higher rates (Alam, 1996). From 1959-82, there was a seaward growth (accretion) at Noakhali, perhaps due to increased soil erosion, deforestation or changes in estuary circulation (ibid) but accretion may also be caused by "channel migration" meaning accretion is offset by erosion elsewhere. Subsidence varies, from 0.65mm/year at Dhaka to 20mm/year in Sylhet trough and over 30mm/year at Hayita Trough (ibid). 1.33 billion tons/year of sediment discharge through the rivers are needed to balance the subsidence (ibid).	• SLR by 2050 would be 32cm, and by 2100 it would be 88cm (Mohal et al., 2006). 11% more land would be permanently inundated over the next century (ibid). However the model has limitations as it is a fixed model that does not include land subsidence, erosion, accretion or adaptations (ibid). • 1 metre of SLR could inundate 17.5% of the country (Salwar and Khan, 2007) although it could be partially compensated by downstream sediment flows (CEGIS, 2010) • Tol (2007) estimated 10% of dryland in Bangladesh will be lost by 2100, amounting to 5% of GDP (ibid). As with most studies, the study stops at 2100 although SLR will extend beyond this. • A range of anthropogenic and natural factors influencing coastal erosion, as well as climate change, and complexity in isolating the climate signal (see Appendix). In 1990, a Bangladesh Task Force estimated sea level change would be 90% due to SLR and just 10% due to subsidence (Ali, 1996). However Walling and Fang (2003) argue the construction of reservoirs is "probably the most important influence on land-ocean sediment fluxes".

Impact	Observed Change and Current Observations	Projected Changes Under Climate Change
Flooding	• Bangladesh experiences regular flooding, inundating an average of 20.5% of the country annually which can reach 70% in extreme cases like the 1998 floods (Mirza, 2002).	• Karim and Mimura (2008) find a 2 ºC SST rise and 0.3m SLR would increase the flood risk area by 15.3%. The high risk zone (HRZ) would require an additional 320 shelters to protect people during extreme cyclones (ibid).
	• The 1998 flood caused an estimated 2-2.8Bn USD of damage; including 2.2-3.5m tons of crop damage, costing directly 5.5% of agricultural GDP and 1.5% of total GDP (with indirect effects of about 10% and 3% respectively) (ibid).	• For the Meghna basin (Eastern Bangladesh) the probability of a 20-year flood occurring increases tenfold under 6C of warming in the HadCM2 scenario (and a 20-year flood causes about 1.51m tons of crop damage) (Mirza, 2002).
		• 18.5m people are currently exposed to more than 1m of inundation. Under the baseline scenario, with population growth this increases to 28.3 million by 2050 (53% increase) while climate change increases this to 35.3m people by 2050 (World Bank, 2010)
Extreme events; cyclones and storm surges	• In 1991, the devastating storm in Bangladesh resulted in 150,000 deaths (Ali, 1999). In 1970, the cyclone killed approximately 300,000 people (IPCC, 2007). 1.4% of the world's total cyclones hit Bangladesh (Ali, 1996), and 49% of the world's total deaths due to cyclones occur in Bangladesh (Khan et al, 2000; Ali, 1996). • About 5-6 cyclones form over Bay of Bengal and Arabian Sea each year. May, October and November are the stormiest months of the year (Khan et al, 2000). • Frequency of intense tropical cyclones has increased, with the highest positive trend in November (Khan et al, 2000). Intensity of cyclones reaching the 'severe' cyclone stage in November has increased by 20% per 100 years (ibid). Frequency of severe cyclones increased faster than weaker cyclones. • Singh et al (2001) found over 1877-1998 there has been an increase in cyclones in November and May. The highest increase was in November with a 2X increase (ibid). Naidu et al (2011) state there is an increased cyclogenesis trend in Nov and May; with an upward trend in tropical cyclone power dissipation index (PDI) values which is at least partly anthropogenic. GCMs suggest an increase in intensities of tropical cyclones, though there may also be a decrease in frequency (ibid).	• Increased SST is expected to intensify cyclone activity and heighten storm surges accompanied by strong winds (Dasgupta et al, 2010), especially since development of tropical cyclones is dependent on a warm ocean surface of over 27C (Khan et al, 2000). • Ericson et al (2006) found SLR increases the delta population exposed to storm surges from 44.9% to 47.3% and the area flooded from 47% to 49.8%; affecting 4.7 million more people. • Increased wind speeds over 10% of the 1991 severe cyclone would increase the storm surge level by 1.7 metres along the eastern coast of Bangladesh (Mohal et al, 2006) • Cyclone impacts will be worsened by potential SLR of 27cm by 2050 (World Bank, 2010) and 10% intensification of wind speed by 2050 (Dasgupta et al, 2011). By 2050 there will be a 69% increase in the vulnerable zone with 3m inundation and 14% increase in the vulnerable zone with 1m inundation (Dasgupta et al, 2010). 8.06 million people in coastal Bangladesh are vulnerable to storm surges over 1m which will increase by 110% with climate change and population growth in absence of adaptation. The model assumed 1% population growth p.a. and 6-8% GDP growth/year (ibid).
Salinity intrusion	• Soil salinity generally increases rapidly in winter months and reaches maximum values in April (Huq et al, 1999). Some salinity intrusion may have resulted from the building of the Farakka barrage in 1975 (Mirza, 1998).	• Under the severe climate change scenario, more areas would be severely affected by soil salinity and this land would become unsuitable for a number of crops (Huq et al, 1999)

Uncertainty in climate models

New et al (2012) explain that over the Indian subcontinent, a major obstacle for deriving reliable projections arises from the difficulties climate models have in simulating the summer monsoon. The monsoon in the Ingo-Gangetic plains region is subject to the influence of a variety of tropical and extra-tropical phenomena and exhibits substantial variability at sub-seasonal and interannual time scales (*ibid*). New et al (2012) explain the warm phase (El Niño) of El Niño-Southern Oscillation (ENSO) is frequently associated with a weakening of the Indian (South Asian) monsoon with an overall reduction in rainfall, while the cold phase (La Niña) is associated with the strengthening of the monsoon. Moreover, the Indian Ocean Dipole (IOD) plays an important role as a modulator of the Indian monsoon rainfall, and influences the correlation between the monsoon rainfall and ENSO (*ibid*). Studies have shown coupled atmosphere–ocean GCMs perform better in simulating the monsoon (*ibid*). Annamalai et al (2007:1082) find that out of the 18 GCM models used in the IPCC AR4, only six out of these have a reasonably realistic representation of monsoon precipitation climatology and only four (GFDL_CM_2.0, GFDL_CM_2.1, MRI, and MPI_ECHAM5) exhibit a "realistic representation of the ENSO-monsoon relationship". Similarly, Roxy et al (2013) show that only the GFDL-CM2.0 and GFDL-CM2.1 models simulate both ENSO and ENSO Modoki patterns as important modes in summer months, and only one model, GFDL-CM2.0, captures both the Modoki and ENSO modes realistically for both summer and winter during the last 30 years of the 20C3M.

However, different models seem to be more accurate when it comes to temperature and precipitation. Analysing data on the mean absolute error of these models, which is a measure of agreement between GCM models and observed values, New et al (2012) found that the GFDL-CM2.0 and MIROC3_2_MEDRES models had less error when it came to precipitation, but that the CSIRO_MK3_5 and MPI_ECHAM5 models had less error for temperature. Thus it is hard to identify which model or models are better than others (*ibid*). New et al (2012) shows that all models project a later onset of the monsoon by several days in the 2050s and 2090s.

5.3.1. Historical climate change and weather trends

Bangladesh has four prominent seasons; winter (December to February), pre-monsoon (March to May), monsoon (June to early October) and post-monsoon (late-October to November (Agrawala *et al.,* 2003). Winter is generally cooler and drier. Moreover the

southern districts are 5ºC warmer (Agrawala *et al.,* 2003). The monsoon brings heavy torrential rainfall and more than 80% of annual precipitation falls during this period (*ibid*). Cyclones and associated storm surges can occur in the pre-monsoon or post-monsoon periods. The devastating cyclones originate in the Bay of Bengal from April to May as well as September to November (Karmalkar *et al.,* 2010).

5.3.2. Sea Level Rise (SLR)

Quantitative data on sea level rise in Bangladesh can be difficult to find, and observations and projections vary (see table above). Overall subsidence and coastal erosion can be caused by a variety of factors including natural subsidence due to compaction, tectonic subsidence, construction of dams and reservoirs, and deforestation of the coastal mangrove forests (see Annex VIII). By contrast, some of the factors leading to accretion (seaward growth) include soil erosion due to crop farming, and upstream deforestation. This demonstrates it is difficult to attribute the changes to climate change or isolate the climate change signal. The literature review also suggests that monitoring the construction of dams and protecting mangrove forest would offer some protection against SLR in the face of climate change (*ibid*).

5.3.3. Flooding and Flood Risk Management in Bangladesh

The impacts of SLR, along with an expected increase in the height of storm surges due to increased sea surface temperature, are both expected to increase the flood risk area in Bangladesh (see Annex IX). Karim and Mimura (2008) estimate that an additional 320 shelters would be needed to protect people during extreme cyclones. The Bangladesh Water Development Board is historically responsible for maintenance of water management structures like embankments, though there is evidence these have not been well maintained (see Annex IX). It is also clear the number of people exposed to flooding in Bangladesh is highly dependent on population growth rates. Refer to Annex IX for further details on flooding and flood risk management in Bangladesh.

5.3.4. Extreme Events: Cyclones and Storm Surges

Bangladesh is already vulnerable to both storm surges and seasonal river floods, both of which are projected to become more severe under projected climate scenarios (see table above, and Annex X). SLR combines with storm surges to make people more vulnerable to inundation during cyclones, while wind speeds and the frequency of intense cyclones are also expected to increase (see Annex X). However, it is argued there has not been an increase in

frequency of all cyclones, though there has been an increase in the frequency of the highest storm surges (see Meehl *et al.,* 2007). Refer to Annex X for more detail on this issue.

5.3.5. Salinity Intrusion

Another impact of SLR in Bangladesh is the impact on salinity intrusion. Increased flooding and seawater intrusion due to SLR will increase the impact of saline and brackish water intrusion on food and rice production. It has already been noted that the subsidence of the delta cause drainage and sedimentation problems, along with soil and ground water salinity which has economic and ecological impacts (Alam, 1996). One of the major impacts of enhanced soil salinity is upon food grain production (Huq *et al.,* 1999). Salt accumulates in the crop root zone, which interferes with crop growth when the concentration exceeds the tolerance limits. Soil salinity generally increases rapidly in the winter months in Bangladesh and reaches maximum values in April (Huq *et al.,* 1999). Under a severe climate change scenario, more areas would be severely affected by soil salinity and this land would become unsuitable for various crops (*ibid*).Although irrigation, high-yield varieties and water management can enhance crop productivity, the coastal zone has largely not benefitted from this due to the lack of quality irrigation water (Mondal *et al.,* 2001). Some of the salinity intrusion may also have resulted from the building of the Farakka barrage in 1975 (Mirza, 1998).

5.3.6. Socio-economic Impacts of Climate Change

The projected impacts of climate change, including those covered above, are likely to have impacts on poverty and development, health (including cholera, diarrhoea and malnutrition), livelihoods, and migration and human security, amongst other issues (IPCC, 2014). Due to space limitations, these socio-economic impacts of climate change are not explored in detail here, but the potential impacts of climate change on migration and health are discussed in Annex XI.

5.4 Agriculture and Food Security in Bangladesh under Climate Change

5.4.1. Impacts of Climate Change on Food Security

As we have seen, climate change is projected to have various different impacts on Bangladesh including increased sea surface temperatures, increased temperatures, ocean acidification, precipitation changes, glacier melt, sea level rise, flooding, extreme weather events (cyclones and storm surges) and salinity intrusion. All of these impacts will affect agriculture and food security in various ways.

With regards to the direct impacts of climate change on food security, climate change is expected to have a direct impact on crop production. Faisal and Parveen (2004) found that by 2050, rice and wheat production in Bangladesh could fall by 8% and 32% respectively, based on 4°C of warming against the 1990 baseline. As well as modelling CO2 and temperature effects, their model included moisture stress (60%), inundation, and salinity impacts. In 2030, the impacts of climate change would be compensated by the CO2 fertilisation effect. The study also stated although wheat requires less water, it is not recommended to switch to wheat as it is more temperature-sensitive. However the authors concluded food security in Bangladesh is more seriously challenged by population growth, land and water scarcity than by climate change (*ibid*).

Basak et al (2010) projected the effects of climate change to be considerably higher with a yield reduction for both the BR3 and BR14 boro varieties of over 20% and 50% by 2050 and 2070, respectively. This was due primarily to the negative effect of the increases in daily maximum and minimum temperatures which did not compensate for incoming solar radiation and CO2. These rice varieties are not widely used at the time but were modelled because the genetic coefficients were available in the DSSAT system (Decision support system for agrotechnology transfer). Lobell et al (2008) used a crop modelling approach to estimate climate change impacts in South Asia, finding that rice and maize production would both decrease slightly by 2030. They noted that impact projections for some crops are more uncertain than for others. This model does not include the fertilisation effect of CO2 upon C3 crops like rice. However, rice requires more water than wheat, and this model does not include the impact of other factors like salinity and SLR. As described in Chapter 3, C3 crops like wheat and rice experience a CO2 fertilisation effect under experimental conditions, but C4 crops like maize do not (Schmidhuber and Tubiello, 2007).

Different crops are differently affected by climatic stimuli, making projected yields complex to model. New et al (2012) points out that wheat and potato grow at the optimum temperature of 20-25ºC and 18-20ºC respectively, while rice has a fairly high optimum at 30ºC (day) and 20ºC (night). This suggests rice is not as vulnerable to temperature increase as other crops. New et al (2012) explain that for irrigated agriculture, maize, rice and wheat are not affected in terms of areas that are suitable for growth except under the warmest scenarios of the 2090s.

Higher temperatures can also have an impact on soil fertility and erosion, since warmer conditions speed up the deposition of organic matter and increase the rate of processes that effect soil fertility. Hence, additional application of fertiliser may be needed to counteract these processes (Rosenzweig and Hillel, 1995) to take advantage of any CO2 fertilisation effect. Additional chemical usage can in turn affect water quality and pollution. Agricultural production and food security are affected by other factors described above, including sea level rise, salinity and extreme events. For example, rice production is vulnerable to severe flooding and cyclones. The flooding after Cyclone Sidr damaged 12% of the rice production in Sidr-affected districts (FAO, 2008a).

Most GCM projections estimate a potential decline in Boro production with a median loss of 3% by the 2030s and 5% by the 2050s (Yu *et al.,* 2010). By contrast, wheat production is projected to increase by 3% out to the 2050s (*ibid*). The Khulna region is particularly affected due to rising sea levels, with a -18% loss projected for Boro by the 2050s and a -10% loss for Aus, Aman and wheat (*ibid*). However economic responses such as price effects are not included in the model and could to some extent buffer these effects.

As well as the direct impacts, climate change is expected to have a range of indirect impacts on food security. As identified in Chapter 3, climate change has impacts on all four dimensions of food security (availability, stability, utilization and access) although only the first aspect has been explored in simulation studies (Schmidhuber and Tubiello, 2007; Ziervogel and Ericksen, 2010). The direct and indirect impacts of climate change on the four dimensions of food security in Bangladesh are summarised in the table below. The table demonstrates there are various different pathways through which climate change can affect food security.

Table 5.2 Impacts of climate change on the four dimensions of food security in Bangladesh

Dimension/Pillar of Food Security	Impacts of climate change in Bangladesh
Availability: Food supply through production, distribution and exchange	• Temperature rise, salinity and flooding are expected to cause a decrease in crop yields, which is only partially offset by a CO2 fertilisation effect for some crops (Faisal and Parveen, 2004; Basak et al, 2010a) • Increased flooding would decrease the growing area and damage crop production • Increased frequency or intensity of extreme weather events such as cyclones would impact on crop yields and land suitability • Sea level rise would lead to inundation which reduces the area available to grow crops. 1 metre of SLR could inundate 17.5% of the country (Salwar and Khan, 2007) although this may be partially compensated by the downstream sediment flows • Salinity intrusion has an impact on crop production in various coastal areas of Bangladesh (Huq et al, 1999) • Increase in drought is possible in the North-eastern region of Bangladesh which impacts on water availability for agricultural crops (Ahmed et al, 2006) • Temperature rise expands the range of many agricultural pests and livestock diseases (Schmidhuber and Tubiello, 2007) • Ocean acidification could have an impact on molluscs and shells which may impact on other marine organisms important for food security
Access: Affordability and allocation of food, including economic and physical access	• Loss of livelihood due to extreme weather events (cyclone or flooding) or environmental change can lead to loss of purchasing power (Schmidhuber and Tubiello, 2007). Loss of income due to extreme events, or loss of agricultural income, leads individuals to switch to less nutritious foods (ibid) • Increased price of food means individuals switch to foods with lower nutritional value or lower dietary diversity (Thorne-Lyman et al, 2010) • Disease pressure can cause a loss in labor productivity which can increase poverty and reduce the ability to buy food (Schmidhuber and Tubiello, 2007)
Utilisation: Metabolism of food by individuals, Food safety	• Increased temperature alters the conditions for food safety, including increasing the range of some diseases and microbes that affect food products (Schmidhuber and Tubiello, 2007) • Daily temperatures increase the risk of food poisoning such as salmonella (IPCC, 2007) • Rainfall variability and temperature rise increase incidence of diarrheal diseases in Bangladesh (Hashizume et al, 2007). Disease pressure from vector, food and water-borne disease, such as diarrheal diseases impact on the ability of individuals to take in adequate nutrition. • Climate change may effect nutritional quality of foods (DaMatta et al 2010) • Flooding particularly affects sanitation and hygiene in areas where infrastructure is lacking (Schmidhuber and Tubiello, 2007) • Vicious cycles are possible where infectious disease causes hunger which in turn makes populations more susceptible to disease (Schmidhuber and Tubiello, 2007)
Stability: Price stability, vulnerability and shocks	• Extreme weather events (cyclones, floods, droughts) may become more common leading to stability of food supplies • Extreme weather events may disrupt food supply chains, including transportation to markets and communication infrastructure • Price shocks may be transmitted from other regions of the world particularly if trade restrictions are put into place

Many factors influence and impact on social vulnerability, and climate change is just one of these factors (Wright *et al.,* 2012). The underlying context of social vulnerability includes market fluctuations, unstable policy and poor infrastructure (Ribot, 2010). Therefore, adaptation to climate change has to be understood in its context and cannot be viewed independently. Under the sustainable livelihoods approach (see Annex V), the focus is on the holistic context.

5.4.2. Adaptation Options in the Agricultural Sector

Yu et al (2010) identifies a series of options for adaptation of agriculture in Bangladesh. For example, irrigation has played a major role in helping farmers adapt to soil moisture deficits in drought-prone areas. This has resulted in the diversification of agriculture and increased cropping intensity. Embankments have also played a role in reducing flood risk (*ibid*). Agricultural research has been important in Bangladesh and the agricultural research institutes that exist include the Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Bangladesh Institute of Nuclear Agriculture and the Bangladesh Agriculture University. However it is vital these adaptive practices reach the communities they are intended to help.

The Department of Agriculture Extension (DAE), one of the largest government departments, plays a vital role in dissemination of new technologies through demonstration plots (Yu *et al.,* 2010). Furthermore, the Agricultural Information Service prepares materials on specific technologies. Adopting a new technology or technique brings significant risks for communities and thus there needs to be further research and communication to help communities choose the right options. Annex XII (from Yu *et al.,* 2010) shows a number of adaptation options in agriculture. These have been tested and demonstrated as options with potential for replicability and scalability. However, it will also be vital to test the effectiveness and suitability of each of these options in a particular area or context.

As noted in Chapter 3, adaptation in the agricultural sector often focuses upon agricultural productivity and increasing the income of smallholder farmers. This tends to address the 'availability' aspect of food security, but other means to tackle 'access,' stability' and 'utilisation' may also be useful. For instance, increasing market access, improving livelihoods, and tackling food access and availability may also be effective, including improving infrastructure. FAO (2006) presents the results of a recent project in drought-

prone areas in Bangladesh, and presents a whole suite of options for livelihood adaptation, drawn from discussions with farmers and experts. These fell under the categories of agronomic management, water harvesting, water resource exploitation, water use efficiency, crop intensification, alternate enterprises, alternate energy, and post-harvest operations (*ibid*). These practices were evaluated and ranked according to various prioritisation criteria relating to drought mitigation potential, suitability and sustainability under future climate conditions, relevancy to vulnerable communities, employment opportunities, gender integration and social acceptability; before identifying the resources required, potential maladaptation risks and non-climatic benefits (*ibid*).

A range of high-tech adaptation options exist such as a seed varieties (also known as 'hard technologies') but there are also a range of low-tech adaptation options including moisture conservation through mulching by straw and rice husks, traditional practices such as pond excavation, and retention of rainwater in ponds or pits to supplement irrigation (Mazumder, 2010). Thus adaptation options can be categorised as 'hard' as well as 'soft' technologies (Glatzel *et al.,* 2012).

Overall, while there are initiatives to tackle to direct impact of climate changes upon crop productivity, there may also be a crucial need to tackle the indirect impacts of climate change on food security including flooding and cyclones. In this section we analyse some options for tackling the direct and indirect effects of climate change on food security in Bangladesh. For a more comprehensive overview of adaptation in agriculture, refer to Clements et al (2011). The intention here is not to give a comprehensive overview of all adaptation options but to provide insight into some illustrative examples.

5.4.2.1. Improved Seed Varieties

Improved climate-tolerant seed varieties include early maturity, short-duration, salt-tolerant and drought-tolerant seed varieties (Mazumder, 2010). The DAE has played a role in promoting paddy varieties that are short-durational such as BR25, BRRI Dhan33 and BRRI Dhan39 in order to avoid the effects of drought, although there are no drought-resistant varieties (Yu *et al.,* 2010). BRRI has also developed some flood-tolerant varieties of paddy rice; BR11, 20, 21, 22, 23 and 24, and BRRI Dhan31, 32, 33, and 34 (*ibid*). The Boro crop plays an important role in offsetting flood losses. Once improved seeds are developed, initiatives are needed to disseminate seeds to farmers. Widespread lack of awareness of new varieties has been found to be a major barrier (Page et al 2009). In the case of improved

wheat varieties (developed by BARI), bottom-up seed production and dissemination systems can be highly effective in transferring this technology and developing an enabling environment for seed dissemination (*ibid*). Further details of climate-tolerant rice varieties are found in Huq and Rabbani (2011).

5.4.2.2. Increased Rice Production

Specific focus on Boro rice has been noted in the literature due to the importance of this rice variety. Deb et al (2009:p.9) note that structural changes in rice production in Bangladesh and more dependence on Boro has "made rice production a function of input supply, policies and prices rather than vagaries of nature". This is also because Boro rice is not rainfed but irrigated. It is produced in the dry season, meaning irrigation is a necessary precondition (*ibid*). It also depends upon other inputs like seed, fertiliser, pesticide, and agricultural credit. Future challenges include water scarcity from falling water tables, low soil fertility and high costs of agricultural inputs. Irrigation (below) is one area in which we can clearly see the interlinkages between food, energy and water scarcity, also known as the 'food-energy-water' nexus (Bazilian *et al.,* 2011).

Coelli et al (2002) finds larger farms are more allocatively and cost-efficient than smaller farms in the labour-intensive 'Aman' season, but were disadvantaged in the less labour-intensive season. Therefore, in the Boro season, smaller farms are more efficient. Infrastructure affects access to inputs, and thus the efficiency of production. The data points to over-use of labour, reflecting the disguised unemployment problem, and also the over-use of fertiliser which means guidelines may need to be revised (*ibid*). Factors such as age, education, experience, soil fertility and extension and training were found not to have a large influence on efficiency (*ibid*). It is recommended that better use can be made of agricultural survey data to increase production.

5.4.2.3. Irrigation and Water Management

Irrigation has been proposed as an adaptation option for Bangladesh in the literature, including in the FAO study on long-term climate change in drought-prone regions (Ahmed *et al.,* 2006). However, Deb et al (2009) report that more than 70% of total irrigation in Bangladesh is dependent on diesel-driven engines. Diesel prices have risen in recent years putting pressure on farmers. The new government reduced the price of diesel by Tk. 2/litre in response to oil price rises (*ibid*). This subsidy is costly to government and may have to increase as fuel prices increase. The adoption of 'alternate wetting and drying' (AWD)

irrigation technology for Boro rice cultivation could save 25% of water for irrigation as well as save energy without reducing yields (Deb *et al.,* 2009). The 'system of rice intensification' could also be promoted to reduce costs and increase yield (*ibid*).

29% of the total irrigated area in Bangladesh is irrigated by electricity, which is cheaper than diesel irrigation. Deb et al (2009) find that the production cost of High-Yielding Variety (HYV) Boro paddy is Tk.12.16/ kg for diesel production and Tk.10.85/kg for electricity-operated production, largely because diesel irrigation costs Tk.5000 per acre compared to Tk.2000 per acre for electricity-driven irrigation (Deb *et al.,* 2009). Therefore it could be argued that policies to promote a switch to electricity-driven irrigation would enhance resilience for farmers, helping them adapt to climate change and rising energy costs, as well as increasing income. The Government in Bangladesh subsidised electricity for irrigation by Tk.75 crore in 2007-8 (Deb *et al.,* 2009). In order to provide enough electricity for irrigation, the government enforced closing shops and malls by 8pm (*ibid*). However, these policies may have other detrimental effects and other measures to improve irrigation methods may have been more appropriate. In two regions (Jhalakathi and Patuakhali) there are reportedly no electricity-operated engines.

IFPRI argues irrigation has made a massive contribution to increasing food security in Bangladesh over past decades (Hossain, 2009). This is because increased rice production is primarily due to the increase in Boro production over these years. The areas under modern irrigation are primarily in the North-West (Deb et al 2009) which is also the 'bread basket' of Bangladesh due to its rice production. Altogether, this has been primarily due to the STW (Shallow Tube Well) development. STW's became available in the 1980's due to the liberalisation of agricultural inputs, as importation of cheap irrigation equipment from other countries became possible (*ibid*). The reform was completed in 1988-89 with the removal of a ban on the importation of small engines and elimination of import duties and other restrictions. Nearly 70% of farmers in Bangladesh use STWs; on equivalent to two-thirds of the total irrigated area (Hossain, 2009). Rahman and Parvin (2009) put this figure at 62%.

Boro rice production is highly correlated with the irrigated areas. A water market emerged after privatisation wherein marginal farmers could access irrigation, as tubewell owners (usually larger landholders) sold their water to the adjoining plots. Privatisation also reduced the price of the tubewells and increased access to fertilisers (Hossain, 2009). Irrigation has thus been a key factor in increasing agricultural GDP and alleviating rural poverty (Rahman

and Parvin, 2009). However, environmental concerns have emerged, including issues such as long-term soil fertility pressures, heavy pesticides use impacting on fish habitats, and possible overexploitation of groundwater (Hossain, 2009). Harvesting rainwater and efficiency improvements are thus required. Another related concern is the contamination of groundwater with arsenic (*ibid*).

Thus despite the gains from irrigation for rice yields and water availability for agriculture, there are potential negative effects, including over-abstraction of groundwater resources which a contributor to sea level rise (Pokhrel *et al.,* 2012). Irrigation might be seen as a 'double-edged sword' which may increase climate change vulnerability whilst appearing to reduce it. Ahamed et al (2006) argues energy is extremely important for food security in Bangladesh, due to the need for energy for irrigation. The interaction between energy and food security exemplifies the interactions between adaptation and mitigation of climate change. There has also been found to be a gap between demand and supply for energy in many places, leading to energy shortages (*ibid*).

Despite the benefits, increased rice profits for farmers do not always lead to improvements for the poor. Hussain (2004:12) argues the distributional aspect of irrigation projects has been insufficiently considered, and the number of landless people has increased, with marginal, small and landless farmers enjoying the "trickle-down effect only". The real wage of agricultural labour has also stagnated (*ibid*) and although irrigation increases agricultural production, this may not necessarily translate into reductions in rural poverty due to other factors such as the "land distribution pattern, land tenurial arrangement" and "demand for agricultural products" (Hussain, 2004:3). Although rice prices were strongly co-integrated with agricultural wages until the 1970's, it is no longer a significant determinant of agricultural wages in Bangladesh (Rashid, 2002). Therefore productivity gains may not always 'trickle' down to the poorest and most vulnerable labourers (*ibid*). Analysis of survey data from CCAFS confirms this because agricultural wage labourers, who are often landless, still suffer from food insecurity (see Chapter 9). There may be other measures needed, therefore, to target the most vulnerable members of society. In fact, whilst we cannot extrapolate from other countries, lessons might be drawn from the work of Thomas Piketty on income inequality, because income inequality might well be growing (Ibrahim, 2014).

5.4.2.4. Agricultural Research and Extension Services

Extension services have been found to be vital for dissemination of agricultural inputs, seeds and information. Coelli et al (2003) argue that 'Green Revolution' technology adoption and research expenditure had an impact on increased technical progress in Bangladesh from 1960-1992. However extension expenditure was actually found to retard technical progress and reduce total factor productivity (TFP) growth, as it competed with research for a fixed budget (*ibid*). TFP was found to be declining, particularly as modern rice varieties spread to less suitable land in regions which were "historically suitable for traditional varieties" but "these have been gradually displaced by modern varieties" (*ibid*:328) combined with the effect of soil exhaustion from nutrient depletion. This indicates that high-yield varieties may be counterproductive when applied in unsuitable locations. Interestingly, education arguably had a negative effect on crop output since "higher education provides more opportunities for moving away from agriculture" and because the educational system is not oriented to agriculture (*ibid*:331). BRRI is now paying more attention to climate-resilient varieties for saline locations (Huq and Rabbani, 2011)

5.4.2.5. Enhancing Awareness of Adaptation

Whichever adaptation options are promoted by policy-makers, these have to be accompanied by a programme of communication to increase awareness for adoption. BBC Media Action conducted interviews with 3,578 households in Bangladesh and found there was high awareness of climate change and changes to livelihoods. Some 77% of people felt that climate change was happening and 36% of people interviewed had made changes to their livelihoods, the highest proportion of all countries in the study (Al Mamun *et al.,* 2013). In terms of barriers and enablers for action, 86% felt lack of government support was a barrier to responding, and 77% said they did not have enough resources to respond, while 57% and 56% cited lack of information and knowledge respectively (*ibid*).

The study sub-divided respondents into five different categories; those who were surviving, struggling, adapting, willing and unaffected (Al Mamun *et al.,* 2013). 43% of farmers and fishermen were found to be 'struggling' (wanting to take action, but finding it very difficult) as opposed to 31% of the population overall (*ibid*). Amongst farmers and fishermen, 91% used television to receive climate-related information, and 85% used mobile phones, while 82% regarded agricultural extension workers as a highly trusted source of information (*ibid*). People from Barisal division were found to be disproportionately struggling; 57% were classified as 'struggling' compared to 31% of the population overall (*ibid*), but media

penetration was comparatively low in this division. Examples of communication channels through which people were receiving climate-related information include the agricultural programme 'Hridoye Mati O Manush' (People of the Land) on Channel i, with discussions about climatic impacts on crops and agriculture, and 'Green Hour' on Radio Today, covering environmental issues (*ibid*). BBC are now using the study to develop targeted TV and radio programmes to increase resilience - an example of how communication tools can be used to promote adaptation options.

5.4.2.6. Polder Construction

As noted previously, construction of embankments (polders) have been proposed as a structural adaptation to control flooding in the coastal zone. According to Chowdhury et al (2010) polder construction has a positive impact on agriculture, because higher rice yields can be achieved as there is a lower risk of salt water intrusion during monsoon-season 'aman' rice production. Overall the 'aman' rice yield was more than double inside the polder compared to the control area, and the mean family income was also double in the area protected by the polder (*ibid*). However, net returns from shrimp cultivation were slightly lower in the polder-protected area, and the wage rate for landless households (who derive their livelihood from labouring) was slightly lower in the polder-protected area (*ibid*). This may have been due to an excess of labour because more households were landless in the polder area. Using a conservative assumption that the main benefit of the polder was on 'aman' rice production, Chowdhury et al (2010) calculate the benefit-cost ratio of the polder is 3.75 and the internal rate of return was estimated at 38% at prevailing market prices. However it was noted the benefit mainly accrued to the land-owning households than the landless, leading to potential increases in inequality (*ibid*).

5.4.2.7. Cyclone Preparedness

As noted in previous sections, climate-related disasters like cyclones pose a threat to food security both directly (damaging crops and agricultural livelihood assets) as well as indirectly (damaging health and infrastructure). Thus, policies to prevent death or injury from cyclones can play a role in preventing the worst impacts. IPCC (2014) highlights that Bangladesh has a world-renowned cyclone preparedness programme (CPP) and early warning system that has reduced mortality from cyclones when compared to neighbouring Myanmar. Refer to Annex XIII for the case study of the CPP.

5.5 Climate Finance and Policy Responses in Bangladesh

5.5.1. Costs of Climate Change

The direct annual cost to the national economy in Bangladesh of natural disasters averaged over 10 years (damage and loss in production) is already estimated at between 0.5% and 1% of GDP (UNDP, 2009; World Bank, 2010a). With Bangladesh's GDP amounting to $100Bn in 2010 (World Bank, 2011) such costs already amount to $500m-$1Bn per year and are expected to increase dramatically due to climate change, with increased cyclones, flooding and drought. This statistic does not include the significant loss of life that occurred. World Bank modelling found climate change is expected to increase damages and losses from an average 10-year return period cyclone in 2050 by $4,560m, nearly doubling the loss and damages compared to the no-climate change scenario (see Dasgupta *et al.,* 2010). This does not include the costs of other changes such as inland flooding, salinity intrusion and loss of crop productivity. Impacts like flooding, erosion, cyclone, sea level rise and salinity intrusion are all expected to have a severe impact on poverty and economic growth (UNDP, 2009). Specific events are very costly, for example the 1998 monsoon flood resulted in damage and loss of over $2bn (4.8% of GDP) whilst Cyclone Sidr in 2007 caused loss and damage of $1.7Bn (2.6% of GDP) (World Bank, 2010a).

Karim (2011) used the Annual Development Programme (ADP) to estimate the costs of adaptation in agriculture by considering the costs of adaptation measures in the sector. Agricultural adaptation investment includes $13m through the Pilot Programme for Climate Resilience (PPCR). Adaptation costing is estimated at $69.67Bn for major investment in agriculture, with the majority for infrastructure development (30% of total) followed by market development, (17%), irrigation and water management (15%) (*ibid*).

The EACC study by the World Bank (2010a:p.37) costed the additional damages and losses due to climate change in 2050 as follows:

TABLE 3.12 ADDITIONAL DAMAGES AND LOSSES DUE TO CLIMATE CHANGE IN 2050

Economic Sector	Damages (Million USD)	Losses (Million USD)	Damages and Losses (Million USD)	Share of Damages & Losses (%)
Housing	1,947	—	1,947	43
Industry/ Commerce/Tourism	88	1,084	1,172	26
Agriculture	75	835	910	20
Transport	240	53	293	6
Power	60	150	210	5
Coastal Protection	17	0	17	0
Education Infrastructure	9	1	10	0
Others	n/a	n/a	n/a	n/a
Total	2,437	2,123	4,560	100

Figure 5.1 Additional loss and damage due to climate change in Bangladesh in 2050.

Amongst the direct impacts of climate change on agriculture, Boro rice production falls by 8% by the 2080's, however this assumes farmers have limitless access to irrigation (World Bank, 2010a). Boro production shows the largest losses (Yu *et al.,* 2010) due to temperature, rainfall and flooding impacts. Modelling also found production in Patuakhali and Khulna is particularly vulnerable. Agricultural climate impacts was found to cost Bangladesh $129Bn over a 45-year period (2005-2050), or $2.9Bn losses each year (an average annual reduction of 1.6% GDP) (World Bank, 2010a). This could rise to $5.1Bn/year in a pessimistic high-emission scenario (*ibid*). The study argued agricultural adaptation ought to focus on the North-West and Southern coastal regions.

5.5.2. Climate Finance in Bangladesh

Climate finance can be seen as coming through various channels, including non-Annex I domestic budgets, Annex-I countries domestic budgets, and the private sector (Persson, 2011). Refer to Chapter 7 for a detailed overview on climate finance.

Persson (2011:9) argues since there is no agreed methodology or metric for determining vulnerability to climate changes, there is a "risk of highly skewed per capita funding both between and within countries". If we were only to consider the principal of 'national sovereignty' and consider adaptation finance as 'pure restitution' (*ibid*) there would be no need to consider the beneficiaries, effectiveness or efficiency of climate change finance. In reality, however, it is crucial climate finance reaches the intended recipients who are most vulnerable in order to build trust for provision of further finance support. Thus, distributional and equity concerns are legitimate concerns.

Since the first NAPA in Bangladesh in 2005 there have been many policy and institutional changes undertaken by the government. There has been an expansion of climate finance in recent years by the GoB, and donors including the EU and UK. The first NAPA identified 15 priority actions including capacity building, awareness raising and projects with a special focus on agriculture and water (UNFCCC, 2005). The first priority issue was afforestation in coastal areas under a $23m project entitled 'Reduction of climate change hazards through Coastal afforestation with community participation' (*ibid*). The updated NAPA in 2009 identified a further 45 adaptation measures with 18 immediate and medium-term measures. In 2008, the Bangladesh Climate Change Strategy and Action Plan was launched (BCCSAP) and was updated in 2009. However this is not a fully "costed and sequenced delivery framework" (Hedger, 2011:7). The BCCSAP is intended to be integrated into the National Strategy for Accelerated Poverty Reduction but the OECD (Organisation for Economic Cooperation and Development) reports it has yet to be fully integrated due to capacity constraints (OECD, 2010a). In 2009 the GoB announced its own $300m Trust Fund funded by the national budget to implement the plan. $300m would be distributed over a 3-year period with $100m designated in 2010, 2011 and 2012. Moreover, in 2010 the Bangladesh Climate Change Resilience Fund (BCCRF) was created as a Multi-Donor Trust Fund towards which bilateral donors contributed $188m. Therefore there are two national funds in Bangladesh which are both intended to contribute to the BCCSAP.

The funds currently available do not meet the needs of the assessment made of the $2.7Bn at risk from climate change in the Annual Development Plan, which has an overall budget of $4.7Bn (Hedger, 2011). The OECD estimated crudely in 2003 that as much of 50% of development assistance goes to areas potentially affected by climate change.
Under the BCCSAP, there are six key pillars outlined below:-

1. Food security, social protection and health
2. Comprehensive disaster management
3. Infrastructure
4. Research and knowledge management
5. Mitigation and low carbon development
6. Capacity building and institutional strengthening

Climate change has therefore become a key strategic and political issue for the GoB. The Action Plan recognizes the risks climate change poses for national development, as well as the importance of climate-resilient development to reduce vulnerability. The BCCSAP also states that cost-effective priority programmes will begin implementation in the next 5 years,

with “special attention on the needs of the poorest and most vulnerable” (BCCSAP, 2008:29). Since funding to tackle climate change is currently limited compared to projected impacts, it is important to ensure this funding reaches the most vulnerable communities.

There have been various different channels of climate finance to Bangladesh. Under Fast Start Finance (FSF), Bangladesh received funds from GTZ (Germany development agency) as part of the €2.7m allocated to ‘Fast Start Finance of Adaptation to Climate change in Asia’. Moreover, Bangladesh has received €9.7m from Sweden in FSF. According to Nakhooda et al (2013), Bangladesh has been the top recipient of ‘fast start finance’ for adaptation globally, amounting to $266m.

Table 5.3 Current funding streams for climate finance to Bangladesh

Funding Channel for Climate Finance	Details
Bangladesh Climate Change Trust Fund (BCCTF)	$100m funded by GoB (Hedger, 2011) $100m p.a. with 66% for projects in BCCSAP and 34% for emergency relief (TI, 2011) Climate Change Unit (CCU) under the Ministry of Environment and Forests (MoEF) oversee and monitor (ibid) 43 government projects and 32 NGO projects approved (UNFCCC, 2011)
Bangladesh Climate Change Resilience Fund (BCCRF)	A Multi-Donor Trust Fund to support implementation of Bangladesh Climate Change Strategy and Action Plan (BCCSAP) $110m with $87m from DFID (UK), and also Denmark, Sweden and EU (Hedger, 2011) Development partners pledged $113.5m and technical assistance will be provided by World Bank (UNFCCC, 2011) $87m of 125m committed by Mar 2012. 90% will go through BCCRF Trust and 10% through PKSF (TI, 2011) The World Bank serves as Trustee for the interim period (2010-2014)
Bangladesh Strategic Programme for Climate Resilience (BSPCR) under the World Bank's Pilot Programme for Climate Resilience (PPCR), one of the Climate Investment Funds (CIF)	$110m branded by UK as 'fast start' (Hedger, 2011) CIF documentation shows $50m in grant funding and $60m in loans (CIF, 2010). Further $515m co-financing available from MDB (loans) made up of 300m in credit from IDA (International Development Association) for coastal embankments and 215m in loans from the ADF (Asian Development Fund) of the ADB for water resources Total $575m loan element and $50m grant (8.7% grant)
Comprehensive Disaster Management Programme (CDMP)	Supported by UNDP. $70m with some activities on climate change (Hedger, 2011)

The proliferation of funding mechanisms does run counter to the principles of harmonisation and alignment in the Paris Declaration. Monitoring is a challenge because there are weak records and no coherence on modalities for data collection (Hedger, 2011). There is a clear need for more coordination between channels of finance and between partners. Therefore, experts have urged for the creation of a 'clearing house' for climate finance in Bangladesh. It is also very challenging to differentiate climate and development spending to determine what is "new and additional" (Hedger, 2011:9). For the requirements of MRV (Monitoring, Reporting and Verification) it will be necessary to distinguish what is development aid (that may be mainstreamed to take account of climate change) and what is climate finance. Donors have mentioned the need to develop institutional capacity for fiduciary management

before climate finance is channelled directly through the government (Interviews; Hedger, 2011).

The Two Climate Funds

Table 5.4 The main characteristics of the two funds:

	Bangladesh Climate Change Trust Fund (BCCTF) – The Government Fund	Bangladesh Climate Change Resilience Fund (BCCRF) – The Donor Fund
Funding Available	$300m over three years, with $100m between 2011-12;	$125m up to 2015 As of Dec 2014, $188m USD pledged
Source	From national budget	From bilateral donors
Management and Ownership	Climate Change Unit (CCU) within the Ministry for Environment and Forestry (MoEF)	World Bank is the 'interim trustee and takes a 1% fee + up to 8% in technical assistance.
Criteria for Funding Allocation	Not yet publicly available	Based on 7 selection criteria: -Implementation by line agencies -Projects greater than $15m -Eligible Activities meet CCSAP objectives -Basis of approval; approved project grant request, World Bank project appraisal, and signed grant agreement between GOB and WB -Readiness for implementation in the next 3 years -Results Monitoring based on agreed results indicators -Priority given to proposals using 'existing project units of development-type operations to administer the grant' (BCCRF, 2012; BCCRF, 2012a)
Status of Implementation	Projects approved: 30% allocated to mitigation projects and a further 30% to infrastructure projects. As of Dec 2014, 2900 crore Taka (29Bn Tk) has been allocated (around $372m), for 282 projects (63 implemented by NGOs and 219 by government). Of the 219 government projects, 31 were completed.	1 project is underway to build cyclone shelters – See Box Below 13 approved projects, around 145.9m USD allocated (as of Dec 2014)
Coordination and Harmonisation	A single body at the Ministry of Environment is designed to coordinate.	World Bank is the interim trustee responsible for fiduciary management and disbursement. MoEF is the nodal agency, and members of the governing board are the same as for BCCTF to enable harmonisation (BCCRF, 2012)
Monitoring of Results	Results framework is not available	Results framework is not available

In the Climate Public Expenditure and Institutional Review (CPEIR) the need for coordination emerged prominently as did the lack of intra-government coordination mechanisms (CPEIR, 2012). The study argued coordination of climate adaptation could be classified into policy and planning coordination (headed by the Planning Commission in coordination with MOEF); financial planning and performance coordination (this role lies with the Finance Division, implemented by MTBF); and technical coordination (lying with the MOEF) (see figure below). In addition, horizontal coordination between national, regional and local government appeared limited, illustrated by the lack of reference to climate change in the MBF (Ministry Budget Framework) of local government (*ibid*). Human resource and institutional capacity issues were also highlighted (see Annex XIV).

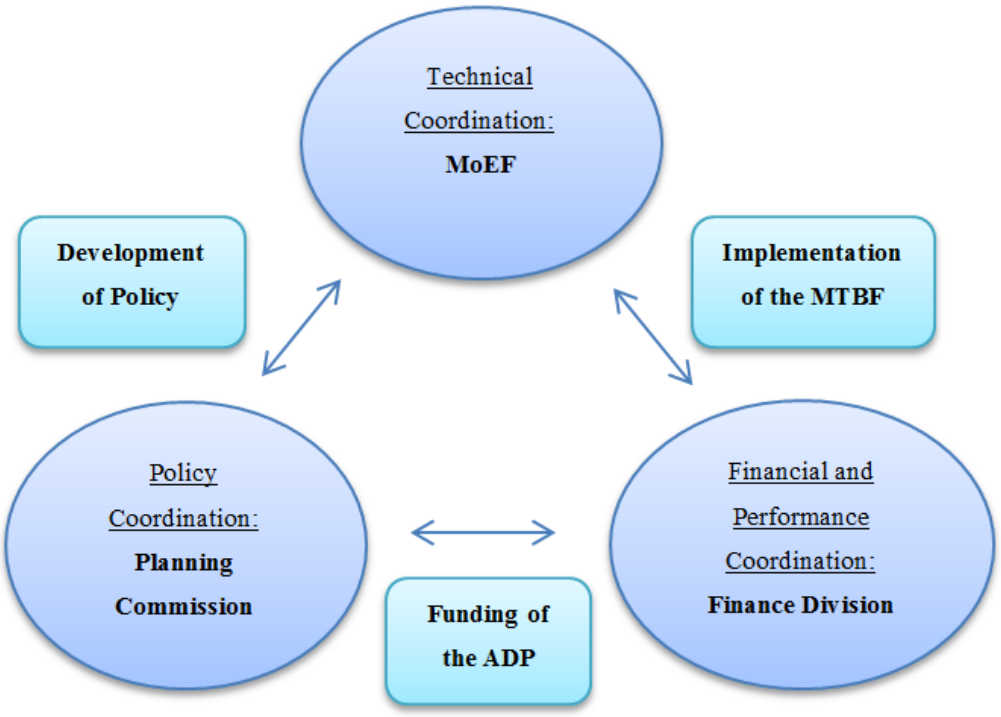


Figure 5.2 Coordination function of each body (represented by ovals) and the mutual interfaces between all three coordination functions (represented by rectangles). Developed using from information from CPEIR, 2012.

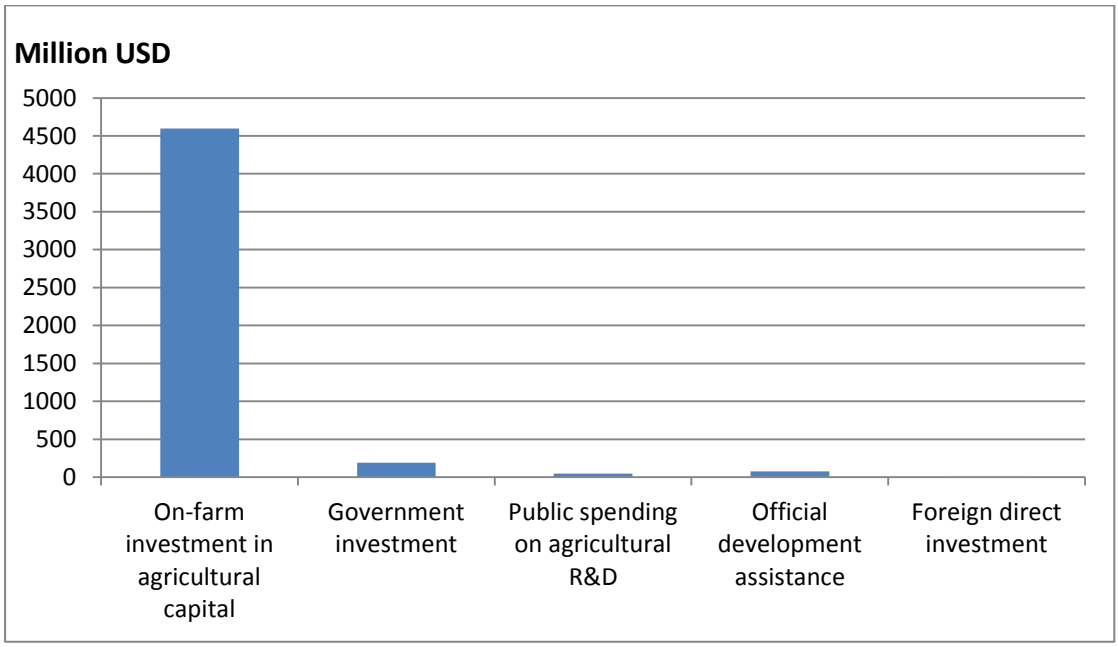
Overall, it was found the GoB spends around 6-7% of the annual combined (development and non-development) budget on climate sensitive activities, amounting to around $1Bn, or around 1.1% of GDP (CPEIR, 2012). This was around 77% from domestic resources and 23% from foreign sources (*ibid*). There has been a shift towards loan-based resources from donors, away from grants, and loan funding increased from 58% to 82% of foreign resources between the 2009-10 and 2011-12 programmes (*ibid*).

It was recognised during the CPEIR that, for sound operational reasons "climate change budgets and expenditure are integrated with existing historical activity and institutions and cannot readily be separated from this" (CPEIR, 2012:111). At the time of the study, there was no functional recognition of climate change in the Government accounting system. It is also notable that the international standard for budget classification, GFSM 2001, does not identify climate-related expenditure either (*ibid*). However, following the study, the GoB introduced a climate budget code with indicators in the 2013 budget, so it can track spending on a more continuous basis across all sectors (UNPEI, 2013). Furthermore, the Ministry of Finance is now spearheading the introduction of a 'Climate Change Fiscal Framework' to allow the government to track demand and supply for funds associated with climate change, as well as sources of funds available from domestic and external sources (*ibid*).

5.5.3. Adaptation finance for food security in Bangladesh

This section provides an overview of the flows of finance that could make a contribution to adaptation in Bangladesh, with a focus on food security and agricultural resilience. As shown below, on-farm investment in agricultural capital by smallholders is estimated to make up the vast majority of investment in agriculture, demonstrating the importance of micro-finance and providing an enabling environment for farmers to invest at local-level. However, government investment plays a key role in local infrastructure, markets, institutions and enabling environments. For further details on financing agricultural adaptation, refer to Chapter 7. This literature review was used to inform the results and analysis section.

Figure 5.3 Average annual investment in agriculture in Bangladesh (Data from Lowder *et al.*, 2012)



Data are the average for 2005-2007 or for the most recent years available prior to that (Source: Lowder *et al.*, 2012). There may be some overlap between data on ODA on the one hand and government investment in agriculture or agricultural R&D (*ibid*).

The figure above does not specifically include multilateral or national adaptation finance. As noted above, in 2009 GoB announced the $300m BCCTF for climate change, and in 2010 the BCCRF was created with funds from multilateral donors. A certain percentage of these funds would go towards agricultural adaptation. This does not significantly change the overall picture in the figure above, especially since most multi-lateral donors count their adaptation finance as part of their official development assistance.

5.5.3.1. Public finance for agricultural adaptation

The two main climate funds in Bangladesh (described above) are likely to overlap and interact in providing food security under climate change. In particular, both funds aim to coordinate together to achieve the objectives of the BCCSAP, which as described above, prioritises food security, social protection and health (BCCSAP, 2008). However it is not yet clear how the funds will coordinate other than within the CCU of the Ministry of Environment. Conversations with experts in Bangladesh highlighted that the Resilience (donor) fund projects are usually intended to be larger in size and scale that the national fund projects. This is partially because the World Bank eligibility requirements mean that larger

projects are favoured. Under the PPCR, there has been criticism of the emphasis on loans for adaptation as well as the bias toward heavy infrastructure (see box below).

By early 2014, 11 projects had been approved under the Trust Fund (BCCTF) to tackle agriculture and food security, out of 62 total projects approved. Under the Resilience Fund (BCCRF), three of the 13 approved projects were targeting agriculture and food security (see also BCCRF, 2014). The first approved project under the agriculture sector allocated $22.8m for a programme jointly operated by the FAO and the DAE entitled 'Agricultural Adaptation in Climatic Risk Prone Areas of Bangladesh'.

Box 5.1: Loans and debt under the PPCR

The World Bank's Pilot Programme for Climate Resilience (PPCR), under the CIF (Climate Investment Funds) has been criticised by civil society groups for the loan element which may increase debt levels in Bangladesh. Under the PPCR's SPCR (Strategic Programme on Climate Resilience), Investment Project 2, entitled 'Coastal Embankments Improvement and Afforestation' include building embankments and water management structures, and planting mangroves greenbelts of coastal forests. Project costs are $330m made up of a $30m PPCR grant and $300m in IDA credit (so there is a 91% loan component) (CIF, 2010).
For example, Bangladesh's external debt in 2010 was 24.96Bn USD which is 26% of GNI (Gross National Income). In 2010, interest payments on this debt were 199m USD. Bangladesh pays back $1.50 for each of the $1 it receives in aid (Shamsuddoha and Chowdhury, 2007). In its favour, the CIFs are arguably "comparatively transparent and well documented" (Hedger, 2011). However, contentious issues remain around loans for adaptation, and "heavy bias to hard infrastructure" (ibid).

5.5.3.2. Policies relating to agricultural adaptation

Since the issues of climate change and food security cut across various sectors, there are a range of national policies, plans and programmes in Bangladesh that could be affected by climate change (Haque and Haque, 2009; Karim, 2011; Mallick *et al.,* 2012). Exploring these policies and plans enables further analysis on efforts to direct adaptation finance effectively. A review of these policies and programmes related to agricultural adaptation is featured in Annex XV.

5.5.3.3. Prioritisation of adaptation finance

At international-level, the vulnerability of Bangladesh suggests that it should receive funding. As explained in Chapter 3, vulnerability is a function of both the sensitivity to the risk, and exposure. As shown in Chapter 7, vulnerability indices have also been developed that incorporate indicators for exposure, sensitivity and adaptive capacity, but these vulnerability

indices are not presently being used to guide allocation of finance, for a number of reasons. However, it is clear these tools could potentially be used on an international and sub-national level to determine the allocation of adaptation finance and to lead to more targeted adaptation finance. It is also possible that at times those same factors that contribute to vulnerability, such as weak governance systems, may also lead finance to be misused, misdirected or not used efficiently. This assertion will be analysed further in the semi-structured interviews.

As we see above, under the BCCRF project selection was based on seven selection criteria relating to projects, but not on any regional or district-based vulnerability criteria. Similarly, at international-level the GCF has not yet established firm criteria for prioritisation of funding (see Chapter 7). Hence, it is possible that political influence or corruption at national levels could impact on climate finance prioritisation or project selection. The BCCRF selection criteria listed in Table 5.4 included the monitoring of results, and 'readiness' criteria but not any indicators estimating the social, environmental or economic impacts. These issues are further explored in the semi-structured interviews (see Chapter 9).

Benefits of using vulnerability indices include potentially more targeted, equitable and effective use of resources, but drawbacks include the resources and data required for using such indices. At present, there seems to be a gap between the development of indicators at international-level, particularly in the academic or scientific context, and their uptake and use by the policy-makers in this area. This assertion will be further tested in the analysis.

This was also evident from semi-structured experts interviews in which government officials highlighted the political influence on funds. It emerged that that vulnerability indices and tools were not being widely used in Bangladesh, possibly due to the constraints on time and resources for policy-makers (see Chapter 9).

In Nepal, 80% of funding is earmarked for village or municipal-level project implementation (Oxfam, 2011) but there is no such political commitment in Bangladesh. In Bangladesh, local government authorities do not currently have access to the BCCRF funds (see Christensen *et al.,* 2012). The Local Government (Union Parishad) Act 2009 intended to bring in reforms for good governance, decentralisation and transparency, which may have implications for the participation of local government in adaptation planning but has not been fully implemented yet. The engagement of local government is a further issue to be explored at local-level.

5.5.3.4. Private Sector Engagement, Trade and Agricultural Adaptation

Public adaptation finance, the key focus of this case study, is available due to the international context and commitments made under the UNFCCC. However, it is recognised that mobilisation of private finance will be a key objective in order to enhance action on adaptation and mitigation, which is the rationale behind the GCF's Private Sector Facility. Technological development including research (for instance, on improved crop varieties) can be done by both private and public actors (Glatzel *et al.,* 2012). Private sector engagement in adaptation in Bangladesh has been limited to date. In one study, 99% of corporate stakeholders perceived climate change to be either an irrelevance or at best "an extension of their Corporate Social Responsibility" (IFC, 2010:7). This resulted from short-term thinking in businesses (*ibid*). However various stakeholders expressed interest potential public-private partnerships in areas such as development of flood-tolerant or saline-tolerant crop varieties and vulnerability mapping (*ibid*).

Whilst FDI is recognised as important for the economy, and could enhance agricultural investment, a major barrier to FDI results from the slow legal system in which the enforceability of contracts is uncertain (DoS, 2013). Refer to Chapter 7 for related discussion of foreign direct investment (FDI).

The ability of trade and marketable products to enhance capacity to adapt to climate change is contingent on trade policies, including both subsidies and tariffs. Hence this will be explored in greater detail in the results. In chapter 9 of the IPCC-AR5 report, trade is recognised as having an impact on climate change adaptation, including "deepening agricultural markets and improving the predictability and the reliability of the world trading system through trade reform" (IPCC, 2014, Section 9.3.3.3.4). In fact, technology transfer can be seen as encompassing trade, in general, as most transfers of technology will occur as a part of international or regional trade. Subsidies and tariffs can both be seen as trade policies which can constrain or enable adaptation (Glatzel *et al.,* 2012). Refer to Annex XVI for examples of adaptation-relevant tariffs and subsidies in Bangladesh.

5.6. Summary

This chapter highlighted the main impacts of climate change in Bangladesh with a focus on food security, before providing an overview of the main finance and policy responses that have taken place to date. The information in this chapter informs and provides background to the national-level (Bangladesh) and local-level (Kalapara) case studies which are detailed in

forthcoming results chapters 8 and 9. Overall, the literature review found climate change is projected to lead to temperature rise, precipitation changes, ocean acidification, glacier melt, sea level rise, flooding, cyclones and salinity intrusion in Bangladesh, amongst other effects. However, uncertainty remains in the projected impacts, particularly with regards to the impacts of climate change on the monsoon. Furthermore, impacts such as sea level rise cannot always be attributed to climate change as these environmental changes are affected by a range of other geophysical and socio-economic causes, and recognising this can lead us to identify some innovative solutions to reduce the impacts.

In analysing the impacts of climate change on food security, it was noted climate change is likely to have both direct and indirect impacts on agriculture and food security in Bangladesh, with impacts for food availability (e.g. crop productivity impacts) but also on accessibility (e.g. loss of livelihood,) utilisation (e.g. nutritional impacts), and stability of food (e.g. price shocks). Thus climate change can impact on all four aspects of food security.

In reviewing the main finance and policy responses in Bangladesh, it was found that existing climate finance channels include a range of different mechanisms, which are not coordinated together, although the intention is for all the mechanisms to contribute to the BCCSAP. It will be interesting to find out how the funds and priorities at national-level are experienced at local-level. There are ongoing efforts to mainstream climate change into development but the range of existing policies relating to agricultural adaptation in Bangladesh do not all take climate change into consideration as yet.

6. International Trade Regulation and Diplomacy for Food Security under Climate Change

6.1. Introduction

In this section, the opportunities and risks created by international agricultural trade under climate change are analysed, barriers and enablers to climate resilience are explored, before looking at issues related to the international negotiations on climate change. Finally, certain parallels are drawn between the international architecture on climate change under the UNFCCC and agricultural trade under the WTO. The international scale is the jurisdiction of analysis in this chapter. The chapter provides background to inform the international-level analysis (Chapter 10).

International agricultural trade creates both risks and opportunities under climate change. While globalisation and inter-connected trade have led to benefits including innovation and income growth, Goldin and Mariathasan (2014) argue it creates systemic risks. Climate-related disasters like floods can cascade over national borders and affect global supply chains (*ibid*). For instance, the 2011-12 floods in Thailand affected the long-distance supply chains of many technology and semi-conductor companies. Climate change has a 'multiplier effect' on supply chain risk, particularly in agriculture (Glenhill *et al.,* 2013). That is, global supply chains are already susceptible to disruption from systemic risks, especially where a commodity is sourced from a small number of suppliers (e.g. agricultural commodities like rice which can grow only in certain places), and climate change adds an additional element to this existing supply risk. Many goods that are needed for adapting to climate change are traded internationally, whilst international trade regulation can impact on the vulnerability of smallholder farmers.

6.2. Trade, environmental protection and food security

The IAASTD report (International Assessment of Agricultural Knowledge, Science and Technology for Development) found that expansion of commercial-industrial agriculture has put a strain on many small-scale farmers in developing countries and moreover, that focus on exports has left many small-scale producers vulnerable to volatile market conditions and international competition from subsidized producers in the Global North (IAASTD, 2009). Globalisation has therefore been described as a double-edged sword that can be a force for progress as well as a source of harm (Goldin and Mariathasan, 2014). In this chapter we explore the impacts of international trade on the vulnerability of farmers, considering the

history of the international trade negotiations, and consider the case of the impact of EU agricultural subsidies.

International agricultural trade policies such as perverse subsidies (e.g. agricultural or fossil fuel subsidies) may have an impact upon adaptive capacities. Rigid agricultural policies including "subsidies for certain crops in certain areas" can "constrain change and reduce the flexibility of land-use changes" (Kurukulasuriya & Rosenthal, 2003:p43, in Glatzel *et al.,* 2012). Thus it is suggested such distortions should be removed in the WTO's Doha Development Round. Arguably, the potential impact of import tariffs and agricultural subsidies upon adaptive capacity requires further research and recognition (*ibid*). Structures and regulations within the international trading system can be a determinant of vulnerability. For example, O'Brien et al (2004:303) argues farmers in India are simultaneously vulnerable to impacts of climate change, as well as globalisation, a situation they describe as "exposure to multiple stressors". Globalisation and marketization of the rural economy can create opportunities, as well as risks for smallholder farmers, like vulnerability to agricultural input prices.

Furthermore, trade regulation is also relevant in the case of IPRs. Patents on seed varieties can potentially act as a barrier to uptake of new drought-resistant seed varieties (Glatzel et al 2012), especially where the seeds are sterile to ensure IPRs over seeds are upheld. 'Terminator seeds' could be seen as a negative example of intellectual monopoly, but biotech companies argue that the gene-use restriction technology (GURT) was initially introduced to prevent spread of transgenic genes into the environment for biosafety reasons, as well for protection of IPRs (Black *et al.,* 2006). The Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs) under the WTO compels all WTO member countries to implement and enforce IPRs on plant varieties. Farmers associations and civil society expressed concern that this places breeders' rights above farmers' rights, and undermines farmers' rights to use and save seed (GRAIN, 2003). For further details, please refer to the co-authored chapter, Glatzel et al (2012), which provides background to these issues (see Annex I for published works).

6.3. Barriers and Enablers to Climate Resilience and Food Security

Although international trade is threatened by climate change, recent literature highlights the role that trade can play in adaptation to climate change, for example, importing food might enable countries to adjust to climate-induced productivity shocks and mitigate welfare losses

(see Chapter 9; IPCC, 2014). Moreover, many of the technologies and tools that help with adaptation to climate change are tradable goods, known as 'market goods' (see Boldt *et al.,* 2012).

Under the UNFCCC, countries have been conducting 'Technology Needs Assessments' (TNA) to identify priority technologies for adaptation and mitigation. Agriculture was the most commonly prioritised sector (UNFCCC, 2013). Adaptation technologies in agriculture included irrigation, HYVs, crop diversification and early warning systems (UNFCCC, 2006). New crop varieties (such as short-maturing or flood-tolerant varieties) were regularly highlighted (UNFCCC, 2013). In almost all countries there were a range of barriers to technological development and transfer: including an insufficient regulatory/legal framework, or inadequate financial resources (*ibid*). Another barrier might be the lack of R&D investment in developing-country agriculture (IAASTD 2009).

The barriers may well differ depending upon the scale of analysis, or the scale at which a particular technology is introduced, for instance, market goods like crop varieties may meet with different barriers to public goods. Thus, policies might need to be tailored to specific local needs (Boldt *et al.,* 2012), but other barriers will be cross-cutting, like WTO rules (Abbott, 2010). Since governments can only act on national barriers, there is a need for international collaboration, for instance on WTO regulations. This relates to the next section on subsidies.

As discussed in chapter 3, it is important to recognise the limits to adaptation. For example, bio-physical limits, such as the thermal limits for heat tolerance in plants. Some might be defined as 'mutable' while others may be 'absolute' limits (Kolikow *et al.,* 2012). However, Moser and Ekstrom (2010) argue barriers are different from limits as they can be overcome.

Jones (2010) divides barriers to adaptation into categories of social barriers (e.g. cognitive and institutional), and human and informational barriers (comprising of knowledge, technological and economic). Social barriers to include psychological barriers, and these could be personal to an individual, for example, if a farmer will not adopt a strategy if they perceive the cost exceeds the benefit (Kolikow *et al.,* 2012). The possible options for adaptation can change over time with innovation, for example, so these barriers can be dynamic.

The ‘enabling environment’ is important. This enabling environment can be divided into national, macroeconomic conditions human, organisational and institutional capacity; research and technological capacity; and social and cultural aspects (Boldt *et al.,* 2012). Each of these elements has policies associated with them and there are also different and interacting levels (e.g. regional/local), at which different actors work (UNFCCC, 2003). However, this discussion has been far more developed for mitigation than for adaptation (*ibid*). In fact it can be argued the whole focus on ‘technology’ is more suited to mitigation. Yet, some of the low-climate innovation literature can be usefully applied, for instance Grubb (2004) argues there is often a ‘valley of death’ between technology demonstration and commercialisation.

6.3.1. Identifying Barriers and Enablers

In identifying barriers, Boldt et al (2012) subdivide adaptation technologies into categories of ‘market goods’ (like consumer/capital goods) and ‘non-market goods’ (publicly-provided goods and other non-market goods). Many adaptations fall under the categories of consumer or public goods (UNFCCC, 2013). Seed varieties can be considered a tradeable consumer good, while a sea wall would be a public good. Where technologies are traded in a market it is necessary to identify market or trade barriers. Many ‘soft’ technologies, like farming techniques, do not easily fall into this categorisation as they are not traded but are learnt and adopted. Indigenous knowledge for adaptation (see Chapter 4) also does not easily fall into this categorisation. In fact, the prioritisation of technologies for adaptation under the UNFCCC’s TNA process could inadvertently favour ‘hard’ rather than ‘soft’ technologies (Christiansen *et al.,* 2011). Thus, the suitability of this framework for exploring barriers to adaptation is uncertain.

While technology is important, its actual effectiveness depends on the ‘enabling environment’ – including legal, economic, institutional and socio-cultural contexts (Christiansen *et al.,* 2011) (see previous section). In the TNA process, many countries identified barriers and enablers using tools like ‘market mapping’, problem trees or logical problem analysis (Boldt *et al.,* 2012). A root-cause analysis was also used to identify which barriers are only symptoms of problems, and which are real problems.

Life cycle analysis (LCA) might also be a useful tool for analysing resilience of food products or systems, as it evaluates environmental effects of a product, process, or activity throughout its life-cycle or lifetime. For example, Heller and Keoleian (2003), in analysing

the US food system, propose a set of indicators addressing economic, social and environmental aspects sustainability, including diversity of seed purchasing, number of community organisations, or rates of malnutrition. In future, adaptation standards might enable companies or organisations to assess the climate resilience of food products across their life-cycle. A related concept is that of the 'value chain,' popularised by Porter (1985), referring to the activities within and around a company that create a product or service. Most LCA studies have so far been developed for developed-country contexts and used to evaluate environmental sustainability rather than food security. Potential 'resilience' indicators in the context of Bangladesh, for example, might include the percentage of farmers using saline-tolerant rice varieties, or the nutritional value of food at the consumption phase. However, in the context of a developing-country, such data is extremely difficult to find and would require multiple studies. In a developing-country context, analysing the various elements of food security (e.g. availability, utilisation and stability) might be more relevant. These approaches (LCA or value-chain analysis) are noted here for reasons of completeness but might be more applicable to adaptation for companies with globalised supply chain risks, rather than smallholder farmers. Identifying barriers to adaptation remains an important consideration in the analysis.

6.3.2. Perverse Subsidies as Barriers to Climate and Food Security

Whilst subsidies can play a role in addressing market failures or advancing public policy objectives, they can also contribute to over-exploitation of resources, curb trade opportunities and distort competitiveness (ICTSD, 2012). Trade regulation or subsidies can both be categorised as global or cross-cutting barriers to food security under climate change. In this section we review the extent and impact of perverse subsidies on climate change and food insecurity, with particular attention to agricultural subsidies and fossil fuel subsidies. Finally opportunities for reforming these subsidies are reviewed.

Under Article 3 of the WTO's 'Agreement on Subsidies and Countervailing Measures' (SCM Agreement), subsidies are prohibited if they are contingent "upon export performance" (Art. 3.1(a)) or "upon the use of domestic over imported goods" (Art. 3.1(b)) (WTO, 1994). Subsidies are also actionable if they are deemed to be "specific to an enterprise or industry or group of enterprises or industries (referred to in this Agreement as "certain enterprises") within the jurisdiction of the granting authority" under Article 2 of the SCM Agreement.

According to Myers and Kent (2001), subsidies are 'economically perverse' when they do the following things: (1) maintain production processes that would otherwise not occur; (2) reduce costs so far that natural resources are overexploited or wasted; (3) deter efforts at sustainable exploitation, (4) while benefiting one economic area, harm others so that the net impact is negative. Subsidies are 'environmentally perverse' when they; for example, foster activities that result in environmental harm; or encourage inefficient, if not profligate, use of fossil fuels (*ibid*).

Resource subsidies on energy, agriculture, water and fisheries amount to $1.1 trillion globally, of which over 70% went to energy and agriculture (Dobbs et al 2011). Moreover, according to data from the OECD, agricultural subsidies rose by 4.2% per annum from 1995 to 2010 (*ibid*). The estimates refer only to direct cash payments to producers and do not include a range of other indirect support mechanisms including tax measures (*ibid*).

Global fossil fuel subsidies amounted to $544Bn in 2012 according to IEA (2013). This increased from $52Bn in 2011, and had been pushed up due to higher fossil fuel prices and increased consumption (*ibid*). Meanwhile, agricultural subsidies in OECD countries (producer support estimate) amounted to $258.6Bn in 2012, representing 19% of farm receipts in the OECD, up from 18% in 2011 (OECD, 2013). By contrast, under the UNFCCC, countries committed to mobilising $100Bn by 2020 for climate adaptation and mitigation.

Certain types of agricultural subsidies remain legal under the WTO's Agreement on Subsidies and Countervailing Measures because Art.3 of the agreement states that subsidies are prohibited "except as provided in the Agreement on Agriculture" (WTO, 1994). Moreover, while a WTO member would be able to request withdrawal of subsidies if they cause "adverse effects" in terms of "injury" or "serious prejudice to the interests of another Member" under Article 5 of the SCM Agreement, Art.5 states; "this Article does not apply to subsidies maintained on agricultural products" (WTO, 1994). Therefore, the Uruguay Round Agreement on Agriculture has precedence over the SCM Agreement, and the agricultural sector has a particular status providing it exemptions from the SCM Agreement.

Agricultural subsidies have a range of effects including shaping decisions on production and consumption, altering land use, and determining the viability of livelihoods around the world, thus their impact on sustainable development and climate change has been a subject of intense debate (ICTSD, 2012). Subsidies create winners and losers, making it difficult to

reform subsidies (*ibid*). For example, EU agricultural subsidies benefit rich landowners and agribusinesses in the EU, but the losers are poor developing-country farmers (Joseph, 2011). Please see the next section for further details of the environmental and development impacts of the EU's agricultural subsidies under the CAP and attempts to reform it. Specific duties in agriculture make it difficult to calculate average tariffs as they "obscure true levels of protection, and penalize developing countries that supply cheaper products" (Aksoy, 2005:6).

Fossil fuel subsidies are a drain on government budgets and promote consumption of fossil fuels, contributing to climate change. At least eight countries (Egypt, Iran, Iraq, Kuwait, Saudi Arabia, Turkmenistan, the United Arab Emirates, and Uzbekistan) commit 5% or more of their GDP to energy subsidies (Dobbs et al 2011). In Iran, energy subsidies in 2008 totaled $101Bn or one-third of the annual central budget (IEA, 2013). These fossil fuel subsidies also generate dependency and drive over-use of agricultural fuels. Fossil fuel subsidies are relevant to this thesis because industrial or mechanised agriculture consumes fossil fuels, and also because agricultural fuel subsidies can undermine resilience. For example in India, energy subsidies for irrigation have contributed to unsustainable groundwater abstraction (Mukherji *et al.,* 2012).

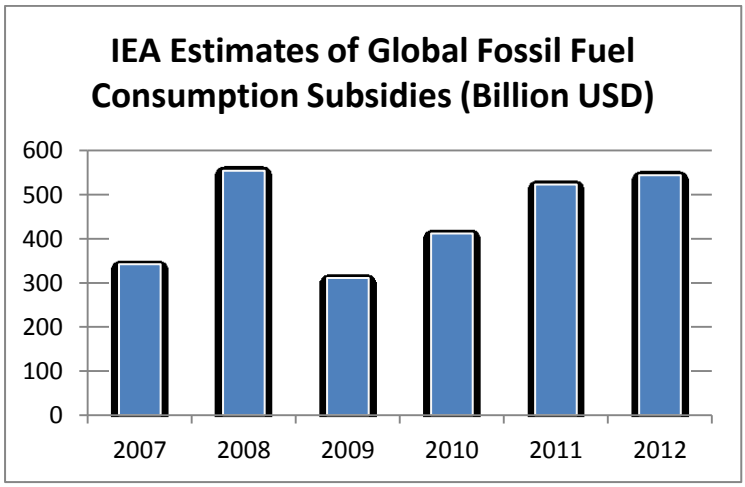


Figure 6.1 Global fossil fuel subsidies. Source: IEA, 2013

Moreover these subsidies are socially regressive. Only 8% of the $409Bn spent on fossil fuel subsidies in 2010 went to the poorest 20% of the population (IEA, 2011). However, removal of subsidies is politically challenging (Dobbs *et al.,* 2011). Measures may be needed to reduce negative impacts of reform on poor communities. In Indonesia, unconditional cash transfers were used to compensate low-income households for fuel subsidy cuts (Beaton *et al.,* 2010).

Under the WTO Agreement on Subsidies, such fossil fuel subsidies are considered "actionable" (giving cause for legal action) if they were found to be "specific to an enterprise or industry or group of enterprises or industries" (Art.2;WTO, 1994). Arguably many fossil fuel subsidies could be considered "specific" since they relate specifically to the fossil fuel industry. A WTO member can also refer the matter to the Dispute Settlement Body to request withdrawal if they cause "adverse effects to the interests of other Members" (Art.5; WTO, 1994). 'Dual pricing systems' are often used by energy-rich countries to set a lower price for domestic consumption of fossil fuels than the price charged for imported fuel, and would be either prohibited or actionable under these definitions (Selivakova, 2007; Meyer, 2013) especially since these subsidies are contingent "upon the use of domestic over imported goods" (Art. 3.1(b)) (WTO, 1994). However, clever drafting by legislators has meant most dual pricing systems have avoided these conditions, for instance, avoiding specificity by applying the schemes "to all industries and enterprises throughout the economy" (Meyer, 2013:2). Furthermore, measures to combat the negative environment impacts of fossil fuel subsidies by subsidising renewable energy, have also come up against WTO challenges (for instance, wind subsidies in China) because policy-makers have not been careful to ensure WTO-compatibility (*ibid*).

The scale and extent of perverse subsidies demands increased political attention to reform them. Effective pricing of resources is the single biggest consistent driver of accelerated resource productivity (Dobbs et al 2011). The effectiveness of finance committed to the Green Climate Fund (GCF) to mobilise action on climate change could be enhanced by policy measures to remove perverse subsidies. Where there are political challenges to removal of fossil fuel subsidies in developing countries, one mechanism to overcome such challenges would be using climate finance to cushion the impact on vulnerable communities, for example, subsidising alternative (or renewable) energy in communities affected by a removal of fuel subsidies. Such compensatory mechanisms might, however, suffer from challenges under the WTO if they are not drafted correctly.

6.3.3. The Case of the WTO and EU Agricultural Subsidies

The EU Common Agricultural Policy (CAP) is one of the EU's most important policy areas, making up over 40% of the total EU budget with 50Bn EUR in subsidies in 2011 (EC, 2014). However, as detailed below, the CAP may conflict with international commitments to promote free trade under the WTO, and climate change commitments. Whilst a percentage of Pillar II subsidies are intended to go towards environmental or social objectives (equivalent

to the 'Green Box' measures under the WTO Agreement on Agriculture), subsidies also go toward meat and dairy production, contributing to GHG emissions. For instance, EU beef producers receive export subsidies and direct payments. It can also be argued that the capacity of developing-country farmers to adapt to climate change through development is hindered by a lack of fair market access for their products. The CAP may contribute to a situation where local production in rural communities of developing countries is hampered by competition with subsidised EU exports (FAO, 2005).

The existing round of WTO negotiations, known as the Doha Development Road, was supposed to be completed with an agreement on substantial reductions in trade-distorting support to agriculture. However there has been little progress in reducing EU subsidies (Cunha and Swinbank, 2012). It can be argued completion of the WTO's Doha Development Round would contribute positively to adaptive capacity in developing countries. Agricultural trade liberalisation acts as an important vehicle for economic adaptation to climate change, whereby increased price transmission via global trade results in increased global welfare (Randhir and Hertel, 2000). For example, sugar trade liberalisation would shift production to efficient, low-cost producers in the tropical zone, saving global resources and increasing incomes (Borrell and Hubbard, 2008). Subsidies exacerbate the effects of climate change by encouraging production from the highly subsidised EU agricultural sector (Randhir and Hertel, 2000) because this disadvantages developing-country producers that are also highly vulnerable to climate impacts.

Agricultural trade policies were brought into the global trade negotiations for the first time in the 1994 Uruguay Round. Before then, the import barriers in agriculture were coupled with widespread use of subsidies linked to production (Aksoy, 2005). The URAA imposed an obligation of tariff reduction by 36% for developed countries, and 24% for developing countries. However, under Article 6, direct payments are exempted from reduction commitments if they are in the "green box" – all subsidies in this box are permissible, which included "payments under environmental programmes". The EU could even increase its support beyond the reduction commitments since the "green box" subsidies were excluded from the calculation of a member's total level of domestic support under Article 6 (5)(b). Environmental objectives could thus potentially be used as a cover for protectionism.

The 2003 CAP reform featured a 'de-coupling' of agricultural production from subsidy payments (Cunha and Swinbank, 2012). Subsidies were now paid regardless of whether the

farmer produces or not. Thus a 'single payment system' (SPS) was implemented whereby subsidies were allocated according to other indicators like land size rather than production. These payments were generally considered as falling in the 'Green Box' as they were deemed to have little or no distorting effects on trade, meaning they were exempt from reduction commitments. Some countries, like France, still maintained coupled direct payments in some sectors, for instance for livestock (SAC, 2008). The CAP Health Check of 2008 also abolished milk production quotas, but Member States were permitted to maintain 'coupled support' for suckler cow, goat and sheep permia (EC, 2009c).

The new post-2013 CAP reform does include some environmental provisions (see EC, 2012b). 30% of the direct payments will go towards farmers who have turned towards environmentally-friendly practices and improved use of natural resources, including crop diversification, maintenance of permanent pasture, and preservation of environmental reservoirs and landscapes. Yet crop diversification is already widespread, since most arable farmers already grow three or more crops (Westhoek *et al.,* 2012). Loopholes may enable farmers to rent marginal land nearby which could render the whole measure ineffective (*ibid*). The post-2013 CAP reform fails to address any of the serious issues of livestock production, including animal welfare, antibiotic use or the indirect effects on deforestation for animal feed (*ibid*). Predictably, lobby groups and farmers unions, e.g. COPA-COGECA made an effort to weaken the reforms (Euractiv, 2013). Overall, CAP proposals have not seized the opportunity to change the environmentally-damaging livestock sector by reducing the subsidies going towards intensive livestock farming. Thus, experts have concluded the proposed greening measures will hardly be effective in stimulating biodiversity and reducing GHG emissions (Westhoek *et al.,* 2012). Thus there has not been much progress in trying to get the CAP to align with the EU's global development or climate change commitments.

6.4. International Diplomacy on Climate Change and Sustainable Agriculture

The international architecture on climate change (and climate change finance) is drawn up at the UNFCCC under a process of negotiation between member states (Parties to the Convention). Thus, processes of negotiation and diplomacy between states are at the root of the international regulation and treaties to tackle climate change under the UNFCCC, as well as those determining agricultural trade under the WTO.

Parties negotiating at the UNFCCC use a range of tactics in the negotiations ranging from 'hard' tactics (conflictive or aggressive) to 'soft' tactics (cooperative or friendly tactics)

(Bailer, 2012). Other classifications of negotiations strategies include cooperative versus non-cooperative strategies (*ibid*). However, it is recognised the structures at the UNFCCC negotiations are inequitable as poorer countries cannot afford to send large delegations and their level of expertise usually remains below that of wealthier countries (UNFairplay, 2011; Schroeder *et al.,* 2012). Many negotiations go on in parallel with one another, and go on late into the night on the last days, putting smaller delegations at a further disadvantage (*ibid*). The UNFCCC negotiations under the SBI, focusing on implementation, tend to be relatively more contentious, whilst those under the Subsidiary Body for Scientific and Technological Advice (SBSTA), with its function for learning and developing the evidence-base, tend to be less contentious.

Whilst transparency and access to information might go some way towards helping under-resourced delegations to engage in dynamic and fast-paced UNFCCC negotiations, a delegate from Austria commented "if everything was transparent you would never make progress" [sic] (UNFairplay, 2011:27). Some delegates prefer a level of discretion to enable them to speak openly with each other. Meetings on sensitive issues, including climate finance, are often 'closed' meetings meaning the public and international media have restricted access. Lack of transparency is likely to restrict the participation of stakeholder groups such as civil society and the media, who might be supporting the interests of climate-vulnerable countries, as well as limiting the access to media information about the negotiations. The actual impact of the lack of transparency in UNFCCC negotiations will be explored and discussed further in this thesis through semi-structured interviews and participant observation at the UNFCCC (see Chapter 10).

Consensus-based decision-making arguably stifles progress. The decision rule in international politics is typically unanimity (consensus) meaning the consent of all states is required. Unanimity is the prevailing rule at the UNFCCC. This generally means the 'law of the least ambitious program' applies (Hovi and Sprinz, 2006) so the final decision can only be as ambitious as that of the least ambitious party. Any Party can hold a veto, so the climate negotiations effectively march at the "pace of the slowest", and countries opposed to change can accumulate burdensome "side-payments" (Ward *et al.,* 2001:438). One example of this could be observed at the UNFCCC negotiations in Bonn in 2013, where Russia was observed using a tactical vote to stop the negotiations for two weeks, in the words of Tuvalu "crashing the car to prove the seatbelts don't work". Thus, it is argued a stronger reliance on qualified majority voting would speed up the decision-making process, and weighted voting

mechanisms can ensure decisions take all major interests into account (Biermann *et al.,* 2012).

This architecture is broadly similar to that for other important international issues like those relating to agriculture under the WTO's Doha Development Round, which also involves a process of international negotiation between states. At the WTO, small low-income countries are also at a disadvantage. It has been found that small low-income countries face barriers to participation in the WTO Dispute Settlement Mechanism (Abbott, 2007). This may limit the extent to which smaller of low-income countries can participate in enhancing their interests through recourse to international trade law.

Major issues are at stake for agriculture in developing countries with subsidies being discussed at the WTO, and climate finance discussed at the UNFCCC. The cross-cutting issues at stake include the use of policy mechanisms like food reserves, which may help countries ensure food security for poor consumers in the face of climate shocks. The UN's Special Rapporteur underlined that food reserves are "a crucial tool" for ensuring food security, yet there are concerns about WTO rules restricting the use of food reserves (UNSR, 2013).

Furthermore, at the WTO 'divide and rule' tactics may be at play, with countries divided into different interest groups like LDCs and Non-LDC's, as well as the African, Caribbean and Pacific group of countries (see Aksoy, 2005). Under the WTO, preferential trade schemes offer special preferences to LDCs, but these create a complex mosaic of tariffs, quotas and import restrictions (Hasha, 2004), acting as a disincentive for LDCs to agree to a more comprehensive agreement for fear of losing special preferences. Preferential access is only granted for a specific range of products, constraining the ability of developing countries to diversify exports (Brenton and Ikezuki, 2005) and move into high-value exports. Similar divisions occur within the UNFCCC with different interest groups of countries as well as multiple strands of negotiation. Overall, as described above, there is some evidence the international trade talks mirror the climate talks in terms of weighting of outcomes in favour of the most powerful states, limiting the extent to which negotiation outcomes can be reached that benefit the most vulnerable countries.

6.5. Summary

In this chapter, we provide an overview of important issues relating to international agricultural trade and climate change. While globalisation of international trade has benefits

for food security under climate change, there are certain risks. For example, agricultural subsidies persist in developed countries and this may limit the capacity for smallholder farmers in developing countries to adapt, by hindering fair market access for their products. Subsidies can be viewed as a global or cross-cutting barrier to food security under climate change and reforming such subsidies, while challenging, is recommended.

The barriers and enablers to adaptation technologies were explored in the context of TNA's. However, it was observed the categorisation of 'technologies' under this approach might be biased toward market-based adaptation at the expense of insights into non-market adaptation practices or locally-generated knowledge.

Finally, the chapter explores the international architecture for decision-making on climate change at the UNFCCC, drawing certain parallels with the WTO. Both the structures and interests at play in these international negotiations guide the decisions that are made and the extent to which outcomes can be reached to address the impacts of climate change. Due to the importance of these structures it was decided that the UNFCCC negotiations would be taken as a case study to observe the negotiations on adaptation finance.

7. Climate Finance for Food Security: A Framework for Analysis

7.1. Introduction

This chapter provides an analysis of climate change finance, focusing particularly on public adaptation finance for food security under climate change. Various issues and challenges relating to adaptation finance are explored and, as described in Chapter 2, these issues form the basis for many of the questions with experts and stakeholders in the semi-structured interviews. Criteria to determine between adaptation options as well as evaluate their effectiveness are reviewed. This chapter aims to develop an indicator-based framework for analysing the effectiveness of climate finance.

Annex I Parties committed to providing 'new and additional resources' for developing countries under Article 4 of the UNFCCC Convention. However the UNFCCC Convention is not specific about the resources for adaptation being new and additional under Article 4.4, as most of the original convention is directed towards mitigation. Subsequently in Article 1(e) of the Bali Action Plan, parties committed to "provision of financial resources and investment to support action on mitigation and adaptation and technology cooperation" including "adequate, predictable and sustainable financial resources and financial and technical support" (UNFCCC, 2007). Following this, in Article 8 of the Copenhagen Accord, developed countries committed to "a goal of mobilizing jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries" (UNFCCC, 2009). At COP-16 in Cancun, Mexico in 2010, Parties agreed to establish the Green Climate Fund (GCF) to distribute this climate finance. Paragraph 98 of the Cancun Agreements reiterates that "developed country Parties commit, in the context of meaningful mitigation actions and transparency on implementation, to a goal of mobilizing jointly USD 100 billion per year by 2020 to address the needs of developing countries" (UNFCCC, 2010). If countries fulfil these commitments, there will be a tenfold increase in climate finance flowing to developing countries by 2020, compared to the current climate finance flows of about $10Bn per annum (Carty, 2010). Aid commitments in 2010 were around $128Bn (OECD, 2010). Article IV (A) of the Cancun Agreements takes notes of the promise for $30Bn in new and additional financial resources for the period 2010-12 with a "balanced allocation between adaptation and mitigation" whilst "funding for adaptation will be prioritised for the most vulnerable developing countries" (UNFCCC, 2010) in decision 1/CP.16, paragraph 95. This is known as 'Fast Start Finance'. At COP-17 Durban in 2011, Parties to the Convention approved the

governing instrument for the Green Climate Fund (UNFCCC, 2011b) and under the Annex, Article II F (26), the World Bank was recognised as the interim trust of the GCF, subject to a review three years after operationalisation of the Fund. In decision 4/CP.19 at the Warsaw conference in 2013, the additional guidance to the GCF (Section B, Article 13) called for "ambitious and timely contributions by developed countries to enable an effective operationalization" (UNFCCC, 2013d). However, UN Secretary-General Ban Ki-Moon, speaking at the Ministerial Meeting at Warsaw, described the GCF as an "empty shell".

In Doha (COP-15), in decision 1/CP.18 (paragraph 68), countries were encouraged to provide resources at least to the average annual level of the fast-start finance period for 2013-15, and under paragraph 67 were invited to submit information on approaches for mobilising scaled-up climate finance to $100Bn per year (UNFCCC, 2012a). However, with financial constraints due to the global economic downturn, there are increasing concerns for adaptation finance to be scaled-up and to be as effective as possible, since climate change is already threatening to erode global development gains (WDR, 2010). There is a risk that governments and communities are becoming trapped in a vicious cycle, where climate change disrupts economic and social development, meaning countries have even less financial capacity to tackle climate change (see diagram below).

There is also a danger that instead of getting on with the urgent tasks of adaptation, governments are getting embroiled over debates about governance, monitoring and additionality (Fankhauser and Burton, 2011). However, ensuring the effectiveness of climate change finance is crucial because "nothing is likely to undermine progress on adaptation in the developing countries more than evidence, or even suspicion, that the funds are being diverted or used wastefully, and are not reaching those most in need of assistance" (*ibid*:p.5). A major challenge is that lack of transparency and unclear guidance on what constitutes climate finance have made reporting and tracking climate finance difficult (Nakhooda *et al.,* 2012).

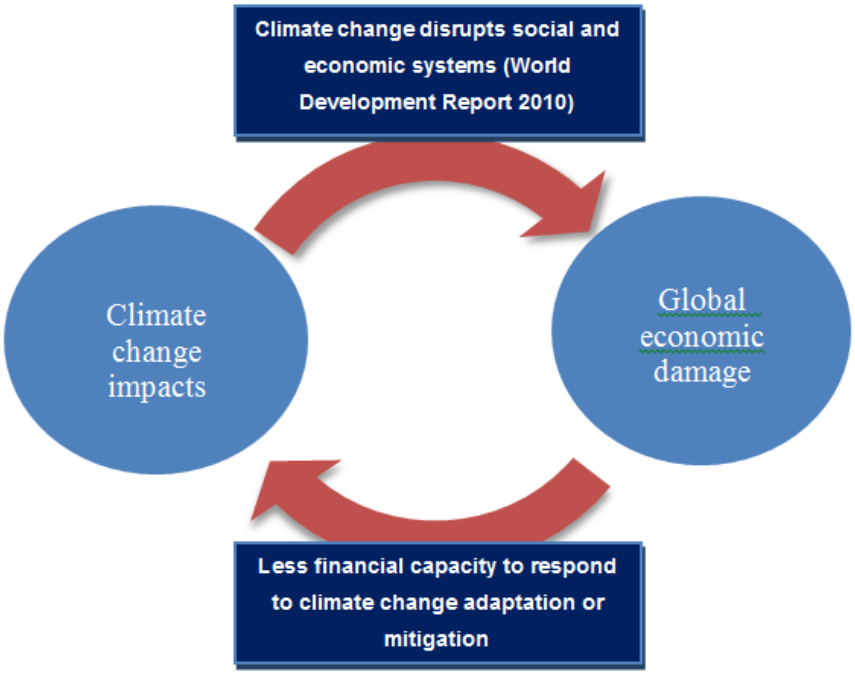


Figure 7.1 Potential vicious cycle of economic damage under climate change at global or local scales

In 2010, the High-Level Advisory Group established by the UN Secretary General found that raising the $100Bn per year by 2020 was "challenging but feasible" (AGF, 2010:5). The Advisory Group assessed the different sources against the set of 8 criteria set out in its terms of reference which were: revenue, efficiency, equity, incidence, practicality, reliability, additionality and acceptability (*ibid*). Private flows were included, as well as leveraged loans from the multilateral development banks. However, there is no widely accepted methodology for calculating the 'net benefit' of gross private flows to developing countries. Direct budgetary contributions were expected to play a role, dependent on national circumstances, whilst innovative sources such as a 'financial transactions tax' were considered. It has been recognised that grants and highly concessional loans will be particularly important for adaptation and that emphasis must be placed on spending funds wisely (*ibid*) including prioritisation based on cost effectiveness.

Under the UNFCCC, three funds were created at the climate conference in Bonn in 2001, the Special Climate Change Fund (SCCF) the Least Developed Countries Fund (LDCF) and the Adaptation Fund. The Adaptation Fund is funded uniquely from a share of the proceeds from the Clean Development Mechanism (CDM) amounting to 2% of Certified Emission Reductions (CERs) issued, but can also receive contributions from countries as part of

official commitments under the Convention. In addition the EU's Global Climate Change Alliance (GCCA) is one of the largest funders of adaptation activities (Schalatek *et al.,* 2012).

In parallel to the climate finance architecture under the UNFCCC, the multilateral development banks established a series of funds to distribute 'Fast Start Finance' commitments. The graph below shows the pledges and disbursement of funding as of July 2014. The PPCR (Pilot Programme for Climate Resilience) was established as a programme of the Strategic Climate Fund which is one of two funds within the CIF (Climate Investment Funds) framework. Operational in 2008, the World Bank serves as the Trustee and Administrating Unit for the PPCR, a role which has been controversial due to opposition by civil society bodies to the use of 'loans' for adaptation (EquityBD, 2011). The PPCR contains a 'sunset clause' under Article 57 which establishes the closure of funds once a new financial architecture becomes effective under the UNFCCC (CIF, 2008). The article states; "the SCF will take necessary steps to conclude its operations once a new financial architecture is effective". However, the subsequent Article 58 states the SCF may continue "if the outcome of the UNFCCC negotiations so indicates" (*ibid*). This is there to leave open the possibility of the continuation of the SCF if determined by the COP.

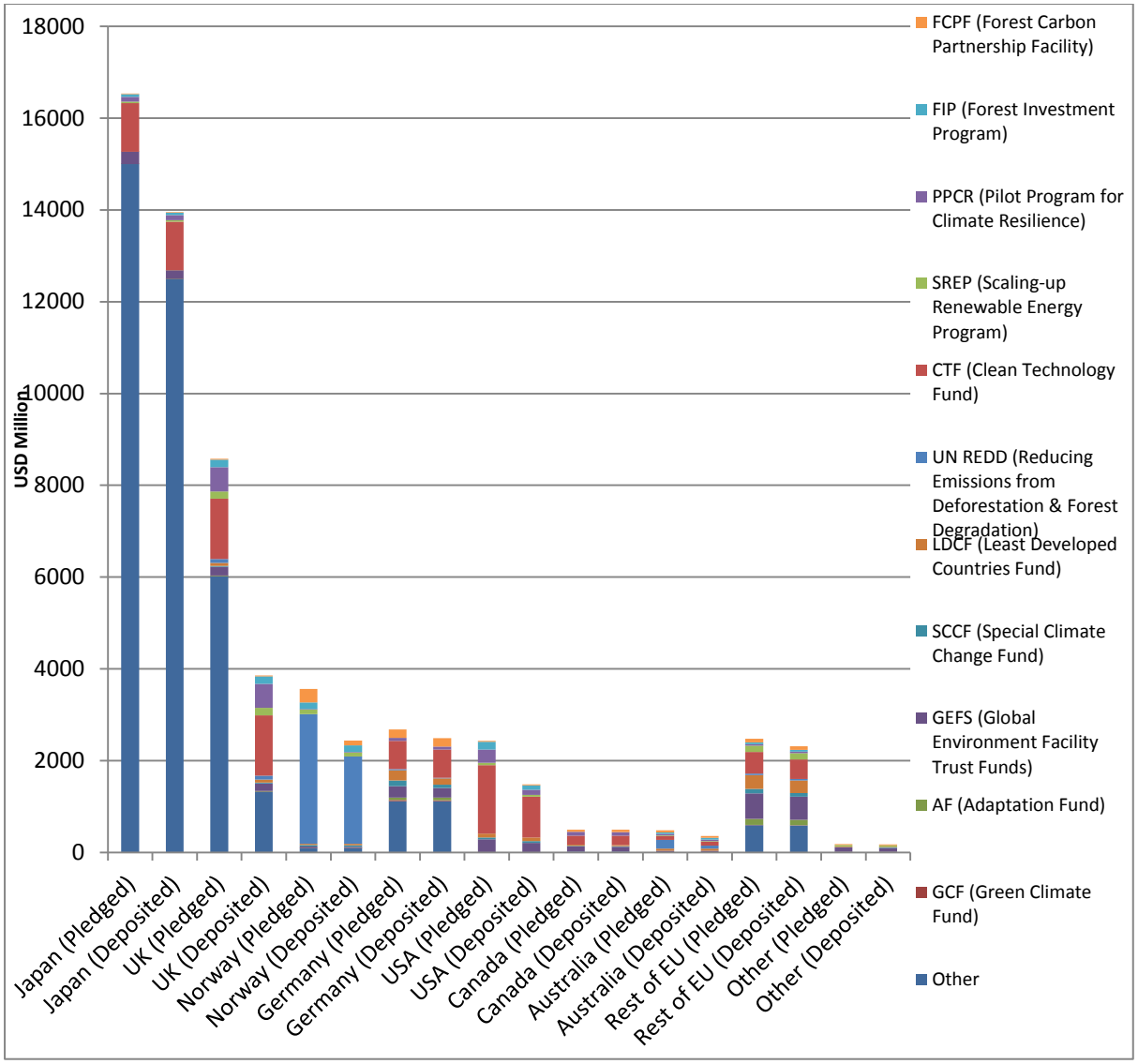


Figure 7.2 Climate Finance Pledges and Deposits, as of July 2014. Source: Author's Own, Data from: www.climatefundsupdate.org

The Development Co-operation Directorate (DAC) of the OECD has gathered statistical data on climate-related aid and in 2011, released the data using the 'adaptation markers' which shows that mitigation-related aid was estimated at $17.6Bn in 2010, whilst adaptation-related aid was at $9.3Bn (OECD, 2011). The fourth high-level forum on Aid Effectiveness was held in November 2011 in Busan, which re-iterated the importance of effectiveness for climate change finance under Article 34, calling for "coherence, transparency and predictability" in climate finance (OECD, 2011a). Adaptation finance has been marginalised historically by comparison to mitigation finance, although it has been seen as the priority for developing countries. The same can be said of adaptation as a whole (see Schipper, 2006). Columbian representative Cavelier pointed out in the Bonn UNFCCC meeting in 2012: "if

countries did not adapt today, they could not mitigate in the future" (Williams, 2012:vol.7411). In analysis of the 'fast state finance' commitments between 2010-12 it was reported by Derek Gibbs that in the earlier period, before 2012, adaptation made up only 10% of finance whereas in the latter period it reached 22% of total flows (Williams, 2012). Therefore there was no major readjustment in favour of adaptation, although some parties such as UK and Australia did achieve a balance in their funding allocation. Developing parties have also criticised the failure to use the direct access modalities of the Adaptation Fund (*ibid*). In more recent analysis by ODI, it was found that $5.2Bn of the $30.5Bn in FSF went to adaptation (around 17% of the total) (Nakhooda *et al.,* 2013).

At COP-16 in Cancun (Sixteenth session of the Conference of the Parties to the UNFCCC) in 2010, countries promised that the financial flows for climate change would reach a target of $100 billion per year. However, the 2010 World Development Report estimates that the overall cost of adaptation and mitigation in poor countries would reach $170-275Bn per year by 2030 (WDR, 2010). UNFCCC (2007a) estimated that global annual investment and financial flows of $200-210Bn would be needed in 2030 for mitigation alone. While countries agreed under 4.3 of the UNFCCC Convention to cover the 'agreed full incremental costs' of mitigation, there has been no agreement on what these costs are (Haites, 2011). Estimates of incremental costs are likely to be much lower than the levels of incremental investment, but are more difficult to calculate (Olbrisch *et al.,* 2011). Haites (2011:965) argues that estimating the costs of adaptation are more challenging because there is "no operational definition that can be used to specify adaptation measures" so this is usually done using sectoral estimates. Estimates are almost always limited to the costs of 'hard' infrastructure measures rather than 'soft' measures such as capacity building (Smith *et al.,* 2011) and the costs of operating and maintenance are also rarely included. It is challenging to estimate costs to natural ecosystems (see Parry *et al.,* 2009). Furthermore, we may question whether increased resilience is a cost or a benefit, whether to count residual damages as a cost (which has not usually been attempted), and whether benefits in one sector offset damages to another (Haites, 2011). The sensitivity of the adaptation costs to the choice of development baseline has not yet been explored (Smith *et al.,* 2011). Worryingly, the global estimates of the costs of adaptation assume a level of warming of 2°C, for example the World Bank estimate under the EACC estimated costs of $70-100Bn per year by 2050 (Narain *et al.,* 2011). In the case of Bangladesh, agricultural GDP is projected to be 3.1% lower each year

(US$36Bn in lost value-added) and total GDP US$129Bn lower due to climate change over the 45-year period 2005-2050 (World Bank, 2010b).

Whilst the Paris Declaration Principles on Aid Effectiveness have been invoked (see 7.3.5), Stern (2008) argued that an effective adaptation response to climate change must consider both efficiency and equity. Bird and Brown (2010) highlight the principles of timeliness, appropriateness, national ownership and focus on the most vulnerable. UNFCCC (2011a) argues equity is a key principle for adaptation, since climate change disproportionately affects vulnerable populations, most of whom are poor. Therefore, the distributional impacts of adaptation options and effective targeting are particularly important. Furthermore, although some broad principles have been developed for what climate finance can be expected to achieve, it has been noted there has not been sufficient attention to principles governing finance disbursement itself (Bird and Glennie, 2011). Other challenges include the concept of 'readiness' which has meant that so far, finance has often gone towards middle-income countries that are consider "more ready to absorb" (Bird and Glennie, 2011:2) as well as having increased emissions. In terms of the first Paris Declaration principle of ownership by developing countries, the Adaptation Fund's modalities for direct access have generated significant interest as an innovative element that seeks to ensure this (Brown *et al.,* 2010).

Researchers have previously tried to define 'successful adaptation' to climate change, and using an Delphi panel of experts, defined this as "*any adjustment that reduces the risks associated with climate change, or vulnerability to climate change impacts, to a predetermined level, without compromising economic, social or environmental sustainability*" (de Franca Doria *et al.,* 2009:p.815). This research will contribute towards this debate.

Bird and Glennie (2011:1) argue insufficient attention has been paid to country-level delivery mechanisms to ensure climate actions are "effective, efficient and equitable". Furthermore there has been little clarity about which type of investments will need to be made. Since climate finance will be different from development aid in various ways, there may a need for additional principles going beyond the Paris Declaration. For instance, a need for additionality beyond Official Development Assistance (ODA), which will be challenging since the existing commitment of 0.7% of GNI has not been met by many countries. Due to financial and budgetary pressures in the current economic climate, developed countries at the

UNFCCC have been pushing for the consideration and prioritisation of 'private flows' within climate finance as this is a key economic interest. Furthermore, oversight by OECD-DAC may not be preferable because the OECD has been seen by developing countries as a small club of elite countries who further their own interests (Bird and Glennie, 2011). Moreover, it is not clear whether focusing on 'aid effectiveness' principles, whilst it may have improved transparency, has actually led to improved effectiveness in reality.

Overall, finance for adaptation needs to be effective in targeting the most vulnerable and needs to be as efficient as possible. Since the funding is limited in comparison to projected impacts of climate change, it is all the more important to ensure it is as effective as possible in implementation and delivery. Therefore it is necessary to investigate principles by which this finance can be made effective, including 'ex ante' frameworks by which finance can be directed towards priority programmes or projects, and 'ex post' frameworks for results-monitoring and evaluation. This study will attempt to analyse both 'ex ante' methods of assessing adaptation options and prioritising the direction of finance, including vulnerability indices, and 'ex post' methods for monitoring and evaluating plans and projects after they have been financed. In the long-term it may also be necessary to ensure the 'mainstreaming' of climate change into the wide range of related government departments, national institutions and policies, which may include finance mainstreaming.

7.2. Finance for agricultural adaptation

This section aims to identify the flows of finance and investment that could make a contribution to climate adaptation, specifically for agricultural resilience and food security in developing countries. Particular attention is given to effectiveness in benefiting the most climate-vulnerable. As shown in chapter 6, the enabling environment is important in shaping the context in which adaptation can occur and there are a range of stakeholders and bodies that could be involved in promoting adaptation and resilience for agricultural finance, trade and investment.

Agricultural investment is a highly effective poverty reduction strategy. However, investment and growth in agriculture has been slow over the past decade (FAO, 2009). Schmidhuber et al (2009) estimate at least $83Bn of additional net investment is needed in agriculture year-on-year until 2050 to meet targets for poverty and food insecurity reduction, without factoring in climate change.

Parry and Boyle (2012) explore the different financing options for food security under climate change, and differentiate different types of public finance; (1) international development assistance, (2) microfinance institutions, (3) national governments. Climate finance specifically includes UNFCCC financing, climate finance outside the UNFCCC; and carbon markets. In terms of agriculture-related climate finance, Murphy (2011) argues that there is a need for 'triple dividend' funding tackling adaptive capacity, mitigation and food security altogether. This section also considers additional issues relating to finance for agricultural adaptation, including on-farm investment in agriculture (including microfinance), agricultural R&D investment, agricultural FDI and inclusive business models.

7.2.1. International development assistance

In real terms, Official Development Assistance (ODA) in the agricultural sector has declined between 1980-2005 (Parry and Boyle 2012). This trend is particularly stark when we view the trend of agriculture as a percentage share of ODA which has fell from 17% in 1980 to as low as 3.8% in 2006 (FAO, 2009; see figure below). Presently this percentage stands at around 5% as there was a slight increase due to the food crisis (*ibid*). Little of this finance within ODA is linked to climate change, and the limited extent to which the agricultural ODA is linked to climate change partially reflects the concerns climate finance should be new and additional (Parry and Boyle, 2012). Hence there is a suggestion that mainstreaming of climate change into agriculture is inhibited by the requirement for additionality. However, this may reflect a missed opportunity to encourage 'climate-smart' practices through initiatives such as the G8 leaders 2009 L'Aquila Food Security Initiative (*ibid*).

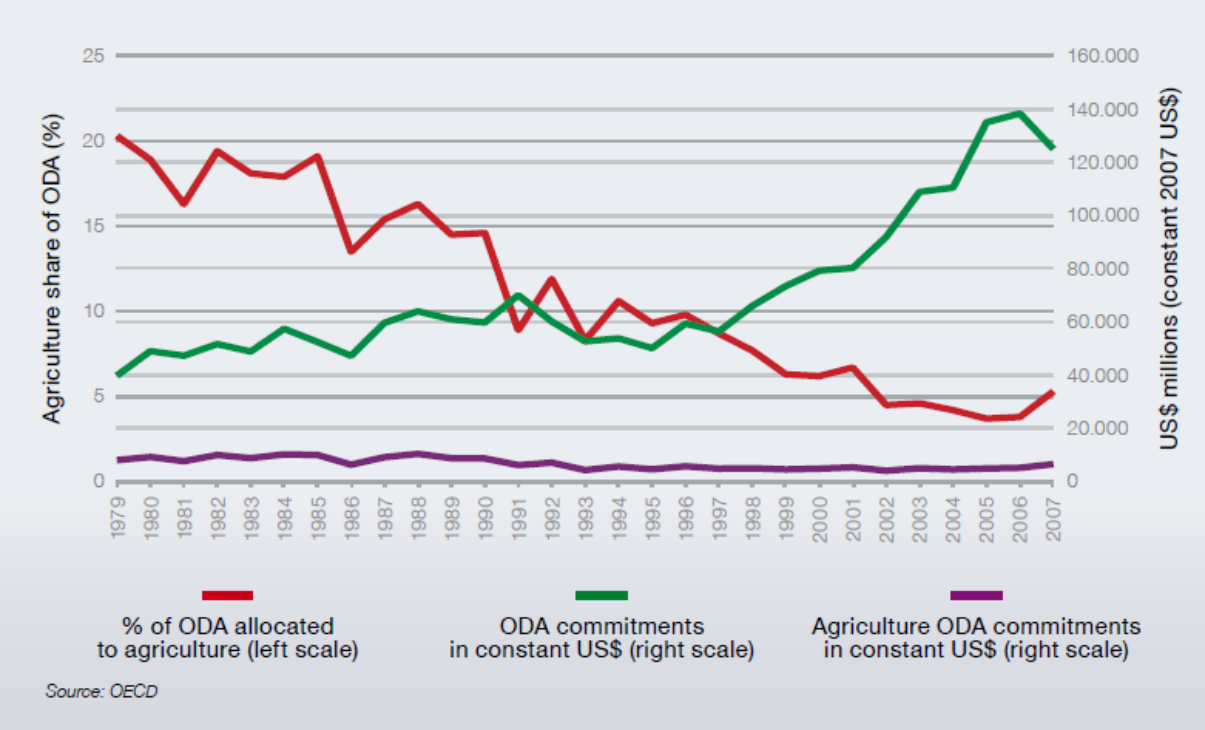


Figure 7.3 Annual ODA commitments: overall trends and share allocated to agriculture. Source: FAO, 2009

7.2.2. Climate finance and the UNFCCC

Within the UNFCCC system, the Least Developed Countries Fund (LDCF) has supported implementation of NAPAs (National Adaptation Programmes of Action) of which many projects (the largest share) relate to food security (Parry and Boyle, 2012). REDD+ (the United Nations Program on Reducing Emissions from Deforestation and Forest Degradation) and NAMA (Nationally Appropriate Mitigation Actions) plans both have relevance for agriculture and food security as well. Other UNFCCC channels include the SCCF and Adaptation Fund. Yet these funds have been dwarfed by the climate finance channelled outside the UNFCCC, including into multilateral development bank funds such as the PPCR and CTF (see Figure 7.2). Outside of the UNFCCC funds, the priorities have arguably largely been set by the developed countries and so these focus on mitigation primarily (refer to the introduction section above). At the UNFCCC it was discussed whether the Green Climate Fund ought to have an 'integrated' adaptation-mitigation window which could include agricultural activities (*ibid*). However, after recent GCF negotiations it appears the GCF will have separate adaptation and mitigation windows, with "enhanced agricultural and rural adaptation" as one of the sectoral results under the 'adaptation logic model' (GCF, 2014a:11).

7.2.3. National governments

Public spending has also fallen to around 7% on agriculture in developing countries (FAO, 2009; Hallam, 2011). It is as low as 4% in some agriculture-based economies, including some Sub-Saharan African countries (WDR, 2008). Since some developing countries receive ODA directly and report this in their spending on agriculture or agricultural R&D spending, Lowder et al (2012) notes there is likely to be double counting between ODA and government spending on agriculture or agricultural R&D.

Agricultural extension services could be pivotal in building adaptive capacity due to their role in reaching local farmers with information and tools for agriculture, and these systems may also benefit from reform and modernisation (Parry and Boyle, 2012). Furthermore, reforms in terms of land tenure could be beneficial. There are also opportunities for smallholder groups or cooperatives to deliver grants (*ibid*). Yet, it is argued the absorptive capacity of some governments is inhibited by weak governance systems or corruption (Parry and Boyle, 2012).

7.2.4. On-farm investment in agricultural capital, including microfinance

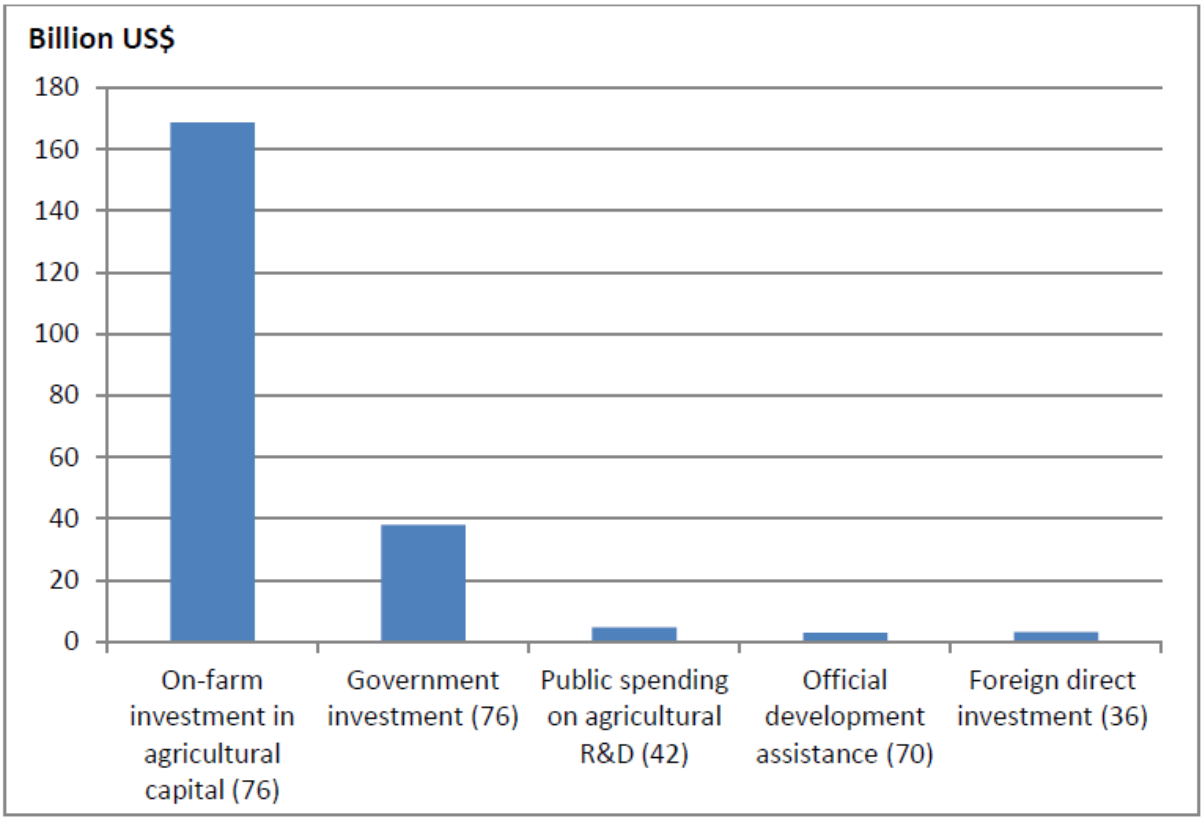


Figure 7.4 Average annual investment in agriculture in selected low and middle income countries by source (Source: Lowder *et al.*, 2012). Note: Number of countries covered is shown in parenthesis.

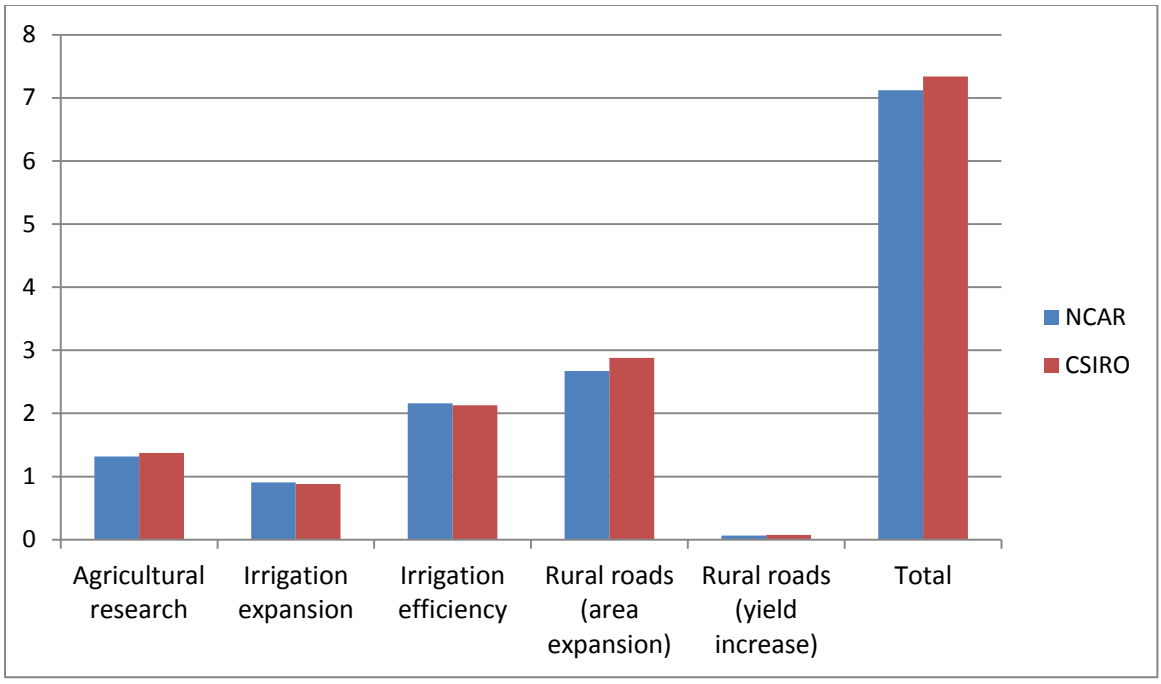


Figure 7.5 Additional annual investment expenditure in developing world needed to counteract the effects of climate change on nutrition (Billion/year in 2000 USD) (Source: Nelson *et al.*, 2010). Note: Results are based on yield changes that do not include the

CO2 fertilisation effect. 127 countries are included in the IMPACT model of the developing world.

Public investment in agriculture, as noted in the previous section, has faltered in recent years. In fact, as shown below, farmers themselves are by far the largest investors in agriculture in low and middle-income countries, dwarfing other forms of agricultural investment (Lowder *et al.,* 2012). On-farm investment by farmers is more than three times as large as all other sources of investment combined, and exceeds government investment by more than 4 to 1 (*ibid*). Moreover this is a conservative estimate. Much of the investment in agriculture is also intangible, for example, when farmers spend time and resources forming producer associations, a form of social capital that reduces risk and enhances productivity (*ibid*). Arguably, particular attention needs to be made to on-farm investment by smallholders, including helping women, and creating an enabling environment. In Lowder et al (2012) the on-farm investment category includes estimates of on-farm agricultural capital stock calculated in the FAO statistical database, including physical assets such as machinery and equipment, plantation crops, livestock and structures for keeping livestock. The category could therefore also be considered to be underlying physical capital making up one of the assets in the local adaptive capacity framework (see Jones *et al.,* 2010 and Chapter 4).

On-farm investment is contingent on access to rural finance. According to FAO, rural finance encompasses the range of financial services offered and used in rural areas by people of all income levels (FAO, 2013). This rural finance includes agricultural finance, dedicated to financing agricultural related activities like input supply, production, distribution, wholesale, processing, marketing (*ibid*). In addition, there is agricultural 'value chain finance' (taking account of inter-linked processes from farm to consumer and using them to increase efficiency and lower lending risk) (*ibid*). Finally, microfinance offers smaller loans and savings services to poor farmers, while accepting a variety of assets as collateral on the loan (*ibid*). Many countries have seen a microfinance boom in recent years, including the well-known example of Grameen Bank in Bangladesh. In Africa, innovative technologies are enabling expansion of microfinance, for example, 'M-PESA' in Kenya, which has enabled payments by mobile phone. Emerging ICT technologies provide new opportunities for rural finance and banking by reducing costs and alleviating asymmetries in information (Kloeppinger-Todd and Sharma, 2010). Furthermore, index-based insurance has been piloted in some areas as a way of managing climate risk in agriculture, although it is inhibited by lack of high-quality weather data (*ibid*).

The majority of microfinance institutions (MFIs) source their finance from multilateral development agencies. This intends to fill a gap, since commercial bank lending to the agricultural sector is small (FAO, 2009). However there may be a disproportionate focus on high-value cash crops for export (Parry and Boyle, 2012) and also concerns about transaction costs of microfinance, which excludes the poorest smallholders. Moreover, critics express concern that in places like Bangladesh, microfinance can have negative impacts, leading to debt and placing an additional work burden on women without empowering them (Karim, 2011a). Despite these objections, in countries like Bangladesh with MFI's, rural areas have outpaced rural areas in neighbouring countries (like India) against various development indicators, and this success can be partially attributed to microfinance (Dreze and Sen, 2013). However, it is clear microfinance is not a panacea for poverty reduction or similarly, adaptive capacity in the face of climate risk. In the words of Mohammed Yunus, microfinance works best as a poverty reduction tool when it is "combined with other innovative programmes" (Chowdhury, 2009:2). Furthermore, a proliferation of small micro-enterprises will not by itself reduce poverty and build up adaptive capacity. There is a need for other supply-side (infrastructure, skills) and demand-side (macroeconomic) factors to make those micro-enterprises more productive (*ibid*).

7.2.5. Private Finance: Challenges and Opportunities

Agriculture accounts for less than 10% of commercial bank lending in developing countries (FAO, 2009). Thus, as shown above, the majority of private investment in agriculture comes from informal national sources like friends and family (Havermann & Muccione 2011, in Parry and Boyle, 2012). However agricultural FDI plays an increasingly important role, as described in the box below. Yet, there are limitations to the extent which the private sector can be mobilised to engage in adaptation in vulnerable countries. Investment opportunities for FDI are lower in low-income countries as a result of worsening business conditions and increased informality of the economy (CAN, 2013). This may therefore leave the most vulnerable countries marginalised, where needs are greatest.

Box: Agricultural Foreign Direct Investment (FDI)

Investment in agriculture makes up only a tiny percentage of total flows of foreign direct investment to developing countries. FAO (2013) estimated that the average annual inward FDI flows over 2007-2008 were USD $922.4Billion but the FDI into agriculture (including hunting, forestry and fisheries) represented only 0.4% of this. However, trends in FDI were also found to be difficult to monitor and track due to missing data, and the private investments by institutional investors (mutual funds, banks, pension funds and hedge funds) were not included in these estimates (ibid).

FDI (foreign direct investment) in agriculture in developing countries has also been increasing, with growing economies such as China and India playing a growing role, as well as a spike due to the 2008 food crisis and growing demand for biofuels (Parry and Boyle, 2012). However, there are concerns over recent large-scale land acquisitions, known as 'land-grabs' which are of little benefit to the local food-insecure population (ibid). Criticisms have also arisen where the FDI promotes mechanised practices that generate fewer employment opportunities or depletes water resources and biodiversity. There are important implications for food security if the food produced is destined for export. Often, the legal framework favours the investor rather than the host country (Hallam, 2009). There is therefore an urgent need to monitor impacts of international investments and to catalogue best practices in law and policy, in order to minimise risks and maximise benefits (ibid). Regulatory approaches towards product labelling, certification schemes and focus upon the sustainability of commercial supply chains could help alleviate some of these concerns. While an International "code of conduct" to promote responsible investment has been suggested as a solution (Hallam, 2009) critics have argued that such a code of conduct would not lead to pro-poor outcomes because the objective of such land transfers is not to protect the interests of the poor (Borras and Franco, 2010).

Mechanisms to mobilise the private sector can use public funds to incentivise private-sector investments. An example is the IFC (International Finance Corporation) loan engaging private-sector seed companies in development of stress-tolerant varieties as part of the PPCR in Bangladesh (IFC, 2014). Another example is the 'Katalyst' project, a DFID-funded project in Bangladesh that worked with Banglalink (a mobile company) to launch an agricultural helpline (see www.katalyst.com.bd). Direct instruments include grants (including subsidies), debt (loans, credit lines), equity (public or private, shares), quasi-equity (debt-based or equity-based loans), de-risking instruments (loan guarantees, insurance) (CAN, 2013). Governments can also use indirect tools, like enacting legislation affecting private companies, or creating a bond market (CAN, 2013; Moriel and Bordier, 2012). Indirect instruments include market mechanisms (e.g. an 'adaptation credit mechanism'), bonds,

internalisation of adaptation costs by companies, or technological development and transfer (*ibid*).

Challenges for mobilising companies to internalise risks in their agricultural value chain include the fact that many companies have been found to be aware of climate risks, but due to the uncertainty and long-term nature of climate change, few companies implement actions to tackle these risks (CAN, 2013). Private investment requires an 'enabling environment' including legislation and institutions. Also, some adaptation projects are "non-bankable" in that they do not generate a cash return or it is too small (*ibid*:13). This may be applicable for many vulnerable smallholder farmers, already struggling regularly from issues such as drought or floods. Most agricultural investments have focused on cash crops and industrial production (*ibid*). Another challenge for private sector engagement is that there is no established methodology for the estimation of leverage ratios for private adaptation finance (Pereira, 2013). In addition, public actors engaged in the same project often claim to have leveraged one anothers' money, leading to double counting (*ibid*). Existing safeguards are largely insufficient since Multilateral Development Banks (MDBs) and other DFIs (Development Finance Institutions), like IFC, continue to support fossil-fuel based energy projects, and often fail to ensure ethical practices are kept to, for instance, preventing use of tax havens which could undermine developing countries' revenues (CAN, 2013).

7.2.6. Agricultural R&D investment

There is likely to be a significant deficit in investment in private Research and Development (R&D) for technologies related to adaptation to climate change. The IAASTD found that only 6% of global agricultural R&D investments were spent in the 80 low-income countries with a combined population of 600m people (IAASTD, 2009 in Glatzel *et al.,* 2012). Lack of investment in private R&D for climate change can occur because the commercial payoffs are uncertain and long-term (Grubb, 2004). Levels of uncertainty about the precise geographical impacts of climate change can make estimating returns extremely difficult (Newell & Wilson, 2005).

Research suggests that investment in agricultural R&D pays off. For example, in Bangladesh, it has been estimated that TFP has grown by slightly more than 1% per annum from 1975-6 to 1997-8 (Pardey *et al.,* 2006). Estimates by Ahmed and Karin (2006) in Pardey et al (2006) show that the TFP increase of 1% annually equates to 170,000 metric tons of rice, valued at $42.5 million (1.913Bn Tk), while the public expenditure on rice research averaged only

118.9m Tk during 1990-7, suggesting a benefit:cost ratio of around 16:1 which is an extremely high rate of return.

As part of their review for the Foresight Report, Piesse and Thirtle (2010) found that the public sector share of R&D expenditures in agriculture has fallen and that there has been a rapid concentration in the private sector, where six multinationals now dominate. These companies are now accumulating intellectual property to an extent that public and international institutions are disadvantaged (*ibid*). It is argued the functions of the multinational corporations are largely incompatible with those of poverty reduction (Piesse and Thirtle, 2010). Participation of private entities in agricultural R&D is also hindered by the lack of IPR in developing countries (Pardey *et al.,* 2006). Realistically, Pardey et al (2006) argue one should not expect private funding to displace public funding in developing countries, and that public involvement will be required if biotechnology products are to be developed for subsistence farmers.

Whether the source of R&D funding is public or private is important because "governments may be more inclined to make technology available to a wider group of enterprises than private-sector individuals" (Abbott, 2009:22). Privately-funded R&D outcomes will be subject to the IP rights retained by the company or companies involved (Wright and Pereira, 2012). Yet, publicly funded R&D outcomes do not always become available publicly as there are various other barriers to commercialisation (*ibid*). Results stemming from public R&D are not necessarily publicly available, as the IP rights may be publicly-owned and therefore retained by the public entity so the technology is still not commercialised. Overall, a key challenge in policy relating to patenting is ensuring that publicly-funded research yields the maximum possible societal benefit. For example, patenting on seed varieties could potentially act as a barrier to uptake of new drought-resistant seed varieties, like sterile GM varieties that undermine farmers' abilities to save seeds. Publicly-funded R&D in resilient seed varieties can overcome these types of problems as the resilient seeds can be made available to all. For further details on this issue, refer to Glatzel *et al.,* 2012. Recommendations for adaptation finance are discussed in the conclusions section.

7.2.7. Inclusive business models

In their survey of inclusive business models that provide opportunities for smallholders, Vermeulen and Cotula (2010) find that there are a range of business models that provide an alternative to large-scale land acquisitions. These include contract farming, management

contracts, tenant farming and sharecropping, joint ventures, farmer-owned business and upstream/downstream business links. The study found no single model emerges as the best possible option for smallholders - this is very much context-specific and contingent on tenure, policy, culture, history and biophysical considerations (*ibid*). In fact "the devil is often in the detail" – with the detail often being more important than the abstract model (Vermeulen and Cotula, 2010:6). For example, while joint ventures can be a vehicle for greater local control, at times this can be nominal in practice (*ibid*).

7.3. Issues and Challenges for Adaptation Finance

This section seeks to explore various issues and challenges for adaptation finance, building upon the literature review, and then informed by stakeholder interviews (see Chapters 8-10). The issues explored below are non-exhaustive and are limited to a select number of the total number of possible issues. Subsequently, an indicative framework of criteria for analysis is developed.

7.3.1. Additionality

As described above, the Cancun Agreements (Art. 95) take notes of the promise for $30Bn USD in "new and additional" financial resources for the period 2010-12. This is understood as being new and additional to existing aid commitments such as official development assistance (Bird and Brown, 2010) in alignment with the polluter pays principle. However, in terms of agreeing on set 'additionality' criteria, according to Smith *et al.,* (2011) there has been no agreement on assessing whether finance is 'new and additional', and depending on the baseline choices, between all and almost none of the amount pledged as Fast Start Finance was new and additional. Of Fast Start Finance (2010-12) it was reported that around 80% ($24Bn of $30Bn) was sourced from ODA commitments (Nakhooda *et al.,* 2013). In that sense the fast-start period may just represent a re-branding of existing ODA commitments as climate finance. Furthermore, only one of the top five contributor countries (Norway) had met the Monterray commitments to deliver 0.7% of GNI as ODA both before and during the fast start finance period, demonstrating that there is already a development deficit (*ibid*).

Additionality is challenging because in addition to the additionality in ***volume***, there are some calls for climate finance to be additional in terms of ***practice***, which may not be practical since there is already a 'development' deficit and much of the underlying vulnerability to climate change is due to the development deficit. That pre-existing vulnerability is why there

is arguably a continuum from activities that target underlying vulnerability or development, to activities that target additional climate impacts (McGray *et al.,* 2007). In fact, three-fifths of the projects in the NAPAs fitted into the category of 'vulnerability reduction' meaning that these investments are basically for development, but can also reduce vulnerability to climate change (Smith *et al.,* 2011). It may be more appropriate for climate finance to target underlying vulnerability and urgent development needs which is why at the ground level, adaptation activities may often look like conventional development activities. The 'adaptation deficit' (also known as the development deficit), in terms of the degree to which societies are not adequately adapted to the current climate, has not been included in all estimates of adaptation finance needs, an exception being for the 2009 study by Parry et al (Smith *et al.,* 2011). Hence these studies did not estimate the cost of reducing present vulnerability.

According to Werksman et al (1996:248) additionality "describes the origins of the financial resources needed to solve global environmental problems," while incrementality "determines the total size of those resources" but these concepts interlock since the greater the 'incremental' costs of climate change, the more 'additional' resources are required. The concept has different definitions for developing and developed countries, depending on their interests. For developing countries, the concept drew from concern that contributions to GEF should not diminish funds available for development (*ibid*). For developed countries and donors, they have supported definitions that "place their practices in the best light" (Werksman *et al.,* 1996) including definitions that mean they could count their contributions as 'additional'. GEF has adopted rules that mean that the 'additional' costs of responding to climate change are identified with comparison to a counterfactual (Nakhooda, 2013a) and only those additional costs have been financed. GEF will only fund the 'incremental' costs of activities that generate 'global environmental benefits' (Verheyen, 2005). Unsurprisingly, this has proved difficult and controversial to apply to practice, especially in light of the well-recognised links between development and climate change (Nakhooda, 2013a). Developing countries have expressed concern that developed countries have disallowed projects which are domestically beneficial from being eligible for funding (Werksman *et al.,* 1996). Arguably, adaptation activities are more likely to have close links with development benefits than mitigation activities, and thus they are even more difficult to finance under this approach. Overall, this problem could be resolved by more flexible criteria under the GEF. Alternatively, the problem could be resolved by providing climate finance to mainstream

adaptation and mitigation into development (as is currently happening) whilst also scaling up ODA commitments to meet the 0.7% of GNI target in order to ensure the 'adaptation deficit' is addressed.

7.3.2. Adequacy

A key issue relating to adaptation finance is the adequacy of finance provided. This issue has been highlighted by the Parties under the UNFCCC, for instance under Decision 8/C.19 it is one of the criteria to be used to assess the effectiveness of the financial mechanism, under the fifth review of the financial mechanism (UNFCCC, 2013d). As described above, there have been various different estimates of the costs of adaptation to climate change. Some of these estimates and their various methodologies are shown below:

Table 7.1 Global adaptation cost estimates.

Source	Cost of adaptation in US$ billion p.a.	Comments/Methodology
World Bank (2006)	9 – 41 (8-34 in 2009)	Cost of climate-proofing FDI, GDI and ODA flows
Stern (2006)	4 – 37 (3-31 in 2009)	Update, with slight modification of World Bank (2006)
Oxfam (2007)	50 (40-41Bn in 2009)	Based on World Bank, plus extrapolation of costs from scaling up NGO projects and immediate needs in NAPAs
UNDP (2007)	$86 – 109Bn ($70-89Bn in 2015)	World Bank plus costing of 'climate-proofing' poverty reduction strategies and better disaster response
UNFCCC (2007)	$49 – 171Bn by 2030 (of which $28-67Bn in developing countries)	$28-67 Billion of this would be in developing countries. Only 5 sectors were included: infrastructure, agriculture (including forests and fisheries), water, health and coastal zones. ***Parry et al (2009) argued this may be underestimated by a factor of 2 or 3 since it does not include estimates for important sectors (mining and manufacturing, energy, retail, financial sectors and tourism).***
World Bank (2009)	$75 – 100Bn (between 2010-2050)	Higher estimates under the wetter NCAR scenario than the drier CSIRO scenario. Assumes a 2 degree warmer world.

Sources: ECA, 2009 and various given above

In terms of the adequacy of climate adaptation finance, estimates of the costs of adaptation to climate change are uncertain at present. The World Bank's Economics of Adaptation to Climate Change (EACC) Study estimated the costs of the impacts of climate change to be around $75-100Bn/year between 2010-2050, assuming 2°C of warming (World Bank, 2010b). The UNFCCC placed the costs of adaptation to climate change at between $49Bn to

$171Bn per annum by 2030, of which $28-67Bn would be in developing countries (UNFCCC, 2007a). Parry et al (2009) argued that these figures may be underestimated by a factor of 2 to 3, since it does not include estimates for various important sectors such as mining and manufacturing, energy, the retail and financial sectors and tourism. Furthermore, these estimates assume that warming is kept at 2°C degrees, a level which is not guaranteed. In fact, current post-Copenhagen pledges see the world headed to 3.7°C of warming (Hare, 2013).

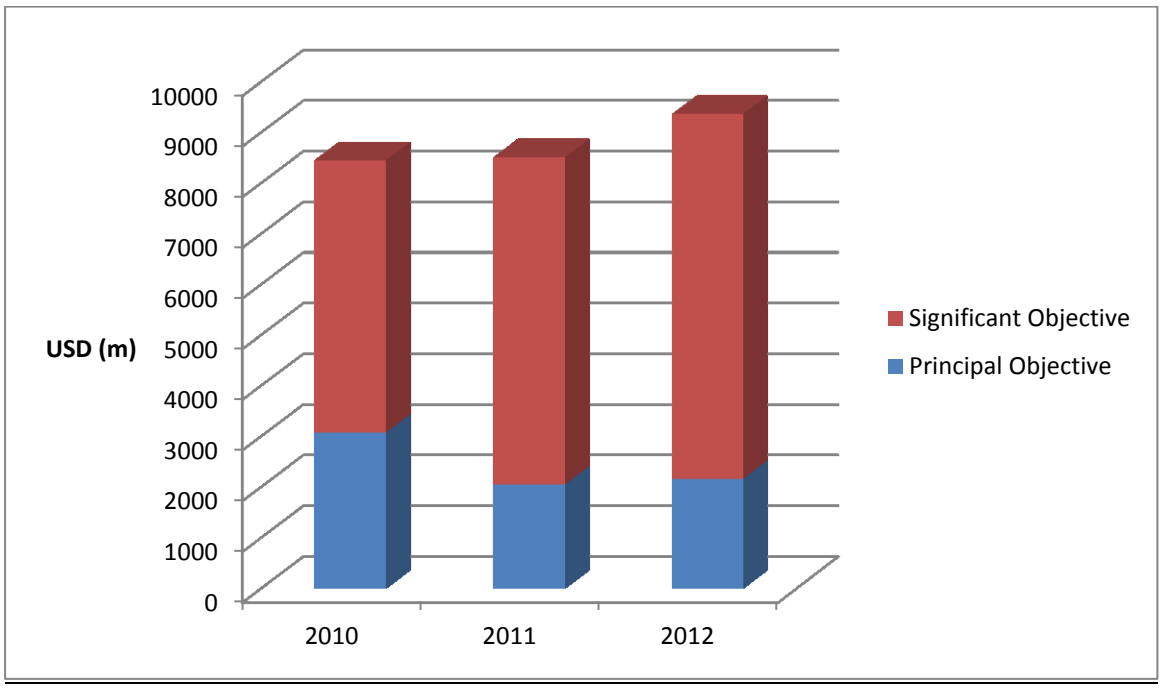


Figure 7.6 Adaptation-related finance, using the OECD-DAC Rio Marker for Adaptation (Source: OECD, 2014)

The data from the OECD (above) shows that adaptation-related finance has increased slightly between 2010 and 2012, but the proportion of finance with adaptation as the principal objective has fallen. Overall, the data provided showed that an average of 42% of adaptation ODA also targets mitigation, 31% targets biodiversity, and 20% targets desertification objectives (OECD, 2014). For both adaptation and mitigation, it was found that the total climate-related aid per year between 2010-2012 reached USD 21.5Bn, with 58% targeting mitigation only, 25% targeting adaptation only, and 18% of the total targeting both together (*ibid*). It was estimated that 69% of bilateral adaptation-related aid was through grants. Note that these figures are slightly different from the ODI estimates.

Research of the climate finance landscape in 2013 has actually found that global climate finance for developing countries has plateaued at around $182Bn in 2013, which has not increased from 2012 (Buchner *et al.,* 2013). The amounts falls well short of the amount required for estimated investment needs for a further successive year, making the keeping below 2°C of global warming even more challenging (*ibid*). Of this amount, only $11Bn is estimated to have been delivered by grants, the rest is instruments such as risk management, debt, and equity (Buchner *et al.,* 2013).

7.3.3. Efficiency and Mobilising Private Action

Efficiency has been another key outcome that has been highlighted as crucial for climate finance. Efficiency, along with effectiveness, were both highlighted in the governing instrument of the Green Climate Fund (UNFCCC, 2011b). This has normally been associated with cost-efficiency, including achieving the least (or lower) economy cost, and also having low transaction costs which means more of the finance gets to activities on the ground (UNEP, 2011). Cost-efficiency is usually measured through use of various economic metrics; for instance return on investment (ROI) or benefit-cost ratio (BCR). Arguably the efficiency of climate finance is also linked to timeliness, which means dealing with the urgent and immediate needs in an efficient way, and also to flexibility. UNEP (2011:24) argues that bilateral finance institutions (BFIs) have "easier and faster modalities for disbursement, and higher flexibility to decide and close on innovative financing solutions". The use of blending instruments, or concessional and non-concessional loans, enables donor to claim to have leveraged higher amounts of climate finance without the same implications for their own budgets. Research has shown that some countries' reports count the leveraged finance towards climate finance contributions (Nakhooda *et al.,* 2013). However, as we see in this section, there can be equity implications.

According to the 'polluter pays' principle the finance ought to come from the emitting countries and therefore should be distributed as grants from public finance from developed-country donors. Arguably, and with limited resources available, there has been a push for climate finance to place a greater emphasis on "private flows and innovative public sources of finance" (Bird and Glennie, 2011:2). With the recession, many governments have tightened their budgets and limited public spending. The focus on the private sector has been emphasised in the UNFCCC convention text. Paragraph 99 of the Cancun Agreements states that funds provided to developing countries "may come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources" (UNFCCC,

2010). The governing instrument of the GCF states under paragraph 3 the GCF will "play a key role in channelling new, additional, adequate and predictable financial resources to developing countries " and will "catalyse climate finance, both public and private" (UNFCCC, 2011b). The GCF agreed to establish a 'Private Sector Facility' under decision B.04/08 to address barriers to private sector investment in adaptation and mitigation activities, such as market failures, insufficient capacity and lack of awareness (GCF, 2013:48). The GCF Board also established a Private Sector Advisory Group.

However, developing countries and civil society organisations mistrust the emphasis on the private sector as it is seen as a way of avoiding international obligations under the 'polluter pays' principle. Hence, the issue of the balance between public and private finance is linked to the principle of equity. Multilateral programmes such as the PPCR administered by the World Bank have been criticised by civil society organisations for providing loans for climate adaptation (Chowdhury, 2011), and there may be a trade-off between equity and efficiency in certain cases where the balance is determined by power. For example, there might be pressure on donors to prioritise cost-efficiency over equitable distribution. The track record of the private sector shows that private finance is difficult to deploy responsibly in low-income countries and marginalised communities (Pereira, 2013). Arguably, adaptation in particular offers few commercially profitable opportunities for private financiers (Pereira, 2013). Thus there can be a conflict between the objectives of equity and value-for-money, because those who need the money most are more difficult to invest in, whilst those who are making money, are not usually those who need it.

Yet private finance is clearly important to consider for adaptation since the private sector accounts for approximately 85% of all investments worldwide (CAN, 2013). In addition, up to 90% of the population in developing countries depends on income from the private sector, and the private sector represents close to 75% of global climate finance flows (CAN, 2013). In Bangladesh, for example, SMEs make up 90% of all industrial enterprises (Alam and Ullah, 2006). Clearly, engagement of the private sector needs to be done in the right way to build trust, maximise benefits, and to ensure that funds are not misappropriated by rent-seeking activities. It is particularly vital to engage the private sector in mitigation, since investments in fossil fuels continue the emissions of greenhouse gases. Institutional investors and pension funds are heavily invested in fossil fuel energy resources. Research by the LSE Grantham Institute shows between 60-80% of coal, oil and gas reserves of publicly listed companies are 'unburnable' if the world is to have a chance of not exceeding global warming

of 2°C (Carbon Tracker, 2013). It is therefore vital for such funds to address climate risk by divesting from fossil fuels and adopt a 'carbon budget' approach to climate risk and capital allocation (*ibid*). The study called on financial regulators and ratings agencies to incorporate systematic assessment of climate risk into their methodologies (*ibid*).

There is evidence many adaptation options are cost-effective. Some actions are also 'no regret' actions in that they are suitable under a range of scenarios (including no climate impacts). Results using the Economics of Climate Adaptation (ECA) methodology show that in general, between 40-65% of the projected increase in losses due to climate change can be averted cost-effectively which demonstrates strongly the importance of adaptation finance (WEF, 2014). The ECA approach uses a threefold methodology which involved scenario planning (developing a base, moderate and high scenario for climate change); assumptions to forecast economic and population growth; and assessment of adaptation measures using cost-benefit analysis (ECA, 2009:p.123). In the case of drought risk in Maharashtra, India, a large proportion (around 50%) of the adaptation measures had lifetime economic benefits greater than costs showing they can be cost-effectively averted (ECA, 2009:p.84). Another 30% of the losses could be avoided through insurance (risk transfer), but the remaining 20% would be a residual loss (*ibid*). This demonstrates the potential of low-cost and 'no regrets' adaptation options like irrigation or drainage construction. However, just because a project is cost-effective with a high BCR, this does not mean it would have occurred without public investment, since there may be other risks or costs which prevent private investment such as transaction costs or non-excludability of 'free riders'.

Some adaptation funds, such as the GEF, have a 'leverage ratio' stipulating that applicants must generate an appropriate ratio of 'co-finance'. For example, during phase 2 and 3 of GEF (GEF-2 and GEF-3), the average co-financing ratio of approved GEF projects was more than1:4, while it increased to over 1:6.4 in GEF-4 and over 1:7.8 in GEF-5 (GEF, 2013). However, as the GEF itself confirmed in 2002, "some countries have less opportunity than others to raise co-financing, because their economic development, absorptive capacity, and familiarity with GEF and global environmental issues makes this difficult. For this reason, it is important to retain low co-financing targets for foundational efforts that build capacity and for small activities" (GEF, 2002:7). Some countries may be disadvantaged by high leverage ratios, such as least developed countries (LDCs) with less developed financial sectors. Yet it has been noted 'co-finance 'or pooled finance is not the same as leveraging, because other bodies or organisations might just as well have claimed to have leveraged the GEF money

(Griffiths, 2012) . This results in the problem of 'double counting' of climate finance. Often, two MDBs each claim to have leveraged each other's money (Brown *et al.,* 2011). GEF also use 'leveraging' describe funding mobilised later through replication (Brown *et al.,* 2011) (an example of scalability), but this would not be considered in a 'leverage ratio' because it is mobilised after the fact. Commentators have pointed out that high leverage ratio actually implies lower financial additionality, because it implies that the project is more likely to have occurred anyway without public sector involvement (Griffiths, 2012).

Data available from GEF suggests it may be more difficult to 'leverage' (co-finance) private finance for adaptation than for mitigation. The overall co-financing ratio from GEF projects on mitigation between 1991 and 2013 was 6.7 according to data reported at the COP (UNFCCC, 2013d). In mitigation, sustainable transport and urban projects in the reporting period had a particularly high co-financing ratio 22.8 (*ibid*), perhaps reflecting ease of access to co-finance in this area. By contrast, NAPA projects for adaptation under the LDCF had a co-financing ratio of 4.5, while the co-financing ratio under the SCCF for adaptation was 7.4 (*ibid*), which might also reflect the difficulty of getting co-financing for NAPAs. However, the relatively high co-financing levels for mitigation might also reflect the overall availability of mitigation finance compared to adaptation, so it may be difficult to draw firm conclusions from these leveraging ratios. Moreover, it may be more difficult for some countries to get co-financing than for others, as the co-financing ratio under GEF was lower for Africa (1:6) than for Asia (1:92) (UNFCCC, 2013d) . Since vulnerable LDCs in Africa find it more difficult to attract private investment, this might be another reason why the co-financing ratio was lower for these countries. Overall, at the global scale it does seem that private finance is used more commonly for mitigation than adaptation. Buchner et al (2013) estimated that all of the adaptation flows captured using their 'landscape of climate finance' methodology were publicly-funded. However, the same report also states there is little agreement on what qualifies as adaptation finance or what qualifies as an adaptation intervention.

The GEF Council views co-financing as an indicator of a project's sustainability, country ownership and mainstreaming of GEF activities in those partners institutions, as well as being an indicator of the GEF's 'multiplier' effect in generating additional resources (GEF, 2009). At the local scale one could argue that if direct beneficiaries are willing to contribute to a project, in-kind or through labour, it is an indicator the project is truly beneficial and the activity will be maintained into the future. However, analysis by GEF of the links between the levels of co-financing and outcomes and sustainability ratings was inconclusive (GEF,

2005). There may also be a level of co-financing beyond which "the risk of the GEF's losing leverage increases the chance of compromising the achievement" (*ibid*:17). Moreover, in poor areas with an adaptation deficit it could be envisaged that local people (or private actors) would not often have capacity or incentive to co-finance an adaptation project. By contrast to the GEF, the Adaptation Fund does not require co-financing and will fund the "full cost" of adaptation with grant funding (Adaptation Fund, 2012). Overall, adaptation planners must ensure such efforts to mobilise private contributions do not place an additional burden on the most vulnerable, for instance through increasing debt (see 7.2.4).

7.3.4. Equity

It can also be argued that insufficient attention has been paid to the principle of 'equity', which would dictate that resources should be made available to the most vulnerable (Bird and Brown, 2010). This can be considered as equity in disbursement of climate finance. The balance between public and private sector finance for adaptation can also be considered to be another equity issue, discussed further above. This can be considered to be an issue of equity in mobilisation. For example, civil society groups have expressed concern regarding the provision of loans for adaptation (EquityBD, 2011) arguing that this violates the polluter pays principle.

Another element of the 'polluter pays' principle is that the finance would be mobilised from those countries with historical responsibility for climate change. The graph below shows there is no relationship between the fast start provided per capita and CO2 emissions per capita. However, the division within the UNFCCC of Annex-I and non-Annex-I Parties' (mainly developing countries) was supposed to draw a division between those with less responsibility for climate change (the latter group) and those with more responsibility.

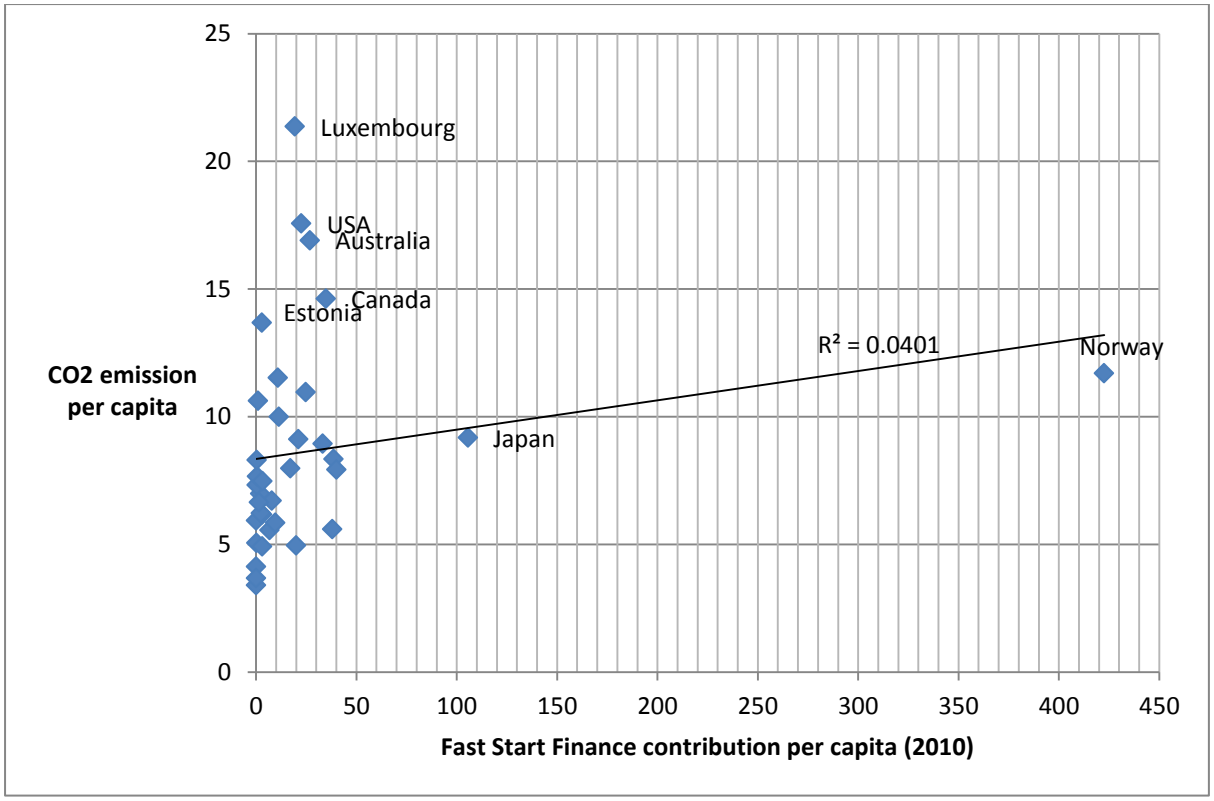


Figure 7.7 CO2 emissions/capita in 2010 against total fast start finance contribution/capita (Source: Data from World Bank, 2011 and Climatefundsupdate.org)

In the Durban COP-17 decision on establishment of the GCF, the guiding principles of the governing instrument were agreed in Article I of the Annex and stated that the fund will "operate in a transparent and accountable manner guided by efficiency and effectiveness" (UNFCCC, 2011b) but within the governing instrument of the Green Climate Fund, 'equity' or equitable distribution was not mentioned. Under the operational modalities (Annex V.E) it states that the allocation of resources for adaptation should take into account "the urgent and immediate needs of developing countries that are particularly vulnerable" (*ibid*) but it does not state that the resources ought to target the most vulnerable. This is despite the fact equity was a founding principle in the original UNFCCC Convention. The UNFCCC Convention (Art.1) called on countries to "protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities" (UNFCCC, 1992). UNFCCC (2011a) explains that equity is a key principle for adaptation because, as pointed out by the IPCC, climate change disproportionately affects vulnerable populations, many of whom are poor. Therefore, it is particularly important to consider the distributional aspect of adaptation finance.

In terms of justice and equity, Paavola (2005) argues that climate justice includes both procedural and distributive aspects. In relation to climate adaptation finance, procedural justice would involve the inclusion of a range of stakeholders in the decision-making process, including vulnerable groups who are most affected by climate change. At the international scale, we can consider this as relating to the inclusion of LDCs in decision-making relating to finance, for instance through direct access modalities. At national or local scales this will include the participation of affected communities. Arguably, Nepal offers and innovative model as the 'LAPA' model seeks to ensure that 80% of climate funds will reach the local-level, but procedural and implementation modalities have not yet been fully established. Bird et al (2013) argue that one way to ensure climate finance reflects local priorities is through increasing the role of local government.

The issue of equity and procedural justice is linked to legitimacy of climate finance. Bird et al (2013) link the issue of stakeholder engagement in climate finance governance to legitimacy, because legitimacy refers to the procedural processes of decision-making as well as related governance arrangements (Biermann and Gupta, 2011). However, in reality, Bird et al (2013) concede that those directly affected by climate change at local levels often lack a powerful voice with which to influence climate-related policy-makers in government. Yet we can also consider that this lack of representation and marginalisation may also be driver of climate change vulnerability, for example, because policies do not consider the needs of these groups. Thus it is suggested that it is prudent for adaptation projects to adopt best practices with regards to stakeholder engagement and participatory processes, drawing on CBA projects.

7.3.5. Monitoring effectiveness

Anderson (2011) argues that monitoring and evaluating (M&E) for adaptation activities needs to be based on the needs of the climate-vulnerable poor, and thus cannot be based only on quantifiable impacts. This is especially true where adaptation gains will be achieved by behavioural and institutional changes, such as improving governance, which cannot easily be assessed by impact evaluations (*ibid*). Furthermore, it is problematic if time and financial resources are consumed by working out 'adaptation is additional to development' rather than pragmatically using developmental indicators as proxies (*ibid*). In the PPCR and Adaptation Fund results frameworks, there is evidence of developmental outcomes linked to the tracking of 'adaptive capacity'. Monitoring results of adaptation becomes increasingly difficult under

the shifting baseline of climate change (Brooks *et al.,* 2011) because the context is changing and there is uncertainty.

Box: Aid Effectiveness Principles
The Paris Declaration on Aid Effectiveness enshrines five principles which are also useful for the evaluation of adaptation finance (OECD, 2005):
(1) Ownership by developing countries
(2) Alignment using local systems
(3) Harmonisation to avoid duplication
(4) Results and measuring of results:
(5) Mutual accountability for results
Experts have suggested that climate finance may have to move beyond these principles in order to be effective and incorporate other principles. For example, McGray and Spearman (2011) argue that the principle on measuring of results must include moving beyond outputs to meaningful outcomes and lasting impact. Bird and Brown (2010) highlight the principles of timeliness, appropriateness, national ownership and focus on the most vulnerable. Stern (2008) argued that an effective adaptation response to climate change must consider both efficiency and equity. It has been argued that oversight of adaptation finance by OECD-DAC, the body which oversees the Paris Declaration, may not be preferable because the Development Assistance Committee of OECD has been seen by developing countries as a small club of elite countries who further their own interests (Bird and Glennie, 2011). Moreover, it is not clear whether the focus on 'aid effectiveness' principles, whilst they may have improved transparency, has actually led to improved effectiveness in reality. The UNFCCC (2011b) has argued that equity is a key principle for adaptation, since climate change disproportionately affects vulnerable populations, most of whom are poor, therefore the distributional impacts of adaptation options are particularly important.

In terms of effectiveness, UNEP (2011) highlights the importance of 'scale' in terms of the amount of outcomes, and amount of finance provided, as well as in terms of the results (e.g. emissions reduction or vulnerability reduction). This links to the issue of adequacy in the above section. Timeliness, flexibility, scalability, replicability and localisation were other outcomes highlighted by UNEP (2011).

Bird et al (2013) also highlight the importance of public expenditure management. Improved public expenditure, procurement and financial accountability systems have been promoted by the World Bank and others through the Public Expenditure and Financial Accountability framework. Climate Public Expenditure and Institutional Reviews (CPEIR) have been undertaken in various countries as a result of this need. Yet Bird et al (2013) argues there is a current absence of systems to track and monitor climate-related expenditure. Please refer to Chapter 5 for the case of the CPEIR in Bangladesh.

7.3.6. Conditionality and National Ownership

Existing aid flows have been characterised by conditionality, however the different nature of climate change and the language of 'common but differentiated responsibility' in Article 3 of

UNFCCC and 'historical responsibility' highlights the need for collaboration and softening of conditionality. It is not clear how far climate finance will offer a new paradigm in aid relations or how far it will be characterised by existing power relations. Bird and Glennie (2011) also point out that the principle of 'equitable representation' has been promoted in the context of climate finance, which departs from conventional donor-recipient aid relationships. This principle links to the concept of 'ownership by developing countries' under the Paris Declaration on Aid Effectiveness, as conditionality can be seen as the opposite of country ownership.

The Adaptation Fund is often given as an example of a fund with a 'direct access' modality, which means there is transfer of financial resources directly to eligible countries rather than through a third party. The logic behind this approach is to increase the level of country ownership, oversight, and involvement, and to create stronger accountability (Brown *et al.,* 2010). National Implementing Entities (NIEs) and multilateral implementing entities (MIEs) must meet certain fiduciary standards for accreditation with the Adaptation Fund, including financial integrity, institutional capacity, and transparency. However accreditation of NIEs has taken time, meeting several barriers. There are some concerns the advantages of 'direct access' are only available to those with established institutions (Bugler and Rivard, 2012). Since there is a cap in resource allocation per country, there has been a tension between accrediting an NIE and the 'first mover advantage' of working through existing MIEs (like UNDP) (Brown *et al.,* 2010).

Moreover, in applying for funds from the Adaptation Fund, proponents also have a certain amount of flexibility (Nay *et al.,* 2014). Proposals must demonstrate they are "cost-effective" and "justified on the full-cost of adaptation reasoning" (Adaptation Fund, 2012:49), with cost-effectiveness assessed based on a provision of a description of alternative options to the proposed measures. Quantitative assessments are only provided where feasible and useful and a review of the technical reviews of proposals shows assessment against these criteria is nearly always undertaken on a qualitative basis (Nay *et al.,* 2014). This allows proponents the flexibility of using the tools best suited to particular local circumstances (*ibid*).

Under Paragraph 47 of the GCF Governing Instrument, the GCF Board will consider "additional modalities that further enhance direct access, including through funding entities with a view to enhancing country ownership of projects and programmes". Hence in addition to 'ordinary direct access' using accredited institutions such as the NIE's, the idea of 'enhanced direct access' has been proposed under which National Funding Entities such as

national climate funds could directly access funds (Muller, 2013). In this regard, the BCCRF in Bangladesh is proposed as a concrete example of a national funding entity (Muller, 2013).

However, most 'fast start finance' commitments were not provided directly to governments. Nakhooda et al (2013) found that only around 35% of FSF targeted governments in developing countries. FSF was in most cases channelled through intermediaries, such as the World Bank's Climate Investment Funds (CIFs), MDBs, and through bilateral cooperation and development agencies. Around 69% of FSF was channelled bilaterally (*ibid*).

7.3.7. Long time-scales and dynamic maladaptation

Over longer time scales, the problem of dynamic maladaptation has also emerged. This means that in the long-term, some adaptation efforts might protect the population for a short while, but then leave them more exposed in future. Hallegatte et al (2011) argue that the combination of uncertainty about climate change and the long lifespan of assets lead to the risk of maladaptation. For instance, embankments or barriers that protect from rising sea levels may give populations a false sense of security, or actually increase the development on a particular area of land. Constructing flood barriers can encourage investment in further development and building on areas that were once wetland, meaning those houses are particularly vulnerable to flooding. A possible example of this has been found in Khulna City, Bangladesh were land prices in newly protected areas have gone up due to the emerging demand to build on them (Haque, Pers. Comm., 2013). Similarly, insurance can lead people to feel more secure so that they take more risks, an issue known as 'moral hazard'. Examples of maladaptation can be found in the IPCC-AR5 report (IPCC, 2014). Moreover, in many places society is also maladapted to today's climate risks as there is an 'adaptation deficit' (Hallegatte *et al.,* 2011). Maladaptation can be avoided by choosing a flexible option that can be iteratively adjusted or by prioritising 'no regrets' actions (*ibid*). Barnett and O'Neill (2010) propose five criteria for maladaptation, arguing it can be avoided by ensuring adaptation actions do not increase emissions, burden the most vulnerable, have high opportunity costs, reduce incentives to adapt, or lead to path dependency. The problem of maladaptation also underscores the need for long term post-project monitoring.

7.3.8. Sustainability and balance between adaptation and mitigation

IPCC (2007) includes a detailed discussion of the trade-offs and synergies between adaptation and mitigation, with a recognition that some adaptation options may result in an increase in emissions, while others result in a decrease. One example would be the

construction of concrete sea walls, as opposed to conservation of mangrove forest in order to protect a coastal area from storm surges. Brooks et al (2011) argue that adaptation should not substantially increase GHG emissions. However, others have argued that the most vulnerable communities should not be required to take on emission-reduction responsibilities since finance for adaptation is already a scarce resource.

Yet issues could arise in 'adaptation' of the energy sector, for instance, if fossil fuel companies were to call for support to adapt to climate change, a scenario which would clearly contradict mitigation aims. Exclusive focus on 'adaptation' could lead to a situation where climate change goes beyond climatic 'tipping points', and thus greater adaptation resources are required in future. Emerging evidence of the limits to adaptation and the 'loss and damage' agenda demonstrate the need for a focus on mitigation as well as adaptation. There are various opportunities where adaptation and mitigation overlap, as evidenced by the finance currently going towards meeting both objectives (OECD, 2014).

Many commentators highlight the need for further guidance on this. Thus there is a need for guidance to ensure adaptation resources are not appropriated for actions that directly contradict mitigation goals. Equally, there is a need for guidance to ensure the most vulnerable communities are not tasked with onerous mitigation responsibilities when adaptation finance is a scarce resource. A distinction here could be placed on which stakeholders are adapting, and whether these are high-emitting stakeholders or low-emitting vulnerable communities, in which case the carbon impact of adaptation is likely to be negligible in any case.

7.3.9. Mainstreaming: Integrating disaster risk reduction, development and adaptation

It has been noted that there are differences as well as similarities and synergies between Disaster Risk Reduction (DRR) management and finance, and adaptation finance, and there has been calls towards integrating these for smarter policies and responses. Integrating priorities could lead to greater efficiency in the use of resources, including finance for adaptation and sustainable development. In the realm of DRR it has been noted that this agenda has been shifting from a focus on emergency response towards capacity-building and prevention which does synthesise with building resilience and adaptive capacity. This is emphasised by the Hyogo Framework for Action - a ten-year plan which was agreed in

Hyogo, Japan in 2005 with the aim of building the resilience of nations and communities to disasters (UNISDR, 2012).

In Vietnam, for example, lack of coordination between adaptation, disaster risk reduction and development in Vietnam has been found to demonstrate a real case of mal-adaptation and wasted resources (Ridolfi, 2011). Examples can be found from the lack of integration between development and climate change in other countries if, for example, development structures could be built which will not be resilience to long-term climate change. Barriers to integration are evident in the 'silo-like' mentality of the institutional structures within organisations like the FAO which had limited collaboration between them (*ibid*). Furthermore, project funding is separated out which is a barrier to integration; and it is thus recommended that adaptation and DRR should be viewed in the context of a continuum to integrate funding at the local level in future (*ibid*).

There have therefore been calls for 'mainstreaming' the integration of development, DRR and adaptation. Klein et al (2007a) suggest that portfolio screening can be one way of ensuring that development projects consider the impacts of climate change on planned and ongoing development projects. However, other commentators including Carruthers, negotiator for the Cook Islands, argued that 'maladaptation' conditionality for adaptation finance it could be another way of countries avoiding their responsibilities to provide finance (Carruthers, 2010). It is important that excessive criteria do not act as a barrier for countries in accessing finance for urgent adaptation needs. Furthermore, it is also possible that mainstreaming priorities together could also be a bureaucratic or administrative burden where the costs in terms of lost resources might actually be costlier than the savings.

7.4. Assessing Adaptation Options at National and International Levels

Assessing and deciding between various adaptation options is important, particularly because not all adaptation options will be possible due to constraints such as insufficient local resources, capacities, and authority (IPCC, 2014). In addition, financial resource constraints mean that not all options can be implemented, thus requiring a process of prioritisation of adaptation options. However, it is important to note that rather than focusing on adaptation options addressing specific climate impacts, more attention is increasingly being paid to mainstreaming climate change into wider government policy and private sector activities (IPCC, 2014) including promoting adaptive management.

UNFCCC (2011a) has suggested various broad criteria to determine adaptation options including efficiency, effectiveness and equity, as well as urgency, flexibility, robustness, practicality, legitimacy and synergy with other strategic objectives. In addition to these criteria, IPCC (2014) suggests various other considerations when selecting adaptation options. These included the following considerations:

- Stakeholder participation, engagement and support
- Consistency with social norms and traditions
- Sustainability (environmental and institutional sustainability)
- Designed for an appropriate scope and timeframe
- Livelihood to avoid maladaptive traps
- Resources available (including information, finance, leadership, management capacity)
- Need for transformative changes considered.

Identification and assessment of adaptation options is crucial for effective targeting of resources and finance. Various methodologies are proposed by UNFCCC (2011a) to assess and evaluate adaptation options including cost-benefit analysis, cost-effectiveness analysis, and multi-criteria analysis. It is suggested from the literature review above, that incorporating analysis of both the tangible and intangible elements of adaptive capacity will be essential. In this regard, **multi-criteria analysis (MCA)** or **participatory cost-benefit analysis** may offer useful approach for assessing and evaluating adaptation options. MCA may be particularly valuable due to the inclusion of social and environment criteria that may not be suited to the monetary approach. Incorporating tangible and intangible elements of adaptive capacity might be essential to evaluate adaptation options.

However it is recognised that after analysis, as with cost-benefit and cost-effectiveness analysis, decisions are often taken based on pragmatism and strategic issues to which policy-makers must also give weight (Dodgson, 2009). Final decisions are usually political and techniques cannot try to incorporate every element such as equity or political impact. Although MCA is potentially a valuable tool for identifying adaptation options for financing, in practice decisions seem to be taken on the basis of the context and other factors (*ibid*). It is valuable as priorities can be put into categories of urgent and less urgent, but ultimately there are trade-offs to be made.

Steps of the MCA include; (1) setting objectives, (2) setting criteria and sub-criteria (3) assessing criteria and (4) setting value scores (Dodgson, 2009). Two further steps in multi-criteria decision analysis (MCDA) include: (5) Setting weighting; assigning weights relative to performance; (6) Combining weights and scores (Keeney and Winterfeldt, 1988). Keeney

and von Winterfeldt (1988) recommend including a wide range of stakeholders and key interest groups. Gathering and processing data consumes resources, which is something to bear in mind when using detailed MCA (Dodgson, 2009) and can justify a simpler approach. If it can be reasonably assumed that criteria are preferentially independent of each other, and uncertainty is not built in, then the simple linear additive evaluation is applicable which involves multiplying the value score by the weight of the criteria, then adding these scores together (*ibid*).

A key feature of MCA is that there is subjectivity in the establishment of objectives and criteria, estimating relative importance weights and, "to some extent, in judging the contribution of each option to each performance criterion" (Dodgson, 2009:20). Although this can be of concern, it may also be more practical than data-intensive cost-benefit analysis. One drawback is that there is no way of showing the action adds more value than it detracts (*ibid*). Positive aspects are that the MCA offers a level of transparency and that it can be also a means of communication.

Indicators have been proposed to assess climate finance at national-level as well as project-level, with many of these indicators being process-orientated rather than results orientated. However, many of the MDG (millennium development goals) have direct relevance to adaptive capacity and could therefore be used as proxies (Levina, 2007). Some of the MDGs also have direct relevance for adaptation, particularly MDG 9 on sustainability development and MDG 10 on water resources (*ibid*). Similarly the post-2015 Sustainable Development Goals (SDGs) on the issues of food security and water will have relevance for adaptation.

In assessing adaptation projects, the international funds each have their own criteria for eligibility of project applications. As described by Nay et al (2014) the Adaptation Funds' project review criteria are largely qualitative in nature and are assessed qualitatively. For example, qualitative project review criteria for the Adaptation Fund include a requirement to demonstrate "economic, social and environmental benefits, with particular reference to the most vulnerable communities, including gender", consistency with national sustainable development strategies (mainstreaming) and a "learning and knowledge management component" (Adaptation Fund, 2012:31). MCA is commonly used to assess projects for adaptation, including for the NAPAs (see Nay *et al.,* 2014).

7.5. Vulnerability Indices and Climate Finance

It has been suggested that 'vulnerability indices' could be used for ex-ante prioritisation of the adaptation finance going towards countries and towards communities. There are a range of national-level vulnerability indices that have been used which also use a range of different indicators (Weadapt, 2012). The two main approaches towards vulnerability which are outlined in the literature are 'outcome vulnerability' which is based on the positivist, natural sciences approach and uses the risk-hazard methodology based on risk assessment techniques, and 'contextual vulnerability' which uses a more normative approach incorporating social vulnerability, based on political economy and determined by socioeconomic factors (Fussel, 2010). Furthermore, outcome studies tend to focus on technological adaptation whilst 'contextual' studies tend to focus on sustainable development. It is therefore recognised that the development of aggregated vulnerability indices are not objective, but requires substantive normative choices, and their design is as much a "political as a scientific task" (Fussel, 2010:7).

For example, Maplecroft's Climate Change Vulnerability Index (CCVI) used a set of 42 factors including exposure to climate-related natural disasters and sea-level rise; human sensitivity, in terms of population patterns, development, natural resources, agricultural dependency and conflicts, as well as indicators of adaptive capacity (Maplecroft, 2013). Oxford University's Climate Vulnerability Index for the water sector (Sullivan, 2008) is based on a set of indicators under the sub-components of 'geospatial' variables (e.g. extent of land at risk of sea level rise), 'resource' variables (e.g. water storage capacity), 'access' variables (e.g. access to clean water), 'capacity' variables (e.g. under-five mortality rate), 'use' variables (e.g. water consumption) and 'environmental' variables (e.g. species loss). Social vulnerability indicators include the UNDP's Human Development Index which is considered by Fussel (2010) to accurately measure social vulnerability to climate change and outperforms other indices in this regard, as it includes life expectancy, education and gross national income per capita. Levina (2007) from the OECD follows on from this approach and suggests possible indicators to monitor progress on adaptation by measuring adaptive capacity at national-level, such as; proportion of the population with income below $1/day (PPP), net enrolment ratio in primary education, literacy rate of 15-24 year-olds, proportion of households with access to secure tenure, or access to micro-crediting. This list of indices suggests the choice of indicators for measuring vulnerability to climate change is somewhat subjective, and there are in a vast array of potential indicators that could be used.

Further indices of vulnerability which have been used include the Climate and Regional Economics of Development's vulnerability index (VI-CRED) at SEI which used just a few relevant indicators; including share of GDP from climate-sensitive industries, coastal share of the population, and freshwater availability based on publicly-available data (Weadapt, 2012). The GAIN index has also been used which assesses vulnerability to climate change as well as other non-climatic challenges for water, food, health and infrastructure (*ibid*), whereas DARA's Climate Vulnerability Monitor (CVM) looks at two points in time, 2010 and 2030. There are other vulnerability indices focused upon environmental vulnerability of ecosystems and biodiversity, such as the UNEP's Environmental Vulnerability Index (EVI) and NatureServe's Climate Change Vulnerability Index but for the purposes of this study this analysis has focused on social vulnerability.

Barr et al (2010) offer an attempt to use a resource allocation framework for the allocation of adaptation investments, based on three indicators: physical impact, adaptive capacity, and implementation capacity. Since exposure and sensitivity were difficult to disentangle, the framework uses their combined effect, physical impact, as the first pillar, whilst the first and second pillar together (physical impact and adaptive capacity) intend to determine vulnerability (*ibid*). The third pillar, "implementation capacity" introduces "adaptation effectiveness" as an explicit concern, e.g. using corruption indices (*ibid*:851). However, the framework does suggest a trade-off between considerations of fairness and equity (favouring the most vulnerable) and adaptation effectiveness which is linked to governance. The framework recognises the normative basis of the indicator system, concluding that there are infinite ways in which the raw data on climate impacts, adaptive capacity and implementation capacity can be combined, scaled, normalised and added up (Barr *et al.,* 2010).

Fussel (2010) argues that all the vulnerability indices used so far have different limitations. For instance, they are being developed in the context of coping with short-term climate variability and extremes rather than long-term climate change. Moreover, they may rely on observed data rather than using projections from climate impact models (*ibid*). Many vulnerability indices also express strong sensitivity to the selection of specific proxy variables (*ibid*). According to IPCC (2014), one of the most comprehensive attempts to validate vulnerability metrics was in Brooks et al (2005) in which it was found that 11 key indicators showed correlation with mortality for climate-related disasters. This used an inductive approach, based on observed data. However, this does not validate these indicators against vulnerability to slow-onset climate impacts like salinity. It would be difficult to develop

vulnerability indicators for long-term impacts of climate change precisely because some impacts have not yet occurred.

A single vulnerability index has not been agreed at the UN level and would be likely to be difficult to agree upon internationally for many of the reasons listed above, especially since countries might have a particular interest in pushing for the use of one particular index if there was an intention for this to guide allocation of adaptation funding. However it has been suggested that an agreement on national funding allocations will be needed at some point, since national governments and programmes may be more effective and better able to address the temporal equity of adaptation measures than international bodies (Haites, 2011).

Eriksen and Kelly (2007) also found that the vulnerability indices used for adaptation policy assessment have varied greatly in the indicators and measures used, as well as the identification of the most vulnerable countries. The categories of indicators fell largely into the categories of social, environmental, economic and institutional indicators. They found that it would be necessary to expand our knowledge of the causes of vulnerability in order to develop effective indicators (*ibid*). Klein and Mohner (2011:15) agree that there has not been a single objective scientific ranking developed for vulnerability, and so the PPCR and Adaptation Fund used a variety of different vulnerability criteria that have been "politically as well as scientifically ambiguous", which remains a challenge for the Green Climate Fund. Therefore this PhD research aims to expand on such knowledge in order to understand how such finance can be effective, particularly in meeting the challenge of food security under climate change.

In their assessment of fast start finance, Nakhooda et al (2013) found that the per capita allocation of adaptation finance was only weakly correlated with vulnerability according to the DARA or GAIN vulnerability indices (see figure below).

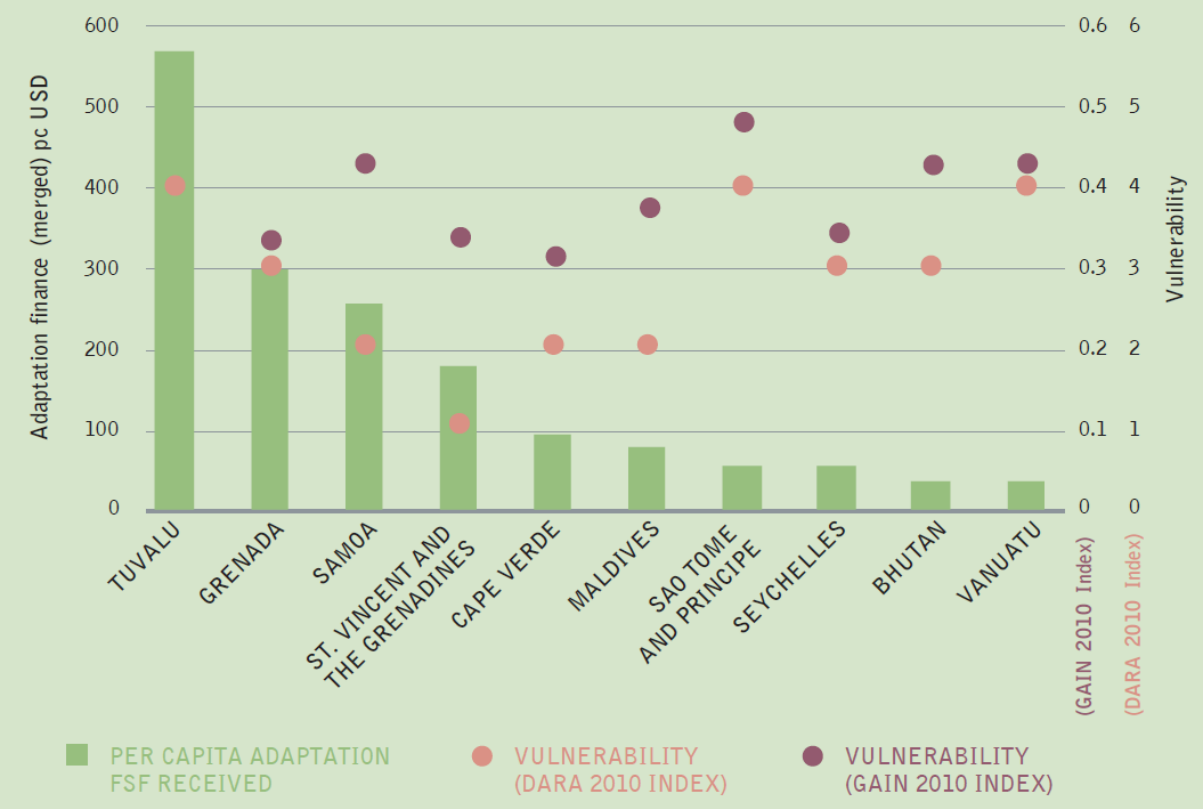


Figure 7.8 Top ten recipients of adaptation fast start finance per capita, against their GAIN/DARA vulnerability score. Source: Nakhooda *et al.*, 2013.

This suggests that vulnerability indices are not currently being used to direct the flows of adaptation finance, and this hypothesis applies at both the international or sub-national level. However, the study did find that most top recipients of adaptation finance under fast start finance (FSF) tended to be small island developing states (SIDS) or least developed countries (LDCs) (Nakhooda *et al.,* 2013). LDCs and SIDS received approximately $2Bn out of the $5.2Bn in adaptation FSF, or around 39% (*ibid*) but 31% of recipients could not be identified. The largest recipients of adaptation FSF per capita were the SIDS (*ibid*).

During the research in Bangladesh it was found that vulnerability indices were not being used by the international donors to guide allocation of adaptation finance at national-scale and in fact the process of adaptation finance allocation has at times been guided by political considerations. In fact there have not been any criteria used to guide prioritisation of funding in the national funds except for a few eligibility criteria (see Chapter 5), which demonstrates the need for such research.

7.6. Monitoring and Evaluation of Adaptation Finance

Evaluation of adaptation has become an increasingly important issue to ensure effectiveness and monitor progress, which has been mentioned in the international negotiations. Brooks et al (2011) argue that the criteria that are likely to be most important in evaluation of adaptation include feasibility, efficacy and effectiveness, efficiency, acceptability and legitimacy, equity and sustainability (see Annex XVII). Development and disaster risk reduction indicators are likely to be used, but additional criteria may also be used. However, it is recognised that the framework proposed is a first step towards solving the 'wicked problem' of what constitutes good adaptation (*ibid*). The implications of the selected criteria are discussed in Annex XVII.

The need to measure, monitor and evaluation adaptation has led to a search for adaptation metrics. Adaptation has no single common reference metric in the way that tonnes of greenhouse gases are for mitigation (IPCC, 2014). Institutions, communities and individuals value things differently and many of those values cannot be captured in a comparable way within metrics (*ibid*). Furthermore there are various different uses for adaptation metrics; firstly measuring vulnerability; secondly measuring and tracking the progress of implementing adaptive actions; and thirdly measuring the effectiveness of adaptation (*ibid*).

Experts have argued adaptation metrics should be policy-relevant, scalable, transferable, context-specific, and comparable (IGES, 2008). There was recognition of the mixture between qualitative and quantitative measures (*ibid*) and it was argued these may be specific to a certain sector such as the agricultural or water sector. Developing metrics for adaptation is challenging due to the often locally-specific nature. However there is a need for these to be implemented into planning processes at all levels (IGES, 2008).

Some authors have highlighted the importance of linking the local to the global, and aggregating the measures used at local-level to make meaningful measures of performance at national or local-level. In this case, 'upstream' assessment of capacity of institutions is combined with 'downstream' assessment of impacts of interventions, and keeping 'development on track (Brooks *et al.,* 2011).

This is highlighted in the diagram below (adapted from Brooks *et al.,* 2011):

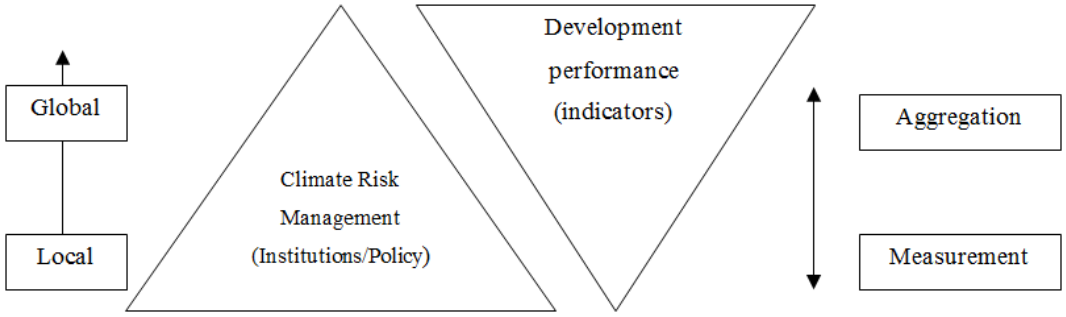


Figure 7.9 Schematic to show the evaluation framework shown in Brooks et al (2011)

At international-level, there are calls for an international framework for MRV (monitoring, reporting and verification). Transparency and accurate reporting will be important in this regard, as is the principle of 'new and additional' finance that is additional to official ODA. Transparency is arguably essential to ascertain who benefits from public climate financing, how scarce public resources are being used, and the extent to which available finance meets demonstrated needs (Watson *et al.,* 2012). Thus independent initiatives have been developed to track climate finance, including the Climate Funds Update.

The Bali Action Plan iterated that the funds must be monitored, reportable and verifiable, and at Copenhagen, parties called for the finance to be "rigorous, robust and transparent" (Tirpak *et al.,* 2010:19). In Durban, the Parties did not adopt a common reporting framework, meaning reporting guidelines are likely to be limited in their "transparency, completeness, consistency, and accuracy" (*ibid*:18). Moncel et al (2009) argue that climate finance also brings up the issues of responsibility and accountability, including the issues of equitable distribution and ensuring that allocation is demand-driven. Therefore the issues of equity and accountability are also raised.

Under the UNFCCC, the 'review of the financial mechanism' has taken place since COP-4 when the Conference of Parties decided to review the financial mechanism of the Convention every four years in accordance with Article 11.4 of the Convention. The initial criteria developed under the decision 3/CP.4 were that the financial mechanism would be reviewed against the six criteria of (a) transparency; (b) adequacy, predictability and timely disbursement of funds (c); responsiveness and efficiency of the GEF project cycle; (d) amount of resources provided; (e) amount of finance leveraged; (f) sustainability of funded projects (UNFCCC, 1998). The review of the financial mechanism happened in 1998, 2002, 2006 and 2010. The criteria for assessing the effectiveness of the financial mechanism has

just recently changed. In November 2013, at the Warsaw COP, in addition to the criteria listed above, Parties agreed to include the following four criteria under Annex C ; (b) the level of stakeholder involvement; (c) the extent to which the financial mechanism is contributing to gender-sensitive approaches; (h) the extent to which the resources provided are contributing to achieving the objectives of the Convention; and finally; (j) the extent to which the financial mechanism is contributing to country ownership of programmes and projects (Decision 8/CP.19, UNFCCC, 2013d). Refer to the international-level case study in Chapter 10 for in-depth analysis of negotiations used to decide upon these criteria. The addition of these criteria was enabled by the COP decision at COP-18 in Doha in 2012, which put the Standing Committee on Finance in the driving seat and enabled it to change the criteria which are used to assess the financial mechanism.

7.7. Development of an Indicative Framework to Assess Effectiveness of Climate Finance

As described during the methodology, the literature review on climate finance in this chapter is used to inform an indicative framework of principles to consider in assessing the effectiveness of climate finance, as well as identifying various other important issues relating to adaptation finance for further exploration in semi-structured interviews. Development of this framework was an iterative process informed by both the academic literature and semi-structured interviews.

Various principles on climate finance effectiveness were available from the literature, and many of these incorporate the principles from the Paris Declaration on Aid Effectiveness from OECD (2005), as well as additional relevant principles from Bird and Brown (2010), amongst others. The original list of principles and components for an indicative framework to assess the effectiveness of climate adaptation finance included the following set of principles and components, many of which are discussed further in sections above:

(1) Ownership by developing countries (OECD, 2005; Bird and Brown, 2010) and direct access
(2) Alignment using local systems / Mainstreaming (OECD, 2005)
(3) Harmonisation to avoid duplication (OECD, 2005) and coordination
(4) Measuring of results; and mutual accountability for results (OECD, 2005; McGray and Spearman, 2011)
(5) Equity (Stern, 2008; Bird and Brown, 2010); including targeting vulnerable communities (UNFCCC, 2011a; Brooks *et al.,* 2011)

(6) Efficiency and cost-effectiveness (UNFCCC, 2011a; Brooks *et al.,* 2011)
(7) Effectiveness, e.g. in reducing vulnerability (Brooks *et al.,* 2011; IPCC, 2014)
(8) Urgency and timeliness of disbursement (UNFCCC, 2011a; Bird and Brown, 2010)
(9) Additionality to ODA and polluter pays (Bird & Brown, 2010; Bird & Glennie, 2011)
(10) Adequacy, precautionary and predictability (Bird and Brown, 2010; Schalatek and Bird, 2013)
(11) Transparency and inclusive governance (Bird and Brown, 2010) with stakeholder participation, engagement and support (IPCC, 2014)
(12) Flexibility and robustness under uncertain projections (UNFCCC, 2011a)
(13) Synergy/coherence with mitigation (UNFCCC, 2011a)
(14) Legitimacy/acceptability/appropriateness (UNFCCC, 2011a; Brooks *et al.,* 2011; Schalatek & Bird, 2013) including consistency with social norms and traditions (IPCC, 2014)
(15) Practicality and feasibility (UNFCCC, 2011a; Brooks *et al.,* 2011)
(16) Sustainability - environmental, technical and institutional (Brooks *et al.,* 2011; IPCC, 2014)
(17) Gender equity (Schalatek and Bird, 2013)
(18) 'Do no harm' (Schalatek and Bird, 2013)/Avoiding maladaptation (IPCC, 2014)
(19) Need for transformative changes considered (IPCC, 2014) including scaling up and creating an enabling environment (Nakhooda, 2013)

Thus, the literature review was used to derive an extensive list of principles from which duplicate principles can be removed or combined where applicable, although some overlap and linkages exist between different principles. For instance, accountability may require transparency, so that civil society organisations can act as 'spotlights' on activities taking place (OECD, 2008a). Trade-offs may also exist between different principles, for instance, between efficiency and equity, as discussed previously. There is also a tension between the efficiency benefits of bringing in innovative sources of finance through private sector engagement, and the equity concerns about this in terms of reducing the 'additionality' of the finance.

This indicative set of principles can also be sub-divided into the categories of 'ex ante' (prioritisation) principles, governance principles, and 'ex post' (monitoring) principles, as follows:-

Table 7.2 Categories of Principles

Category	Principles
'Ex ante' (prioritisation) principles	Efficiency and cost-effectiveness (UNFCCC, 2011b; Brooks et al, 2011)
	Equity in targeting the most vulnerable (UNFCCC, 2011b; Brooks et al, 2011)
	Urgency and timeliness (UNFCCC, 2011b)
	Flexibility and robustness under uncertain projections (UNFCCC, 2011b)
	Legitimacy/acceptability/appropriateness (UNFCCC, 2011b; Brooks et al, 2011; Schalatek and Bird, 2013)
	Synergy/coherence between mitigation/adaptation (UNFCCC, 2011b)
	Gender equity (Schalatek and Bird, 2013)
	Practicality and feasibility (UNFCCC, 2011; Brooks et al, 2011)
	Avoiding maladaptation (IPCC, 2014)
	Need for transformative changes considered (IPCC, 2014) including considering scaling up, enabling environments (Nakhooda, 2013)
Governance principles	Ownership by developing countries and subsidiarity (OECD, 2005; Schalatek & Bird, 2013)
	Alignment using local systems / Mainstreaming (OECD, 2005)
	Additionality to existing aid commitments (Bird and Brown, 2010)
	Harmonisation to avoid duplication (OECD, 2005) and coordination
	Adequacy, precautionary, and predictability (Bird & Brown, 2010; Schalatek & Bird, 2013)
	Transparency, accountability, inclusive governance and stakeholder participation (Bird & Brown, 2010; Schalatek & Bird, 2013; IPCC, 2014)
'Ex post' (monitoring/ evaluation) principles	Results and measuring of results (OECD, 2005) including effectiveness in reducing vulnerability and increasing adaptive capacity (Brooks et al 2011; IPCC, 2014)
	Mutual accountability for results (OECD, 2005)
	Sustainability - environmental, technical and institutional (Brooks et al, 2011)

However, it is also recognised there are various other possible sub-categorisations of these principles, and some 'ex post' monitoring principles may include some of the prioritisation principles, although these have been combined in the table above to reduce duplication. For instance, monitoring the effectiveness in reducing vulnerability should also be considered as a prioritisation principle. Whilst results would of course not be available at the prioritisation stage, applicants to an adaptation fund should be able to demonstrate the expected impact in terms of results for reducing vulnerability and increasing adaptive capacity. Bird and Brown (2010) sub-divided their principles into categorisations of: mobilisation, administration and disbursement. Similarly, Nakhooda (2013) divides her set of principles into 'instrument' principles (relating to governance) and 'outcome' principles (relating to impacts). With regards to national-level analysis, mobilisation principles may not need to be considered at the national level (e.g. the polluter pays principle and respective capability) since the mobilisation of a certain amount is already assumed to be available. Other possible principles could include social, environmental and economic sustainability; however it is

considered that these principles are subsumed under various categories and can be considered as covered under the general 'sustainability' principle.

Implementation of these Principles

Analysis of these principles has shown that at times the principles cited in the literature seem to defy relevance in terms of what they mean, as they could have various different definitions and interpretations. These principles might not be capable of being implemented or operationalised as a set of descriptive terms. To overcome this problem, a set of examples of objective tests for implementation of these principles were derived, drawing on the research, relevant literature and industry best practices. Refer to Annex XVIII for the table. This table was used to identify whether certain principles are duplicated, and whether some were just descriptive terms without potential for practical implementation. Through this process, it was decided legitimacy and mutual accountability for results could be subsumed under the category of inclusive governance (which included transparency, accountability, legitimacy and stakeholder participation). As described in Chapter 10, the criteria were refined after sharing the indicative framework and examples for operationalising it with selected experts.

It is recognised that the identification of these criteria is a subjective process, and as with adaptation metrics, there is no single common metric. Schalatek and Bird (2013) argue that while the precise meaning of these principles remains a matter of interpretation, principles can serve as normative guidance for a coherent framework by which the effectiveness of climate finance can be assessed. A propositional statement for each of these criteria is given below.

Table 7.3 Propositional Statement for each of the Criteria in the Framework

Criterion	Propositional Statement
Equity	Adaptation finance should target and benefit the most climate-vulnerable areas and stakeholders, without marginalising disadvantaged groups.
Efficiency and cost-effectiveness	Adaptation finance should deliver value-for-money.
Effectiveness in reducing vulnerability; results and monitoring results	Adaptation finance should lead to verifiable results and outcomes in terms of reducing vulnerability and building adaptive capacity compared to the baseline situation.
Urgency and timeliness	Disbursement should occur in a timely manner to meet urgent needs.
Flexibility and robustness	Results should be robust under a range of climate scenarios.
Synergy/coherence between mitigation/ adaptation	Synergies with mitigation and low-carbon development should be built where possible and conflicts must be avoided.
Gender equity	Adaptation finance should benefit both genders and incorporate gender equity in planning, governance and implementation.
Practicality and feasibility	Interventions must be technically and practically feasible.
Avoiding maladaptation	Every effort must be made to ensure interventions do not inadvertently increase vulnerability of other systems, sectors or social groups.
Need for transformation considered (scale, enabling environments)	Scaling-up of interventions and outcomes must be considered at the outset to deliver wider long-term impact.
Ownership and subsidiarity	Direct access modalities are used to enhance national or sub-national ownership over projects or programmes, and governance is devolved to the lowest possible level without compromising results.
Alignment/ mainstreaming	Adaptation finance must be based on countries' adaptation strategies and planning, consistent with national/local government strategies; and channelled through a country's own institutions and systems, where these provide assurance that aid will be used for agreed purposes.
Additionality	Adaptation finance must be additional to existing development finance.
Harmonisation	Harmonisation and coordination with other initiatives is ensured to increase complementarity and reduce transaction costs.
Adequacy, precautionary, predictability	Adaptation finance must be predictable in the long-term, implemented according to the precautionary principle, and sufficient to meet the additional costs of climate change.
Inclusive governance (Transparency, accountability, legitimacy and stakeholder participation)	Adaptation finance must be governed in a way that is completely open, ensuring representation of and accountability to climate-vulnerable stakeholders.
Sustainability	Adaptation finance must be environmentally, socially and economically sustainable to ensure long-term results.

As described above, the framework was developed iteratively and adjusted according to new literature and information that became available during the course of the thesis. These principles and components were used to inform the semi-structured interviews with key

informants. An effort will therefore be made to assess climate adaptation finance against these criteria, as will be discussed in subsequent chapters. Similarly, the utility of the indicative framework was validated or disconfirmed through semi-structured interviews with key informants.

7.8. Summary

This chapter outlines the global financial architecture with regards to climate finance, with a particular focus on adaptation to climate change in agriculture. Various different financial flows relating to food security were reviewed, including international development assistance, finance under the UNFCCC, and domestic public spending. The literature review discussed a number of important issues and challenges relating to adaptation finance, including additionality, adequacy, equity, effectiveness, efficiency, conditionality, maladaptation and sustainability. This responds to the research question which asked what issues should be taken into consideration in evaluating the effectiveness of adaptation finance (see Section 2.2). It was evident that there can be contradictions and trade-offs between different objectives, for instance between efficiency and equity. The discussion of challenges and issues are used to inform the key informant interviews during the field research, as well as informing the development of an indicative framework for assessing climate finance effectiveness.

The chapter provides an outline of various frameworks for ex-ante prioritisation of adaptation options. The criteria selected to decide between adaptation options using multi-criteria analysis (MCA) are usually selected on a subjective basis, and qualitative criteria are valuable. 'Vulnerability indices' can potentially be used to determine which regions or sectors are vulnerable to climate change but no evidence was found that such indices are being used to direct flows of adaptation finance at international or national-level (see 5.5.3.3). Various metrics for measuring, monitoring and evaluation were reviewed with a view to identifying common elements. The 'Paris Declaration on Aid Effectiveness' (OECD, 2005) provides a useful basis to analyse climate finance, but it is recognised by Bird and Glennie (2011) and others that there may be a need for additional principles. In particular, providing effective climate finance will require attention to governance and delivery mechanisms. Finally, the chapter outlines an indicative framework for assessing climate finance effectiveness, including some proposed 'ex ante' prioritisation principles, governance principles and 'ex post' monitoring and evaluation principles.

8. Local-Level Analysis and Findings: Kalapara

8.1 Introduction

The following three chapters explain the results and discussions drawn from the three levels of case studies, at local-level (in Patuakhali, coastal Bangladesh), national-level (in the case of Bangladesh) and international-level. The previous literature review informed identification of key issues and principles for further exploration in interviews with expert key informants (Chapter 7). Forthcoming sections 9.6 and 10.6 explore cross-scale linkages, whilst the progress against the framework of analysis at all scales is then summarised in 10.7.

This chapter discusses the findings from the local-level case study. Kalapara Upazila, Patuakhali District, is a coastal area of Bangladesh that was severely affected by Cyclone Sidr in 2007 as well as Cyclone Aila in 2009 (see 4.7). The international NGO ActionAid Bangladesh had been implementing a community-based adaptation project in Poshurbunia village since 2008. Under this project, a group of women from poor households formed People's Research Teams or 'GGD' and a rights-based approach was utilised to provide these groups with information and resources to identify and address their own priority adaptation needs, including accessing local government resources. Ongoing projects in the area included the ECRRP programme to upgrade the cyclone shelters and embankments.

Box 8.1: Scoping Visit to Naogaon

During a scoping visit to Naogaon, Bangladesh in February 2012, focus group discussions (FGDs) took place in 2 villages in this North-Western drought-prone farming district. Fresh water availability was crucial for local livelihoods, since people were dependent on farming, and access to water was closely linked to land rights. Climate vulnerability appeared entwined with structural inequalities. The village was isolated by both religion (Hinduism) and language (Paha) from surrounding communities. The recent CBA project implemented by ActionAid seemed to have enhanced community participation. Villagers explained they had established committees like a 'sanitation committee' and 'lighting committee' to address different issues, and also learnt how to access local government UP (Union Parishad) resources and support. The villagers described the benefits of the CBA project; including improved health and sanitation, livelihood opportunities, food security, women's security, and awareness on "how to conduct with these agencies", particularly getting support from the agricultural department, which they felt excelled all other departments. Previously, drought forced the local people to cook, wash and irrigate from the same pond, leading to disease and water disputes. Water has been voted on by the community as the leading problem. 'Khas land' (government-owned land) and ponds were supposed to be accessible to the poor by law, but had been sold by local officials to rich business-people ("grabbed"). Legal disputes over land appeared to be a key driver of vulnerability. Local officials confirmed income from 'water bodies' and 'haat' (market stalls) were their main revenue sources. Under the 2009 Act, it had also recently been made compulsory by law to elect female 'ward members'. In an Upazila-level meeting (the second rung of local government), the Chairman described female members of local government as "something ornamental until now". The scoping visit raised several interesting issues relating to climate adaptation, gender and governance, but was limited by the fact the FGD transcriptions were not entirely verbatim as the NGO was relied upon for translation.

After a scoping visit to Bangladesh (see Box 8.1), the village of Poshurbunia, Lalua Union, Kalapara Upazila was selected as the local-level case study for analysis, in a coastal region that is vulnerable in terms of sea level rise, salinity, extreme weather events (cyclone and storm surges), flooding and food insecurity (see Methodology and Chapter 4). An earlier survey identified 116 households in the village (Actionaid, 2009), but a local government official updated this to 133 households in 2013. This might have risen due to in-migration from adjacent villages due to river erosion and cyclones.

The local-level household questionnaire included questions on the perceptions of different climate-related hazards (cyclones, salinity, flooding and river erosion) as well as how people were coping and adapting, including a comparison of the perceived benefits of different adaptation options and strategies. In addition, respondents were asked about their relationship with local government, their group membership (a proxy for social capital) and livelihood assets, informed by the sustainable livelihoods approach, as described previously. Finally respondents were also asked how they are affected by changes in food and fuel prices. Due to

resource limitations, the questionnaire was completed with 32 households randomly sampled from the village (24% of the total number of households). Semi-structured interviews were also conducted with key informants from local government (including the agricultural extension officer, LGED and forestry officer) as well as local civil society organisations. Random sampling was used to identify households whilst snowball sampling was used to identify expert key informants.

Where 'climate-related hazards' are discussed (cyclones, salinity, flooding) it was not assumed these local hazards were caused primarily by anthropogenic climate change, but these risks were experienced locally, and there is evidence they may increase under climate change (IPCC, 2014). For further details, refer to Section 5.3. Thus, climate change may be a contributory factor, but estimating to what extent the risks are attributed to climate change was beyond the scope of this study.

Key themes emerging from the local-level interviews and questionnaire included the interconnectedness of different climate risks and the difficulties of prioritising solutions, gender issues, loss of land and tenure insecurity, issues relating to local government and the relative benefits of the various adaptation strategies and options in the vicinity.

8.2. Emerging Issues

8.2.1. Increasing disasters and vulnerability

Most household respondents felt climate-related disasters had been increasing, and that cyclones were increasing in frequency and intensity. One retired man (aged 52) said that "after 1970 there's no cyclone in this area but after 1990's, cyclone attacks very suddenly, almost every year now" [sic]. Only two respondents (out of 32) argued that cyclones had been decreasing, with one fisherman (age 35) saying that cyclones had decreased in number but increased in power. Only one respondent mentioned climate change specifically, a farmer who argued that in the past there were 6 distinguishable seasons, but now there were "only two seasons, winter and summer". This description of changing seasons was triangulated in FGDs, and also emerged from another local study identified in the literature (Andreasen, 2011).

Several respondents argued salinity was less severe than in the past due to the embankment (dam) built in front of the sluice gate, which had preserved fresh water and allowed winter crops to be grown. One respondent (a male farmer) said levels of salinity were "not

decreasing, but all the same due to the embankment". This implies the salinity would have been much worse without the embankment. Most people felt there had been an improvement in the salinity problem since the dam was built to preserve fresh water. This intervention could be attributed to the NGO project in the area which constructed the dam in collaboration with local government.

8.2.2. Seasonal nature of work and food security

Many respondents referred to the seasonal nature of work and to their food security status, which were interrelated. When respondents were asked if there are any months of the year in which they do not have sufficient food for the family, one female day labourer (age around 40) explained she has no work between September and October. A fisherman also explained that fishing work is seasonal and that he does not earn any money for six months of the year, so faces difficulties getting food during that time. A seasonal calendar was drawn in collaboration with the women's group under the recent NGO project (Annex XIX).

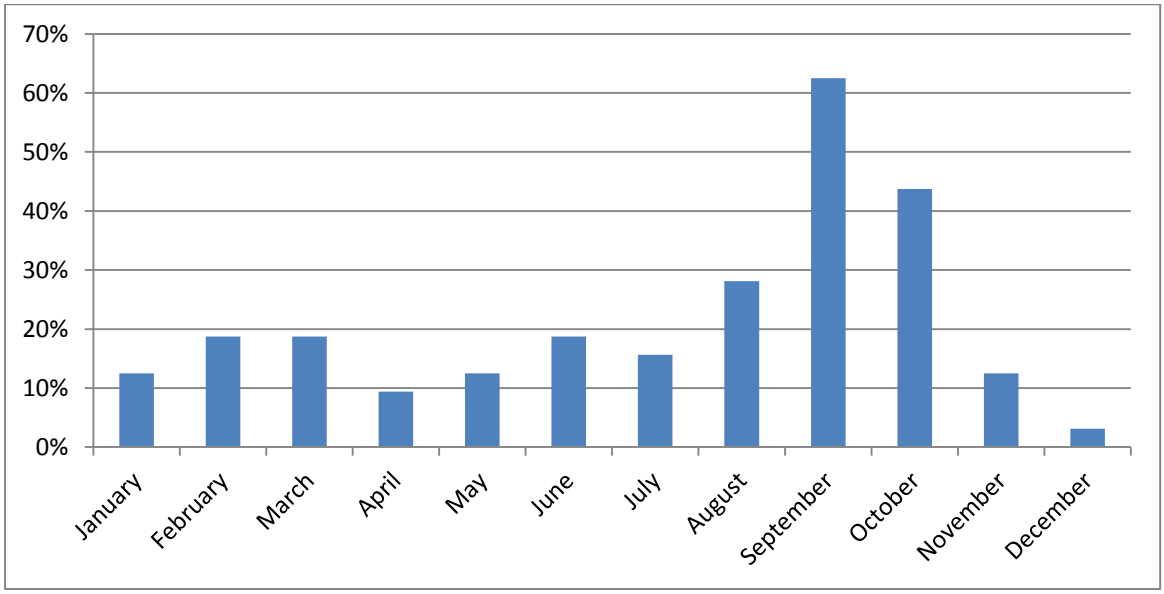


Figure 8.1 Percentage of respondents facing food insecurity across months of the year

Many respondents (63%) stated they faced food insecurity issues during the month of September. One respondent described this as the "disaster period" and another respondent reported; "sometimes we have to starve". As shown in the seasonal calendar (Annex XIX) this is also the period of the year in which flooding is expected. Those who described themselves as day labourers or agricultural labourers were the most food insecure livelihood group, as was found during the analysis of the CCAFS dataset (Chapter 9).

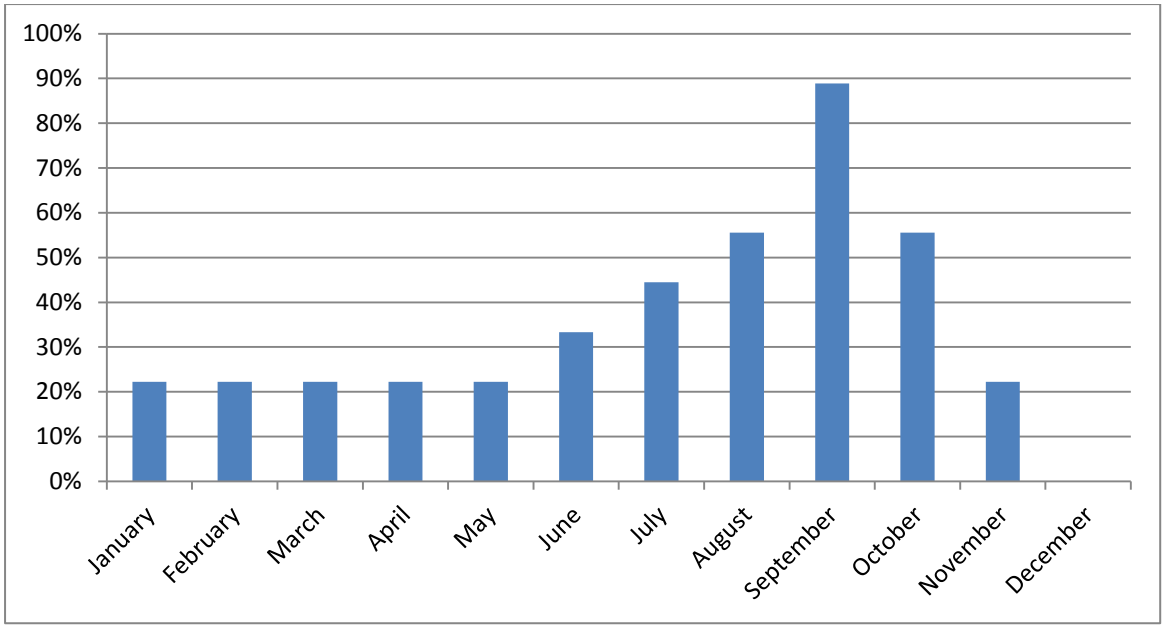


Figure 8.2 Percentage of day labourers facing food insecurity across months of the year

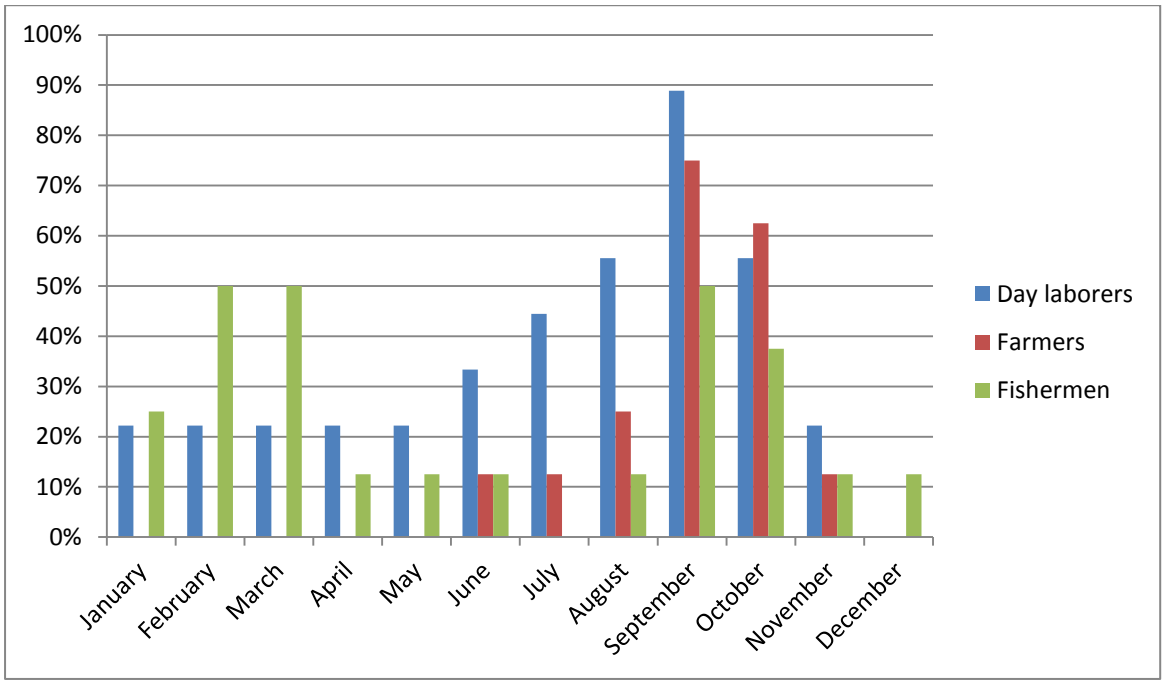


Figure 8.3 Percentage of those in different livelihood groups facing food insecurity across months of the year (as a percentage of those in each livelihood category)

However, there was some overlap between the different livelihood groups, and these are not distinct categories. For instance, one respondent who identified themselves as a fisherman explained later in the interview they also grow crops. Meanwhile, one retired person (who was previously in the army) later explained they were now farming.

8.2.3. Helplessness in the face of disaster

A key issue emerging from the household survey was the feeling of helplessness in the face of disasters. When asked about the coping strategies or adaptation strategies adopted to deal with climate-related hazards, several respondents responded with a question. When asked about possible strategies to cope with river erosion, one female respondent replied: "What can we do, we just want to live here and wish land not be eroded by river erosion - where will we go if it goes underwater by river erosion?" One female respondent asked: "if erosion washes this area away, where will we go?" Being able to physically move away from the hazard was an issue, with one respondent arguing "if there is a cyclone we can rush to any place, but cannot do anything with salinity".

Poverty seemed to exacerbate feelings of helplessness and vulnerability. When asked about adaptation strategies to address salinity, one respondent asked "how can we do it, we've not enough money?" On the issue of river erosion, another respondent asked, "What can I do? We are very poor - the poor people cannot do anything".

On the topic of cyclones, one female respondent (a day labourer) asked:

"What can I do? We get alarm in the evening but storm may come in midnight - so what will I save, myself, my things in the house, or my children and daughters?

Reliance on external support was a key theme in many of the interviews. One respondent said "the embankment will save us but personally we can do nothing to cope". Several respondents referred to the responsibility of government when they were asked about their coping strategies, with one male day labourer saying; "together we get local people together and say to the UP chairman he should repair the embankment". One fisherman, when asked about possible adaptation strategies to cope with river erosion, said "it is the responsibility of government". Some respondents felt they did not have the right skills to respond. One male respondent said they were "not a skilled person" so did not have enough skill to protect against the cyclone. However some respondents did suggest various adaptation options and strategies, discussed further below.

8.2.4. Loss and damage from cyclones

When respondents were asked about the impacts of cyclones Sidr and Aila, many households listed losses and damage to their housing, income, crops, livestock, trees, fishes from the ponds, and boats. As described in the literature review, loss and damage results from the

residual impacts of climatic hazards resulting from limits to adaptation. Although it is not assumed Cyclone Sidr (2007) was caused by anthropogenic climate change, it is explored as an illustrative example of a severe cyclone, since the intensity of tropical cyclones is likely to increase under climate change (IPCC SREX, 2012). As expected, these hazards have a particular impact on the poorest and most vulnerable households. One male labourer described how the cyclone and storm surge washed away the base of his house, as it was made of earth. Most households described devastating losses. One respondent said that during Sidr "water came inside the embankment, and we have nothing – we lose everything, also the house was destroyed". One female respondent said "if there is a flood it washes away everything – during Sidr we lost goats, ducks, chickens… also our house". One female respondent (age 50) described the impacts of cyclone Sidr as such:

"We have so many problems because there is nothing in that time for food. All the crops in the field go underwater… for 2 months the land remains in the same situation… the pond is inundated so the fish go away…. the tube well is lower than the water level so is inundated by the flood water - leading to diarrhoea, skin diseases, scabies, rotten water, and flies come".

In terms of economic losses, household respondents were asked to calculate, if possible, some of the economic losses suffered during Cyclone Sidr. In total, 26 households responded to this question, estimating their losses largely in terms of the costs of housing reconstruction and the value of livestock. The losses described added up to a total of 4263000Tk (£32,792 GBP), or an average of 163962Tk (£1,261 GBP) per household. These losses are devastating when we consider that it was found from the survey the annual household income in the village was 78258Tk (£602 GBP) per year.

Where respondents indicated the economic losses as a range, the median figure was used. This can be considered a conservative estimate since some losses were not calculable. One respondent argued it is difficult to put a value on the burden. It is possible that there were some exaggerations, but overall it was felt that households did not have an incentive to exaggerate.

Regular cyclones seemed to be causing a repeated cycle of disaster and loss. One female respondent described how just as they had started to recover from Cyclone Sidr (2007), Cyclone Aila came (2009). Several respondents reported that although they had to rebuild their house, they could not afford to rebuild it the same as before. One male fisherman (age 45) explained that he lost his boat and nets in Cyclone Sidr and had to take out a loan by

selling land, but still struggles from debt after this loss. Limits to adaptation seemed to result from the fact that the cyclone shelter only protected people's lives from the cyclone, not their homes or crops.

8.2.5. Interconnectedness of climatic hazards

The household survey confirmed most of the climate-related hazards experienced at local-level were interrelated. The cyclone and storm surge brought flooding, which in turn led to salinity intrusion and river erosion. Yet salinity and river erosion were also experienced on a daily basis. Therefore it was difficult for households to rank the hazards (cyclones, salinity and river erosion) or say which hazard was the greatest risk. One male respondent said "it is difficult to put them in order as all have quite a similar effect on us" and so it is "difficult for us to make a rank". Another respondent said that all the climate hazards cause much harm: "if we have flood we cannot grow food, and if cyclone we cannot live, it destroys lives and property". Other respondents did feel they were affected by one hazard in particular. One farmer said, "as I'm a farmer, salinity affects me the most". Overall, 28% said river erosion was the greatest risk, 25% said salinity and 18% said cyclones (see figure below).

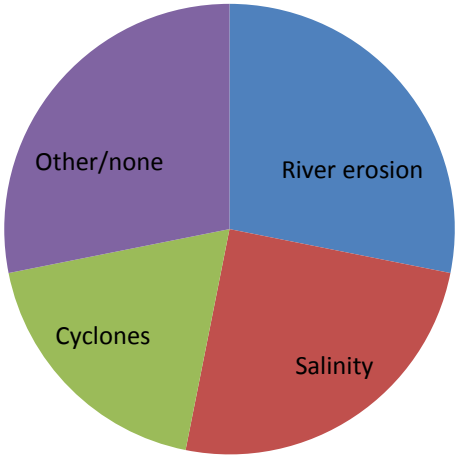


Figure 8.4 Which environmental hazard was the greatest risk?

The local official from Lalua Union Parishad also felt river erosion was the worst climate-related problem facing the area. Meanwhile, an LGED official suggested that cyclones are not a daily occurrence, as they occur only each few years, while the extreme poor face continuous hazards in their daily lives that must be prioritised. Similar difficulties in ranking environmental hazards in the area were experienced by other researchers (Stott, 2014).

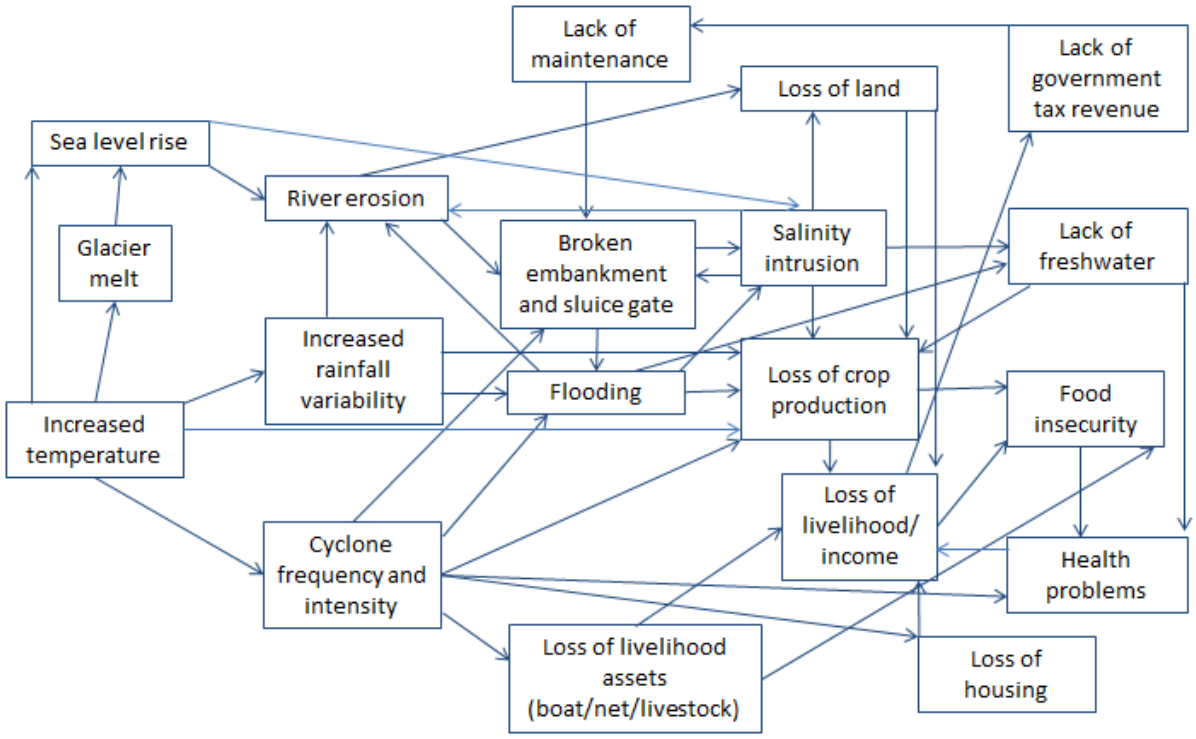


Figure 8.5 Linkages between climate hazards and impacts identified at local-scale (drawn from literature review and local household survey)

From the diagram above, it is clear there are feedback loops in the system, for example, the broken embankment and sluice gate lead to salinity intrusion, and the saline water in turn weakens the embankment further making it more vulnerable. Furthermore, the local LGED official explained saline soils mean the land is more susceptible to river erosion. Climate impacts can impact on food security through direct pathways, such as increasing temperatures affecting crops, but also indirect pathways such as increased water contamination leading to ill-health, which in turn can impact on food security. As in the literature, climate-related hazards include both rapid-onset impacts (such as cyclones) as well as slow-onset impacts like temperature change, sea level rise and riverbank erosion. Since local agricultural produce is consumed directly as well as sold, crop production losses can lead to a direct loss of food availability as well as a loss of income which reduces the households' ability to purchase food.

It emerged from local interviews that people could lose their land from river erosion, but productive land was also lost to salinity intrusion, meaning crops could not grow. Although increasing salinity was a slow-onset hazard, local households reported experiencing particular problems after cyclones and floods. One respondent said "if the embankment is damaged or breaks again all land will be filled with salinity and nothing can be grown on this land".

Meanwhile, cyclones cause direct health hazards, even loss of life, but they can also lead to flooding and lack of freshwater, which can then lead to slow-onset health problems. There was evidence of climate-related 'poverty traps', for example losing livelihood assets like livestock during a cyclone means a household loses income, in turn making it more difficult to recover these lost assets. "Health poverty traps" (Krishna, 2010:86) can also exist whereby illness (caused by dirty water or poor nutrition, for example) make it difficult to work, in turn making it more difficult to access food or resources in order to stay healthy.

The complex interrelationships between different hazards meant it was difficult to rank these interrelated climatic risks. In addition, it also makes it difficult for respondents to prioritise between different adaptation strategies and options as detailed further below. One respondent argued we "need all three" [adaptation options] and could not say which adaptation strategy should be prioritised out of the embankment, the sluice gate or the cyclone shelter.

8.2.6. Land issues and loss of land

Several respondents said they had lost land due to climate-related hazards. Fourteen respondents (43.8%) reported that their family had lost land due to river erosion, while five respondents (15.6%) had reportedly lost land due to salinity. One male respondent (a fisherman) said that his family "had 300 decimals before but apart from 60 all were eroded by river erosion"[1], adding that this occurred over a period of twenty years and it was still eroding.

Loss of land due to river erosion appeared to be a long-term process affecting several generations. Another respondent, also a fisherman, said that about 1.75 kani of land (more than 1 acre) of his fathers' land had eroded, and that if the river had not eroded the land he would have inherited some portion of it. Another fisherman also reported that his forefathers had lost around 20-25 kani (around 30 acres) of land due to river erosion. All of the fishermen in the household questionnaire had reportedly lost land to river erosion, indicating there may be a link between loss of land and the need to go into fishing.

The subdivision of land due to increases in population emerged as another potential issue, which also emerged in the literature. One fisherman reported that his grandfather and forefathers had owned 80 kanis land this area, but from that only 20 kanis was left which "belongs to 16 families now - all these families are relatives of them".

[1] In this area of Bangladesh, 100 decimals of land = 1 acre, and 1 decimal = 0.01 acre. 1 bigha = 33 decimal. 1 kani = 120 decimals, and 1 kani = 1.2 acre (Source: Banglapedia.org).

Insecurity of land tenure was a problem for several families who did not own any land themselves. Some respondents were living on "khas" land (government-owned land) and others said they were leasing land in order to grow crops. It had also emerged from the literature review of World Bank documents that a few landless families living on the embankment would have to be resettled due to the construction of the embankment.

Access to land is a determinant of whether a household can engage in farming. It emerged from the household survey that farmers had an average of 123 decimals (including leased land), fishermen had only 88 decimals on average, and day labourers had very little land on average (only 0.2 acre). In fact, 89% of the day labourers were landless. Although the sample size is too small to draw firm conclusions, it appeared that access to land was associated with income, since farmers were the highest-earning income group, followed by fishermen and then day labourers. These results reiterated the results from the CCAFS dataset at national-level, which found that day labourers were often food insecure and landless. This has implications for the projected sea level rise under climate change in this area, which is likely to lead more households into landlessness and poverty.

8.2.7. Gender issues

Social issues relating to the disadvantaged position of women were mentioned several times during the local-level household interviews. It is clear women faced a range of risks in their daily lives. Polygamy was relatively common, with two female respondents (out of thirteen) mentioning that their husband had another wife. Forced marriage appeared to have been occurring, as one poor lady living in a small hut beside on the roadside explained her husband was mad and lived elsewhere, because her father "gave her to a mad person for marriage". Another female respondent, who estimated her age at around 50-60, explained she had been married at the age of 12 years. In one conversation, a lady explained how she had been taken to Dubai in the hope of working, but soon realised she had been trafficked. Fortunately, with the help of an NGO, she explained she had managed to make her way back to the village and to her children. Thus, local women face insecurity in their daily lives.

Gender issues also emerged strongly from the focus group discussions (FGDs) and semi-structured interviews, as well as during informal discussions with local people. During one FGD with a women's group, the group explained that in this village, girls usually marry at 11-12 years old and leave school. Although the legal age for marriage is 18 for girls, people commonly forge birth certificates in order to arrange marriages earlier. By contrast, the legal

marriage age for boys is 21. This is an example of how legislation and local customs, as well as non-enforcement of legislation, put women at a disadvantage in Bangladesh.

The disadvantaged position of women in society was linked to vulnerability to climate-related hazards. In one FGD with a women's' groups, the women explained they feel insecure in cyclone shelters during disasters, as women and girls facing teasing or violence in the shelter. They described how there was no separate bathroom for women in the cyclone shelter, and no privacy for women and girls.

However, it was felt that recent project interventions by the NGO in the village had enabled women to improve their position in society and gain recognition. In one interview, a female member of the GGD (women's group) argued that "now they are saying in this area, they women are working, they're doing the right things… by them we can be benefitted". In another focus group, various women explained that since the CBA project had started, they felt more comfortable discussing their problems with local government officials and no longer felt they had to wear a hood (headscarf) when talking to outsiders. The interview with the Lalua UP official confirmed these findings, affirming that women participated and "presented smartly" [sic] in local ward shova meetings, whereas in the past they did not have such skills.

8.2.8. Local governance

People in this village in Kalapara seemed to be relatively politically engaged, with several respondents recounting that they had visited the local Union Parishad (UP) office. When asked if she had any contact with local government, one of the members of the GGD (women's group) said she had spoken to local government several times and "we attended a procession raising our demands… they only said there'll be a port this area but God knows when it's built". This was a reference to Government plans to build a third seaport at nearby Kuakata, Patuakhali, aimed at promoting the economy.

As found in the literature review, there were suggestions the local government sometimes handed over the responsibility for local services to NGOs. The extensive NGO sector in Bangladesh has brought fears about the creation of a "parallel state", and some have argued that the parallel efforts of NGOs simply reflect and further contribute to the weakness of the state's ability to serve its citizens (Lewis, 2012:109). During the household survey, one respondent explained; "during disasters the local government often give the relief effort over certain areas to NGOs".

The CBA intervention in this area deliberately attempted to overcome such problems by strengthening the governance capacity of local government in order to strengthen local adaptive capacity. This included supporting the UP to construct dams to preserve non-saline water (see below). One interview respondent also described how the project worked with local government on participatory budget planning, including assisting the UP to explore options to sustainably increase its' own income. Transparency was increased, as the local UP government were supported in producing periodical budget reports at local government level (available in Bengali).

However, corruption was raised by several respondents. One respondent claimed the UP had misused money from the dam, as they had been allocated 50000Tk for the dams, but they spent only 20000Tk. Another respondent claimed that the local government had misused money given to them by the NGO, claiming the NGO had given local government 11 lakh taka for the sweet [fresh] water preservation scheme but "the UP didn't sanction the road". These respondents gave different figures, so it is unclear whether these details were correct. Bribery also seemed to be rife. One respondent stated; "whenever we get anything from the UP we have to pay some bribes", while another respondent argued that "during a disaster, member chairmen [sic] comes to our locality and they only think of their own interest… We have to give bribe to get anything." This suggests that corruption in local government hampers disaster relief and recovery efforts.

At national-level, it was discovered in interviews with Transparency International Bangladesh (TIB) there was controversy surrounding the building of embankments, and in one specific project, 30,000 trees were ordered to be cut down to construct the cross-dam under the BCCTF (funded by GoB). It was later ascertained from documents that this occurred in Kalapara, as the approved cross-dam would connect Patuakhali and Bhola, and would be 5km long with 3.44 under Char Mynka and Char Montaz of Patuakhali District. Kalapara Water Development Board reportedly requested the local Forest Department to allow them to cut 30,000 trees in the protected forest (TIB, 2012). Moreover, there had been no Environmental Impact Assessment (EIA) done on the project, which was approved under the BCCTF. The area adjoins the Char Kukri Mukri Wildlife Sanctuary. Local communities and experts were reportedly not consulted, and following concerns from the forest department, the BCCTF authority stopped project funding disbursement (TIB, 2012). The incident reveals concerns about the accountability of the BCCTF (government fund) in approving such a project.

Similar to the national-level interviews, there were suggestions that allocation of climate adaptation finance was affected by political influence. In one FGD, participants argued that they face discrimination from powerful elites and this affects the allocation of UP budget resources. In fact, members of the focus group claimed that last year a cyclone shelter was sanctioned for this village but a politician had used their political influence to move it to his own area.

However, it was suggested that the intervention by the NGO had empowered local people to demand more from their local government officials, while also giving local officials an incentive to listen to local demands. One respondent suggested they now gave "more importance to us" than before. One respondent argued that the weaknesses of local government could be overcome by working together:

"*If someone goes to UP or any other office they misuse these services and we don't get anything but in this project we got some benefit as we're working together."*

Hence, the sustainability of efforts to improve local governance will be reliant on continued participation of local people as well as the improved understanding of their rights in relation to local government.

Furthermore, in interviews with local government, it emerged the UP (lowest rung of local government) did have a good grasp of local priorities. The UP official said river erosion was the greatest climatic risk facing this area. This aligned with the opinion of the majority (almost 40%) in the household survey. Furthermore, the official confirmed there can be tension between fisherman and farmers over water management, but stated they prioritise the conservation of fresh water "as more people will get benefit from the dam… we give priority for the dam and agriculture". Once again, this aligns with the household-level survey, which found most households were engaged in agriculture and would benefit from keeping out saline water.

8.2.9. Institutions, group membership and social capital

Various members of the community identified themselves as part of informal or formal groups, for example, the women's GGD group which had been established in the recent CBA project. Group membership was important as a form of social organisation determining the allocation of resources locally, including the management of water resources. 53% of household survey respondents confirmed they were part of a formal or informal group, including the GGD, a political party, farmers and fishermen' groups, micro-credit groups, the

Red Crescent, and NGO-linked groups. Groups, such as the CPP volunteers, were linked vertically with local government institutions which were then linked with national-level departments and this provided a conduit for information and resource flows. Furthermore, group membership also provided a forum for horizontally linkages with other formal or informal groups at the same scale, for instance, farmers groups' at the Union level took part in negotiations with the UP over issues which concerned them, like the availability of fresh water.

However, while the 'bard rocca' committee (sluice gate committee) emerged as important for sluice gate management, many respondents did not disclose which groups they were part of. While one fisherman revealed he was a part of Lalua Union fishermen's' group, it was felt some respondents were not fully disclosing their group connections. This could be due to bias, perhaps linked to suspicions by respondents that the research would be used by the NGO, thus leading them to a resource-maximisation strategy in which they did not wish to disclose their connections. This limitation of the study meant that it was difficult to further explore the impacts of group membership on adaptive capacity.

8.2.10. Rising fuel and food prices

The household survey also asked respondents about the impact of rising food, fuel and fertiliser prices on their livelihood. Three-quarters of respondents said that rising food prices had a major impact on their lives and had a much worse impact than rising fertiliser or fuel prices. One day labourer argued "if the price increases we cannot eat… we have to starve". Another day labourer argued that food prices posed the greatest problem for her, as she had three children. Another respondent argued that feeding his family costs 5000tk per month but he earned only around 4000tk per month. However, one male farmer argued he had no problem with increased food prices, but needed to get a fair price for his paddy, arguing that if he could sell his rice for a fair price, he could buy anything. This corroborates the findings from the literature review that food prices affect people in different ways, and some rural farmers benefit from rising prices if this is passed onto them in terms of higher income.

A few farmers felt that fertiliser prices had a negative effect on them. One farmer, aged 25-30 argued fertiliser was the main risk for him as he could not earn money if he could not grow crops. However, others, including one day labourer, said fertiliser had no effect on them because they had no land to grow crops.

In terms of fuel prices, several respondents explained that they were reliant on kerosene lamps to light their homes. Another explained they had to lend a trailer to move the produce to restock their small shop (tea stall) in the village, while another explained they struggled with the price of transport. One female farmer explained:

"We have solar so we have little impact from fuel price increase… those who use shallow machine for irrigation and fly boat, they have a great impact."

Several respondents explained that since they were using solar energy in their homes they were not affected by fuel prices. Solar penetration was high in this village, with 50% of households reporting they had access to solar energy. Interestingly, when asked whether they had access to electricity, a few answered "no, I have only solar", while some answered "yes, I have solar", perhaps indicating some households did not see solar as having electricity. Out of the 16 respondents with solar, only three said they had any problem with fuel prices (two of whom mentioned rising transport costs), and the remaining respondents with solar said they were not affected by fuel costs. One respondent explained that they had to use at least 4 litres of kerosene per month, and this cost 72 taka per litre. One male respondent argued:

"I have no solar energy so have to use kerosine and cannot buy it, so have a problem with high prices."

Overall, solar energy seemed to relieve households from the burden of kerosine costs. However, transportation was also restricted in the area by transport fuel costs. It cost 20Tk one-way to cross the nearby river using a motorised boat to reach the local town, a substantial sum in a place where many agricultural labourers earned only 120Tk ($1.50) per day.

8.3. Adaptation Options and Strategies

Various different adaptation options and strategies were discussed and emerged from the household-level interviews, FGDs and key informant interviews at local-level, including; strengthening embankments, constructing cyclones shelters, preserving freshwater, saline-tolerant rice varieties, the early warning system, planting trees, and developing alternative livelihood activities. These adaptation options and strategies are discussed further in the sections below. Furthermore, embankment and cyclone shelters are both prioritised at national-level as adaptation options (see Chapter 5 and Section 9.4).

Household-survey respondents were asked open-ended questions about their suggestions for adaptation options or strategies. The frequency of these options is shown below.

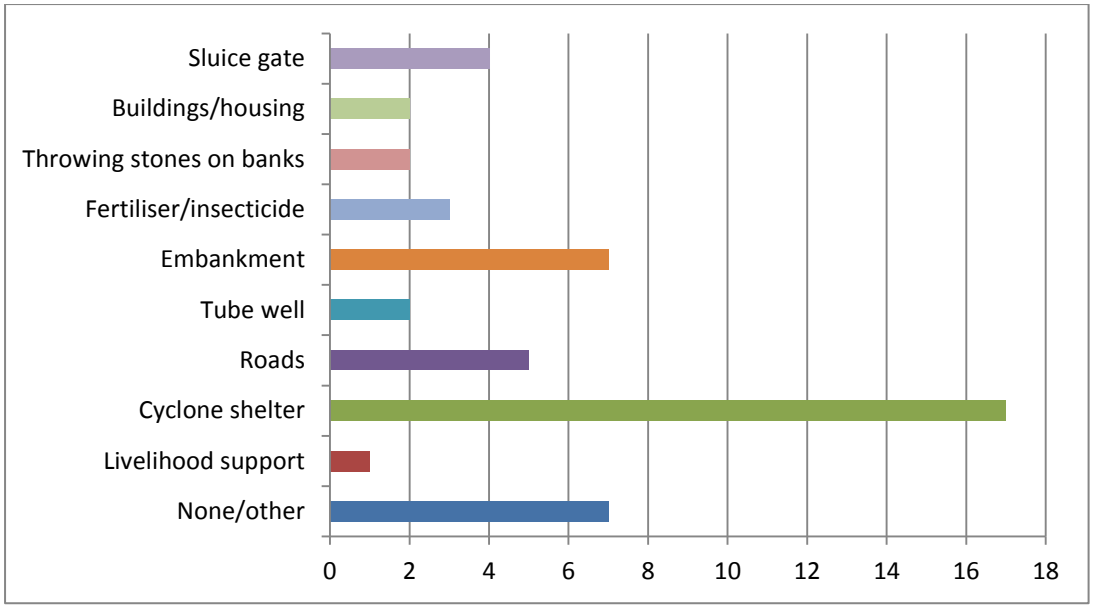


Figure 8.6 Frequency of suggested adaptation options. 'Tube well' refers to installation of freshwater wells. 'Throwing stones' refers to manually strengthening the riverbanks with stones.

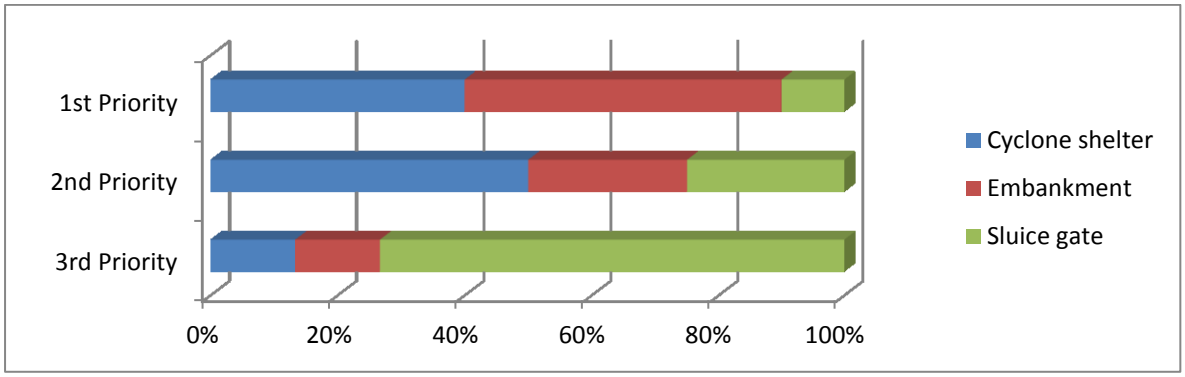


Figure 8.7 Ranking of prioritised adaptation options

It must be noted that 'embankment' and 'road' were used synonymously, but have been differentiated only where this was clear from the context. Furthermore, as noted above, several household respondents did not feel able to place the adaptation options or strategies in rank order, stating that all of them were badly needed.

8.3.1. Fresh Water Preservation and Sluice Gate

One adaptation strategy introduced by the CBA project in this area was the construction of a dam in front of the broken sluice gate to retain fresh water (known as 'mita pani' or sweet water), enabling farmers to grow crops during the winter ('rabi') months. During the survey many respondents reported great benefits from this adaptation intervention, citing economic, food security and environmental benefits.

Respondents argued the preservation of freshwater during these months provided a source of fresh (non-saline) drinking water for livestock, water for fodder, for growth of fruit trees, water for bathing, washing clothes and cooking, and a source of water for irrigation for growing 'rabi' winter crops include watermelon, kashari dal (pulse), sweet potato, potato, chillies, maize and *boro* rice. Respondents also cited health benefits, claiming the intervention meant they were less affected by waterborne skin diseases. Other respondents stated there were health benefits for cattle and livestock, because "cows get diarrhoea from drinking the saline water". Furthermore, day labourers explained that they had more work due to the increase in fresh water available for agriculture, with one day labourer noting: "We can work up to 6 months which we were not able to do in the past".

Box 8.2: Participatory cost-benefit analysis of the freshwater preservation scheme

Benefits: The household survey included questions on the perceived benefits and costs of the dam to preserve freshwater in front of the broken sluice gate and keep out salinity. Respondents highlighted a range of benefits including economic, social and environmental benefits, including having non-saline water for livestock, crops, cooking and bathing. According to data available from the local NGO, an estimated 1,265 farmers benefited from the additional freshwater supply during the 'rabi' winter season in Lalua Union. Data from the marketplace it was found these farmers had produced watermelon, pumpkin, sweet potato and *boro* rice over an area of 4500 hectares. According to Razeev (2012) each farmer grows around *boro* paddy on 102dm and earns gross income of 213Tk/dm, so the total earning in Lalua is estimated at 21,726Tk/farmer or a total of 27,483,390Tk in Lalua Union, on around 129,030dm of land (522 hectares).

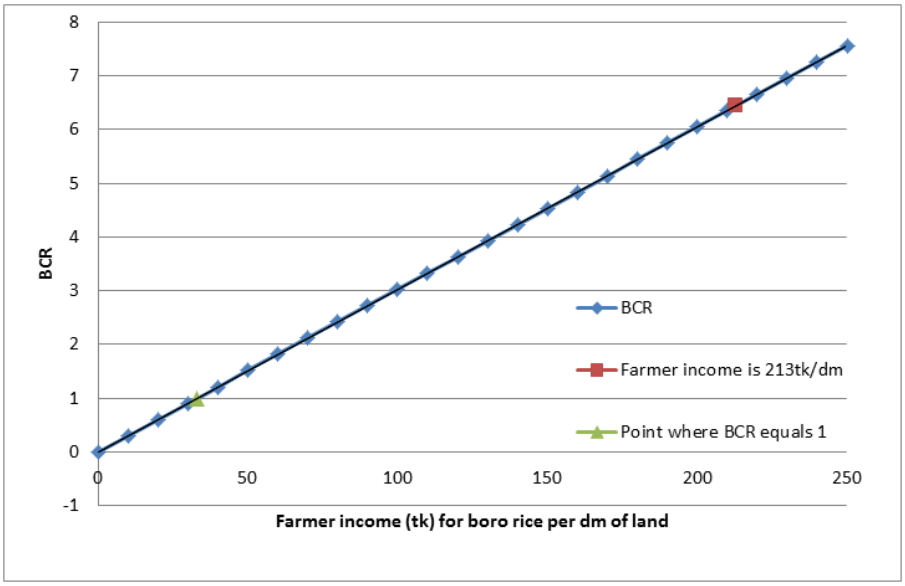
Costs: In 2011, the cost of 8 dams (Lalua Union) was 249,750Tk (approx. £1900) according to data from the UP and NGO. The data showed 3 additional dams were constructed the following year and the UP contributed to the expense which totalled 272,152Tk in 2012 (approx. £2000). Figures from 2012 only have been used as the project is a one-year project, requiring reconstruction each year. As described below, some fishermen also described a loss in income from the dam, because they were unable to use the sluice gate for fishing. Since there were 11 sluice gates, and assuming 3 fishermen were affected per gate, the income losses are estimated at 3,993,000Tk/year. These costs for the fishermen may not continue in future years, as they may change their livelihood.

Stakeholder Group	Benefits	Costs
Farmers	27,483,390Tk	-
Fishermen	-	3,993,000Tk
UP/NGO	-	249,750Tk
Totals:	**27,483,390Tk**	**4,265,152Tk**

Overall the benefit-cost ratio of the freshwater scheme for 2012 was estimated at 6.44.

Sensitivity Analysis: A sensitivity analysis found the results are robust under different assumptions. The farmers' average income from *boro* rice production would have to be just 33Tk/dm for the BCR to be reduced to 1 (see figure below). Furthermore, the fishermen who benefitted from the sluice gate gave their income before the dam as a range (500-700Tk/day for the whole year) and their income after the dam as a range (200-300Tk for 7 months). The highest possible losses for the fishermen

were calculated, using the highest end of this range for income per day before the dam, and the lowest end of this value for the income after the dam, and the BCR was still above 1 (3.71). Moreover, the results are robust against different values for the cost of the sluice gates. The cost of the sluice gates would have to be 23,491,439Tk in order for the BCR to equal 1, which is almost ten times the actual cost of the sluice gates in 2012, as reported in UP documents.



The average area of land being used to grow *boro* rice by each farmer (102dm) from Razeev (2012) was also triangulated against the average area of land owned per farmers in the household survey, which was found to be 123dm. Furthermore, the average additional earning per year from *boro* rice per farmer was estimated at 21,726Tk/farmer, which is also realistic figure when we consider that the average annual earning of farmers in the household survey was estimated at around 76,000Tk per annum. Farmers are therefore estimated to be earning around a third of their total income from the *boro* rice production during the 'rabi' winter season.

The results can be considered a conservative estimate as this does not income the additional income from other types of crops such as watermelon, pumpkin, sweet potato, as well as pulses and wheat, which were described by farmers. These additional benefits could not be calculated due to resource and time constraints. Furthermore, the health benefits, and other reported benefits such as increased freshwater for washing clothes and for giving to livestock were not included. The benefits for day labourers who gained additional work in farming are also not included. The difficulty of quantifying the additional social and environmental benefits of this adaptation option was recognised by several respondents. One NGO representative argued you cannot put a value on most of the benefits, presumably referring to the health and social benefits, such as freshwater for washing clothes.

Several respondents mentioned the dam in front of the broken sluice gate could not completely keep out the saline water, and farming was still a risky business. One respondent explained his watermelons were washed away by salinity last year. While several farmers listed the benefits from growing different types of crops, it appeared drought and salinity were still causing problems because "drought left salinity on the ground". Another respondent explained:

"*If there is heat it withers away water and salinity stays on the ground and if that happens cannot grow crops this year".*

The dam benefitted the farmers more than the fishermen (Razeev, 2012). As one NGO respondent explained, in some areas, fishermen previously used to control the sluice gate to the detriment of the general population. Thus, in some places "muscle men" would use the gate for catching fish. The representative from the Bangladesh Water Development Board (BWDB) agreed sometimes local "elite people" would control the gate for fishing, which affected local farmers. The local government official agreed there was "a little tension" between farmers and fishermen, but claimed there were no serious clashes.

One NGO representative reported there had been initial tensions when the CBA project began. In the first year of the CBA project (2007) the GGD group had "got threats from people they would cut the dam". Eventually the tensions appeared to have been alleviated by the third year, through cooperation with the UP, and because local people demanded the UP should control the sluice gate with a dam. Yet according to the NGO, the sluice gate was still controlled by a "sluice gate management committee" which included "muscle men". The sluice gate committee was reportedly well-connected politically, and according to NGO representatives, this was one reason why the dam had been built in front of the sluice gate instead of pressing for the gate to be repaired. After communication with government leaders at the start of the project, according to one NGO representative: "The MP in that area said do what you like in our area, but you cannot think of touching that committee" [sluice gate committee].

One fisherman interviewed during the household survey explained he used to be the person responsible for managing the sluice gate, and when there was no dam, the fish could go inside and he was able to fish there. He explained that previously he had earned 500-700tk/day for fishing all year round but "now I can't do that because of the dam". He explained his income was reduced to 200-300tk per day for 7 months per year. However, the fishermen seemed reconciled to this and accepted the fact that the dam in front of the sluice gate benefitted more people, saying: "it benefits the common people… if everyone is well I am well".



Figure 8.8 Earthen dam constructed in front of the broken sluice gate (left) and broken sluice gate (right)

The dam was needed because the sluice gate was broken. Respondents confirmed that the earth dam would have to be "cut" each year to allow freshwater to enter, and then rebuilt the next year, leading to the conclusion that repairing the broken sluice gate could be a more viable and sustainable long-term solution as it would not require annual expense. However, an NGO representative explained the sluice gates were under the jurisdiction of the BWDB so local government did not have permission to repair the gates:

"Only WDB have permission to repair or rebuild and the UP [Union Parishad] don't have permission and that's why the UP cannot repair the sluice gates"

One civil society respondent reported that out of 10 sluice gates, none of them are completely working, and "there is no rubber seal to prevent the flow of water". Key informants explained that the sluice gates were in such a poor state that they could not be easily repaired, but would need to be replaced entirely.

It emerged that local people and local government had repeatedly requested the BWDB to replace or repair the sluice gates, but this had not happened yet. As a result, interviews confirmed that the UP supported by the NGO were spending 3-5 lakh taka each year (over £3,000 per annum) on building earth dams in front of the broken sluice gates. In Poshurbunia village, the sluice gate dam in 2011 cost 53521tk (approx. 500GBP). When asked about repairs of sluice gates in the vicinity, the BWDB official argued this was "routine work for us" and they were "doing work regularly". The BWDB official confirmed there was "no formal arrangement" for communication with the UP as they receive information directly from the local people. The lack of institutional coordination between the UP and BWDB might threaten the sustainability of the initiative. It was unclear whether the UP would have sufficient resources to continue to provide their own funds for the scheme if NGO support

ceased in the future. Moreover, repairing the sluice gates may also be hindered by the political control of 'elites' in the sluice gate committees, as indicated above.

The poor state of repair of water control structures in the area has historical roots. Several respondents described how in the 1970s, each of the gates had a 'khalasi' (gateman) who would control the water flow (see figure below). The local government UP official stated that the gates were built in 1963 and since then, BWDB have "done nothing for sluice gates" and have "no fund to manage the sluice gates" so the community have to manage the sluice gates themselves. This confirms the literature review findings that many of the water management structures in coastal Bangladesh, constructed during 1960-80's, have not been effectively maintained.



Figure 8.9 Derelict building in a nearby village which previously housed a 'khalasi' (gateman)

In the literature, Ostrom (1999) suggests local self-governed systems are often more effective in developing rules to fit a local resource, whereas top-down design processes are more limited. Ostrom (1999:495) argues that "state control has usually proven to be less effective and efficient than control by those directly affected". In this case study, similar findings are evident as the poor management of the water resource appears to have its roots in the centrally-established "position" rules which gave priority to the elites in the sluice gate committee. It is likely that a more poly-centric governance system, where local users were able to take back control of the sluice gate and establish their own "authority rules" would enable the sluice gate to be managed to the benefit of a greater number of community members. Drawing on Ostrom (1999) the sluice gate would still require monitoring in order to ensure fishermen did not open the sluice gate by stealth in order to benefit at the expense of the farmers.

8.3.2. Strengthening Embankments

The interviews with key informants and the household survey both confirmed that the embankment frequently had to be repaired as it was regularly damaged by river erosion and storm surges. One NGO respondent argued there was "huge pressure" on the BWDB to continually repair the embankment. The embankment in the village under study (polder number 47/5) was currently being repaired under the ECRRP project funded by World Bank, and co-financed by the BCCRF using multilateral funds. However, one NGO respondent suggested there could be some corruption, in that "they have in interest in not making embankment strong so they keep having to repair it".

In terms of the cost, the literature review of documents showed the cost of the rehabilitation of polder 47/5 over 2012-13 was $5,400,000 (World Bank, 2014). Documentation showed this included construction 0.8km of embankment, 0.4km of slope and bank protection, 4km of embankment to be re-sectioned, 3km extra slope protection and 1 sluice gate (*ibid*).

The interview with the NGO confirmed that participatory monitoring was being undertaken by the local community 'bard rocca' committees, in areas in which they existed, and this information was verified on the ground. The respondent added; "monitoring should be keeping out the influential people otherwise they may try to influence it". This comment shows there was a perception that political interests could influence the quality of adaptation works in the area. The BWDB official claimed there were three tiers of monitoring for the embankment works, which at a minimum included the World Bank monitoring team, the BWDB's own team, and government officials from the Ministry of Water. In terms of participatory monitoring, the BWDB claimed this had started, but was "not 100% yet".



Figure 8.10 Ongoing construction work on the embankment (Polder 47/5)

In terms of the sustainability and flexibility of the embankment under projected climate change, the BWDB official argued that future sea level rise projections were being taken into

account in planning, assuming a 1 metre increase along all the crests of the embankment to cover the next 50-100 year period. These projections were considered under the World Bank's CEIP (Coastal Embankment Improvement Project). However, the engineer confirmed that from time to time, the next generation would have to arrange an additional increase in height. Moreover, the engineer argued the community "will not cope if it happens in a sudden time" [sic].

During the household survey, several household respondents suggested "throwing stones by the bank" as an adaptation option to protect against erosion of the embankment. Several respondents reported they had repaired the embankments themselves at times, including raising the banks of the ponds. In addition, the BWDB engineer suggested afforestation of the embankments as an effective adaptation strategy (see below).

8.3.3. Road Construction

Several household respondents argued the poor state of the local roads was an impediment to dealing with environmental risks, including their ability to reach safety during a severe cyclone. The roads were primarily brick-built and in a poor condition. The word for 'embankment' was used synonymously with 'road' since the roads were raised up and also functioned as an embankment to prevent movement of floodwater. During cyclones households explained they would put their livestock and belongings onto the road to raise them up above the flooded fields on either side. Roads were also necessary to get to the cyclone shelter. Thus several households explained that replacing the brick-built path with a stronger road was an important adaptation priority. One female respondent said :

"We face a long distance to get to shelter… if roads are in good condition then we can more easily get there and help us protect with crops and everything will be saved". [sic]

8.3.4. Cyclone Shelter

Many household survey respondents expressed the need for a cyclone shelter and the difficulties of getting to nearby cyclone shelters during a cyclone. Less than half of the respondents (44%) reported taking shelter in a cyclone shelter in the last cyclone. Many households (31%) reported taking shelter in Banati Bazar cyclone shelter, while others went to the shelter in Charipara or Utter Lalua.

The figure below shows the participatory map of the location of the nearest cyclone shelters which was drawn up in collaboration with local fishermen. Studies have shown unless a cyclone shelter is within 1.5 km of a house, it may be too distant (Rahman and Islam , 2011).

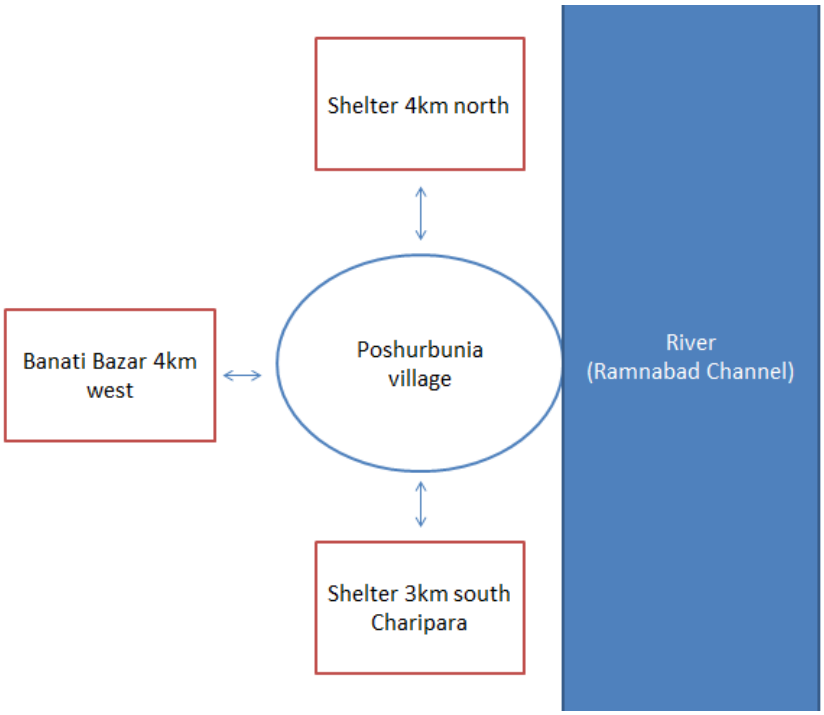


Figure 8.11 Participatory map of the location of the nearest cyclone shelters (sketched by local fishermen)

Several household respondents said there was not enough space in existing cyclone shelters. One lady from a poor family described how she had tried to go to Banati Bazar cyclone shelter during cyclone Aila and was in a corridor with a very small space where she got wet in the rain. Another respondent related this to the village population size, adding that the nearby shelter is not sufficient. In the interview with the UP official, it emerged that the population of the Lalua Union (in which Poshurbunia village is located) is 16,704 people or 4,477 households, and there are only 8 functional cyclone shelters. Since the normal capacity of the cyclone shelter is 500 people, this meant only 4,000 people in Lalua Union had access to a cyclone shelter (less than a quarter of the population). The official said more than 500 people were usually forced to squeeze into the shelters during a cyclone. Women reported having a lack of privacy and security in the cramped conditions in the cyclone shelter.

The UP official said there used to be 11 shelters, but 3 were destroyed by river erosion, demonstrating that this structural adaptation option (cyclone shelter construction) to address

cyclones is also vulnerable to a different climate-related hazard (river erosion). This further confirms the complexity of adapting to multiple hazards.

Some respondents said they did not go to a cyclone shelter because they stayed behind to look after livestock or household belongings. One respondent reported that sometimes when they leave the house during the cyclone, valuables go missing or are stolen. One male respondent described how his wife and children went to the cyclone shelter, but he stayed behind to look after the house. One female farmer reported sometimes people stay behind to take care of their animals, and argued it would be beneficial if both animals and humans could take shelter. It emerged these concerns were being addressed in the new design for cyclone shelters. The LGED official described how the new design included a "killah" platform for keeping cattle, while another design included three storeys, with space for livestock on the second floor. The designs were also discussed in the national-level interviews with the World Bank.

In addition to the distance from the shelter, travelling to a cyclone shelter on the road was also extremely risky. One male respondent (an agricultural labourer) described how some women died going to take shelter and had to "hang in the trees". One respondent argued elderly people and pregnant women face particular difficulties getting to the cyclone shelter. Another respondent said; "we started moving to cyclone shelter but trees fell down on the road so we come back". As noted in the previous section, roads were important to enable cyclone shelter access but were in a poor condition. This issue was raised in national-level interviews with the World Bank, where the respondent explained that poor roads were a barrier construction of cyclone shelters (in terms of transporting materials), as well as a barrier for those who needed to access the shelters.



Figure 8.12: Cyclone shelter construction (left) in Lalua Union showing adjacent platform 'killah' for livestock. Multi-purpose shelter-cum-school (right) in use as a school

In terms of sustainability and on-going maintenance of cyclone shelters, it emerged from the interview with the LGED engineer that maintenance had been considered through construction of multipurpose shelters which double as primary schools. The engineer explained; "it is in multipurpose use as a primary school and so with the government system it is maintained by the education department". The engineer explained this also overcame access problems and ensured the shelter was rapidly available when needed, by constrast, if it was closed for a long time it "may not be possible to open the gate when needed" or the lock may not be in good condition.

It appeared that a few households did not need to take shelter in the cyclone shelter, as they sheltered in a strong two-storey building nearby with family or friends. However, most houses in the village were made from earth, straw and wood which were vulnerable to cyclones. Therefore, one alternative to cyclone shelters would be to build stronger housing. The LGED official also raised this point, praising the nearby NGO pilot project which had built "single person" brick-built housing in Chapli Bazar, Patuakhali. Construction of these houses was limited by household income.

When exploring the lack of a cyclone shelter in the village, one respondent said; "we do not give land that's why there is no cyclone shelter in our locality". The LGED engineer confirmed land scarcity is an important barrier to construction of cyclone shelters and "sometimes there is great need or demand but not enough space to build it", while sometimes there is enough space but the community are not able to give up the land. This appeared to be a social barrier to cyclone-shelter construction.

One elderly male respondent (age 60) recognised there was an intergenerational dimension to cyclone shelter construction, stating: "*We are in the last stages of our life but it will benefit the next generation if we can build the cyclone shelter".*

Finally, when asked about the allocation of cyclone shelters, a UP official argued there are six villages in the area that badly need a cyclone shelter. Whilst the village of Poshurbunia clearly needed a shelter too, the official argued there were other villages in even greater need. The UP official also mentioned there was no scope for funds for repairing cyclone shelters unless these were sanctioned by central government. Interviews at national-level with the World Bank had established that each shelter costs 300,000USD. Thus, there were economic barriers and limits to adaptation (see Jones, 2010), such as limited government resources to construct enough shelters, and insufficient household income to construct stronger homes.

Social barriers were also evident, including the security of women, and unwillingness of local people to give up land to shelter construction.

8.3.5. Early Warning System (EWS)

In the chapter on Bangladesh, it was noted that Bangladesh's Cyclone Preparedness Programme (CPP) is well-known and internationally respected as it has dramatically reduced the number of lives lost during cyclones, by ensuring an early warning is disseminated through a network of volunteers. Around 75% of respondents in the household survey said they heard the alarm before Sidr. However some respondents said they did not hear the alarm because it was too far away. One respondent said the Red Crescent volunteers have to cover about 3km to raise the alarm and the sound level of the microphone is not loud enough, so they can hardly hear it.

One household survey respondent was a member of the Red Crescent volunteer team who was responsible for disseminating the alarm. He was interviewed in further detail, and explained that his unit had 15 people to cover 3 villages. The activities of the volunteers included raising the alarm, rescuing people, cutting trees that fall on the road, and helping people during disaster. The volunteer also explained that 4 people out of 15 are in the ward committee (local government ward representatives) suggesting an overlap between local government engagement and disaster volunteer work. He described the EWS process, explaining that the alarm comes from the thana (sub-district) HQ office through radio and mouthpiece, which informs the unit commander for a ward, who calls each of the 3 villages in that ward. These volunteers then use microphone, siren and whistle to raise the alarm. The volunteer explained that some volunteers are responsible for post-disaster response including first aid.

It seemed to be easier for households to hear the early warning if the cyclone came during the day. Several respondents explained that cyclone Sidr struck very suddenly during the night so some people did not hear the alarm. Overall, the EWS seemed to be working effectively, enabling villagers to prepare by placing belongings inside their homes, moving livestock onto the embankment, and if the alert reached a high level, moving to the cyclone shelter. The UP official pointed out it was important for NGOs and other organisations to increase awareness about the different cyclone alert levels, especially in schools.

The EWS can be credited with reducing the number of lives lost in cyclones. According to the local NGO, there were 4 deaths in Lalua Union (with a population of 16,704) during

cyclone Sidr (2007) and none in cyclone Aila (2009). However, the early warning system does not prevent people from losing their homes and belongings. In the survey, 85% of respondents reported their house was damaged or destroyed in Sidr.

The EWS is reliant on meteorological services, but it was revealed from the interview with the local meteorological officer at Khepupara that there are only five meteorological stations in Bangladesh using satellite. The station at Khepupara was one of only 5 radar stations under the BMD (WMO, 2007). The information was triangulated by literature which showed satellite images are only received through five satellites in Bangladesh (3 US-based, 1 China-based and 1 Japan-based) (MOF, 2014). The officer also revealed that they did not store any weather data locally at Khepupara, it was stored only in Dhaka due to a "lack of manpower" and other logistical reasons.

8.3.6. Saline-Tolerant Rice Varieties

Growing saline-tolerant rice varieties was discussed as an adaptation option to deal with salinity. In the FGDs, different rice varieties were discussed and participants listed various BRRI varieties 47, 28, and 29 (known as BRRI dhan28, BRRI dhan29, BRRI dhan47). Variety BRRI-58 was also being used and farmers reported this variety could tolerate remaining underwater for 15 days. Farmers explained they had learnt about these varieties from NGOs and found out where to get them. Before this, they had not used them. They explained they collected them from the Agricultural Extension Office in Kalapara (around 40 minutes by motorcycle and boat). Farmers also explained they got the seed for free, and could preserve the seeds after cultivation so that anyone with land could cultivate it. From FGDs it was clear farmers with land could benefit more from saline-tolerant rice varieties, but day labourers would also benefit from additional work.

The FGDs corroborated evidence from the literature review that there was not enough awareness about climate-tolerant varieties, as villagers had only been aware of them recently. Moreover, local extension services were lacking in capacity because the extension officer was quite distant. The interview with the local Agricultural Extension officer confirmed they had only just started awareness-raising activities, but had received a great response so far. The officer also confirmed the demand for seeds was often higher than availability. Small and marginal farmers were both eligible for free seeds (it was clarified that those with 50-249 decimals of land were classed as 'small farmers' and those with 5-49 were 'marginal' farmers). In order to identify 'farmers' a list was drawn up in the UP office by the field block

supervisor and agricultural officer, and then approved by the union committee. The extension officer also explained that there were some risks, so new varieties were mainly provided to "advanced farmers" who were ready to take the risk.

However, while the selling price of the climate-tolerant rice was the same, the agricultural extension officer confirmed that they had no way of controlling the price farmers' would get for their produce from middlemen:

"Our department is not responsible for controlling the price of crops so farmers come to us and ask why they're not getting a fair price… we have no answer as we've no authority to control the price."

8.3.7. Livelihood Support/Diversification

In the FGD with day labourers (who were identified as a particularly vulnerable group) it emerged they had many different ideas for future adaptation options and strategies. These mainly related to livelihood support activities and development of small businesses, including "goats for business", "fishing business", "grocery shop", and "tailoring". The day labourers also said they did not want money or "products", because if they got sick, this would have to be sold so they should "use it for business instead". Many of these respondents therefore seemed aware about issues relating to the sustainability of NGO interventions.

In the same FGD, in which participants were invited to identify their key problems in the area (social, environmental and economic problems) many participants stated that a key problem was "no work" (see image below). FGD participants also discussed the seasonal nature of work, which often led them to get into debt for half of the year (see 8.2.2).

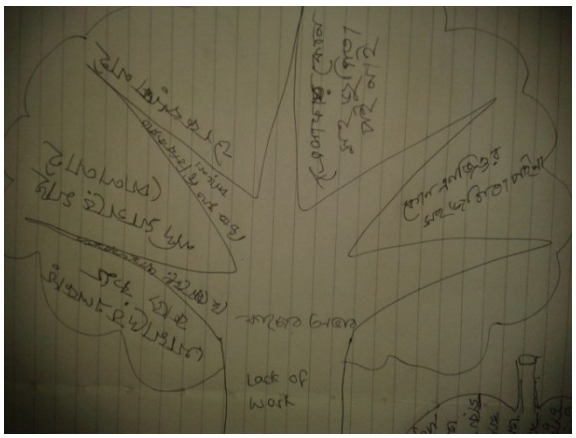


Figure 8.13 Image from FGD where participants identified and discussed lack of work as one of the most serious problems

In particular, the group concluded; "women need training for handicrafts" as well as "goods and support to sell them in market". These livelihood activities had not been discussed in

detail in the household survey. Since many of these day labourers did not own land, it is possible they would benefit more from alternative livelihood activities, as their lack of access to land prevented them from taking part in farming.

8.3.8. Mangrove Planting

Eco-system based activities were not a prominent part of the NGO activities in the area as these focused on community-based adaptation (CBA). In the literature review (chapter 4) it was recognised there is a distinction between ecosystem based adaptation (EbA) and CBA in the literature.

However, the local government engineer from the BWDB strongly recommended reforestation to protect the embankment. The BWDB engineer was responsible for the embankment construction project in the area and had noticed the forested areas of the embankment were subject to less erosion:

"I've seen where it is afforested, the damage is less but where not, it is seriously affected"



Figure 8.14 Image showing the embankment covers an exposed area, while the forested area acts a natural buffer that reduces river erosion of the forested area

The BWDB officer also argued tree-planting would be the "least cost" option compared to construction of embankments that are currently prioritised under the CEIP. He had noticed during his work that wave action is higher where there are no trees, and trees also had other benefits such as fruit production, and use for firewood when mature. He did not mention synergies with mitigation although this was another benefit. However, he argued implementation of such projects had been in "slow motion" and that plans had to be led by the MoEF. As present, he observed there was insufficient afforestation. However, he felt they

should not afforest all the land because they had to consider the demand for agricultural land for food production, thus he thought afforestation should be undertaken mainly on and outside the embankments.

Although trees act as a protective buffer, it was noted by some respondents that trees were also vulnerable. The official from the local meteorological office at Khepupara (Kalapara) said around 30% of the trees in the Sunderbans were destroyed in Sidr and they take 30 years to grow back. This aligned somewhat with reports that around 25% of the Sunderbans forest was destroyed by Cyclone Sidr, but there were also reports that the forest recovered more quickly from the cyclone than expected (Dailystar, 2007). The Forestry Officer also argued many mango trees in the Kuakata area had been destroyed by river erosion.

The key informant interview with the local Forestry Officer revealed that in 2009-2010 there had been a project under the Forestry Department to plant trees on the slope of the embankment, but there were no current projects. The officer explained there are various mangrove species tolerant to salinity and tidal waves including 'kaora' (*Sonneratia apetala*), 'gol pata' or 'nipa palm' (*Nypa fruticans*), 'sundri' (*Heritiera fomes*), amongst others. One project was on-going to protect the trees beside the LGED roads for "poverty alleviation through social forestry". There were also plans to implement a future project in collaboration with the agricultural office on multi-purpose trees and social forestry. There was no climate-related forestry project under implementation in this area, as far as the officer was aware.

In the FGD with women, it was also argued that trees protected the embankment from river erosion. However, the group mentioned that trees also get washed away by river erosion, so in some areas it is not possible to reforest. Yet the women discussed how there were some tree varieties with the capacity to exist in saline water like "kaora", and trees with deeper roots. Interestingly, when describing their involvement in the embankment, the participants mentioned they had been involved in "putting down branches of trees to protect the embankment". However, the women did not seem to be aware that this activity might only have a short-term effect while contributing to deforestation.



Figure 8.15: Deforested trees on the roadside in Lalua Union (March 2013)

8.3.9. Comparison of adaptation strategies

One important structural measure introduced under the CBA project was the construction of dams in front of the broken sluice gates to preserve fresh water. A preliminary cost benefit analysis of the intervention revealed the benefit-cost ratio to be 6.44 (see Box 8.2), demonstrating that each dollar invested generated 6.44 dollars of benefits for the community. However this is a conservative estimate, as intangible non-monetary benefits, such as improved health, were not included in the analysis. However, the dam had negative effects on a small minority of fishermen, resulting in social tensions. These tensions appear to have been gradually resolved through collective negotiation and one local fisherman seemed reconciled to the dams.

However the tensions indicate that although ultimately repairing the sluice gate could be a more cost-effective long-term solution, it would be politically difficult. Several respondents reported that elites had control over the sluice gate committee for their own interests. The problem appeared to be exacerbated by a lack of communication between the local government and BWDB (who are responsible for maintenance of water structures).

Embankment maintenance was a key priority for the community who felt their lives were in danger if the embankment was broken, as this could increase the impact of storm surges and salinity (see Table 8.1). People also felt road improvement was vital for transport, including movement to safety during a cyclone. On the topic of cyclone shelters, many respondents felt they were too distant and experienced difficulties getting to the overcrowded shelters during cyclones. Others stayed behind to protect livestock and belongings. However, while respondents in this village felt they badly needed a shelter, the UP official said there were

other villages in greater need. Land could also be a barrier to shelter construction. One alternative noted by the local LGED official would be to construct individual cyclone-resistant houses.

Table 8.1 Comparison of relative benefits and costs (and limitations) of adaptation strategies

Adaptation	Hazard addressed	Benefits (social , economic and environmental)	Costs (if known)/ limitations and constraints
Freshwater preservation (dams)	Salinity, food insecurity	Food security, freshwater for livestock, cooking and bathing, increased income in winter months. Water for irrigation benefited an estimated 1265 farmers in Lalua Union (4500 ha)	Poshurbunia sluice gate dam in 2011 cost 53521tk (approx. 500GBP). Cost of 8 dams (Lalua Union) in 2011 cost 249,750tk (approx. 2000GBP). Drawbacks are that dams will require rebuilding each year.
Embankments	Salinity, river erosion and cyclone	Protection from erosion, flooding/storm surges and salinity	Rehabilitation of polder 47/5 was 5.4m USD (ECRRP)
Roads	Cyclone (access to cyclone shelter), food insecurity	Accessibility during cyclone, transport links for education/work, access to markets	Not known
Cyclone shelter	Cyclone	Saves lives, multipurpose shelters function as schools	300,000USD (World Bank, pers comm, 2014)
Early warning system	Cyclone	Saves lives and enables protection of belongings/livestock	Not known, already exists with Red Crescent community volunteer network
Saline-tolerant rice varieties	Salinity, food insecurity	Food security, improved income for farmers and farm workers	Low cost, seeds already available from DAE, requires awareness-raising
Livelihood support	Food insecurity, poverty	Improved income for day labourers, poverty reduction, reduces dependence on environmental resources	Not known
Mangrove/ tree planting	River erosion, cyclone, salinity, food insecurity	Protection from erosion of embankments, cyclones, increased income from provision of fruit/firewood	Low cost compared to concrete embankments according to BWDB engineer. Need for community awareness to protect trees.

The EWS under the CPP seemed to be effective with 75% of household respondents reporting they heard the alarm during Sidr. However the warning did not prevent 85% of household respondents from losing their homes during severe cyclones.

Extension services and saline-tolerant rice varieties also provided a vital lifeline for struggling farmers, but local farmers had only been aware of these relatively recently. This demonstrated the need for increased awareness, extension services and supplies of seeds for farmers.

Day labourers emphasised the need for alternative livelihood options and they had many ideas including selling handicrafts and tailoring. These ideas could be facilitated with NGO support, inputs or training. It was also observed that tourism is expanding in nearby Kuakata so there may be a market for locally-made handicrafts. In nearby Kuakata, anecdotal evidence was obtained that most of the handicrafts on sale to tourists were being imported from India.

Eco-system based adaptation did not seem to have been prioritised in the local area. In the interview with the BWDB, the official felt strongly that planting trees on embankments would prevent river erosion. The local forestry official confirmed there were currently no projects in the area on this issue. This could be a low-cost intervention with additional benefits such as providing fruits and other ecosystem services like firewood to the community. Community engagement would be needed to increase awareness about sustainable forestry management in order for the scheme to be sustainable in the long term.

8.4. Progress against Indicative Framework

An attempt has been made to retrospectively evaluate local adaptation progress (including the CBA project and government projects) against the indicative framework for effective finance (Chapter 7). This goes some way towards answering the research question on the progress made in effectively financing adaptation. The findings discussed in this section are summarised in the table in Section 10.7.

Consistent with the framework in 7.7, the local CBA project implemented by ActionAid seemed to have been successful in addressing equity by targeting the most vulnerable groups (women and landless households) and providing them with knowledge and training. The CBA project targeted the poorest more than the BCCRF project. The cost-effectiveness of the project was also demonstrated through particulatory cost-benefit analysis, although the social benefits of the intervention could not be quantified. However, whilst the CBA project appeared effective in reducing vulnerability, the long-term sustainability of the sluice-gate dam is not assured, since re-building the dam requires ongoing annual expenditure. Thus, there was balanced progress on the sustainability of the initiative.

The ongoing local infrastructural projects (cyclone shelter and embankment construction) appeared to align with stakeholders' stated urgent needs in relation to adaptation and were being implemented in a timely way. However, these particular needs might only have been articulated due to the visibility of these projects. Due to uncertainties regarding future climate change, it was not clear to what extent the infrastructure would be robust under different scenarios and therefore neither clear to what extent maladaptation could be avoided nor whether interventions would be adequate. It was not clear to what extent practicality or feasibility were taken into consideration.

Synergies between mitigation and adaptation did not appear to be recognised in either the CBA project or governmental projects. However, the household survey revealed that low-income households benefited from solar energy. Local stakeholder interviews also revealed tree-planting was considered to be potential adaptation option, but that this has not been adequately recognised by government decision-makers. Overall there was little progress in coherence between adaptation and mitigation.

Gender equity had been taken into account in the local CBA project as there were dedicated women's groups (GGD), and women were now becoming involved in local politics and disaster relief work. Respondents noted they had previously been marginalised in decision-making.

In terms of scaling-up, the local government appeared to have adopted the dam-construction (freshwater preservation) scheme in other areas of Lalua Union, but long-term monitoring would be required to demonstrate long-term results. Thus there was balanced progress on this issue. In terms of ownership, the bottom-up approach undertaken by the NGO appeared to have been instrumental in providing a sense of empowerment to climate-vulnerable stakeholders, particularly in relation to their engagement with local government. There was nascent evidence of mainstreaming of adaptation into local government planning, though clearly these results cannot be generalised to other areas. There did appear to be a level of coordination within local government (for example, in allocation of cyclone shelters) but it is not clear to what extent this was objective or transparent. Due to the similarity between adaptation and development, the issue of additionality was not relevant at local-level.

Altogether, the NGO-initiated CBA project appeared to be implemented transparently and had resulted in documentation of the local government spending in various budget reports. However, the top-down World Bank projects (cyclone shelter and embankment construction)

were more difficult to explore at local-level. There was evidence local-level stakeholders had been involved in their own 'community monitoring' of the embankment construction but this may not occur elsewhere. Thus there was balanced progress regarding transparency and stakeholder engagement (see 10.7). Local communities' enthusiasm in this regard may indicate the World Bank and LGED could fruitfully improve such projects through improved stakeholder engagement.

8.5. Conclusions

Interestingly, many households felt cyclones were increasing and becoming more severe. However, it is also possible this perception may have been influenced by the NGO project in the area, in which some villagers discussed climate change in GGD groups. Overall, most households felt their food security was linked to the seasonal nature of work in the area, which was of course linked to the seasonal hazards (like flooding) which pose risks for agricultural production.

Whilst some households were keen to discuss the adaptation options and coping strategies they used, many households felt they were largely helpless in the face of the risks of disasters like cyclones and salinity intrusion. After Cyclone Sidr (2007) it was noted that the loss and damage to homes and livelihoods had been immense. In fact, from the household survey it was calculated that the average losses per household were twice the average household annual income. This demonstrates it is extremely difficult for people to recover from this type of severe disaster without external support and relief.

Households found it difficult to prioritise or rank the climatic hazards in this area, as they were all seen as serious. Furthermore, it emerged from the interviews and household survey that these hazards are interrelated, for example, cyclones lead to flooding and salinity intrusion, which also exacerbates the on-going river erosion and damages embankments leading to further salinity intrusion. The complex web of climatic hazards therefore has a multifaceted impact on local livelihoods. Feedbacks in the system also provided evidence of climate-related "poverty traps".

Land tenure security was an additional issue emerging from the study. This appeared to be exacerbated by river erosion; a slow-onset process which meant that families sometimes lost their land over generations. Access to land is a prerequisite for farming, and a determinant of wealth. Thus, long-term sea level rise under climate change will have severe economic and social implications unless households can access land elsewhere. However, this issue could

not be addressed by local-scale projects but would require addressing by national-level policymakers. The study highlights the need to address not only availability of food but also access.

In terms of the research question on the progress in effectively financing adaptation, there appeared to have been progress in addressing gender. The vulnerability of women emerged strongly from the interviews, including security risks in disaster, and day-to-day risks. Yet, it was reported by women in the village that they had more say in local politics and felt more empowered since the CBA project had begun. This suggests gender issues remain a problem in other areas where the CBA intervention had not taken place and tackling gender issues would also require interventions at national-scale.

Local government capacity appears to have been strengthened in the CBA project through participatory budget planning efforts, which were enabled by empowering local people to understand their rights in relation to local government. Although there were allegations of corruption and bribery in local government, which it was felt affected allocation of resources for adaptation, several household respondents felt governance had improved. Government accountability appears to be a two-way process (Rahman, 2007) requiring active public participation at local levels to demand improved services.

The household survey also found many people are affected by rising prices of food, fuel and fertiliser. Food prices were a particular serious issue for the landless, but one farmer recognised they may benefit from higher food prices. Access to solar (owned by 50% of respondents) seemed to partially offset the impact of rising kerosine prices on households.

Finally, the local study aimed to explore the relative benefits of different adaptation options and strategies, with particular focus on embankments, cyclone shelter and water preservation as these activities were currently being implemented as adaptation projects in the vicinity. A range of other adaptation options were suggested by household respondents including building housing, throwing stones on the embankment, fertiliser and agricultural inputs, tube wells, road construction and livelihood support. Embankment and cyclone shelter construction were widely applauded as adaptation needs by households, and these are the projects being carried out by the World Bank under the ECRRP.

Limitations arising from the local-level study were that a translator had to be used for all interviews, except with a few local officials who spoke English. There were various

confusions arising from translation in several cases, for instance, since the word for ‘embankment’ (‘rasta’ in Bengali) was the same as that for ‘road’ in Bengali. These obstacles were largely overcome through careful facilitation of FGDs, seeking further clarification of various points, and by using a trained and experienced interpreter.

9. National-Level Analysis and Findings: Bangladesh

9.1. Introduction

As described in the methodology chapter, semi-structured interviews were undertaken in Bangladesh at national-level, as well as quantitative analysis of household-level survey data. Semi-structured interviews with 24 key stakeholders and experts took place, primarily in Dhaka, Bangladesh (February-March 2012, and March-April 2013) although some interviews took place via telephone where required. Chapter 5 provides an extensive and systematic literature of the national-level issues of climate change adaptation, food security and adaptation finance in the case of Bangladesh. As explained in Chapter 2, the indicative framework for effective adaptation finance (Chapter 7) was used to inform the analysis in this section. Sections 9.6 and 10.6 explore cross-scale linkages, and progress at all scales is finally summarised in 10.7.

Interview data has been used track progress against the framework for analysis (Chapter 7), to determine to what extent the evidence points towards satisfaction of those principles. Although much discussion focuses on the BCCTF and BCCRF funds, that is not determinative of the evaluation of progress as these are just discussed as they were the two dominant funds.

In summary, expert stakeholders in Bangladesh expressed concerns about the initial lack of transparency in the new multi-donor climate fund, as well as the lack of institutional capacity for disbursement of funds. Overall, it is hypothesised that channelling climate change finance in an appropriate and effective manner will be an institutional and governance challenge, as well as a logistical challenge.

9.2. National-Level Household Survey on Food Security and Adaptive Capacity

In addition to qualitative research, statistical data analysis was undertaken using the household survey data obtained from CGIAR (Consultative Group on International Agricultural Research). The survey data from Bangladesh was collected as part of the Climate Change, Agriculture and Food Security (CCAFS) research programme, a global ten-year highly collaborative research programme led by the CGIAR and the Earth System Science Partnership (ESSP) (see: www.ccafs.cgiar.org). Analysis of the data highlighted the value of different 'assets' under the sustainable livelihoods approach, indicating this approach offers a useful conceptual framework for understanding local adaptive capacity (Jones *et al.,*

2010; DFID, 1999). The rich dataset provided relatively scarce empirical evidence and insights into relationships between household food security and agricultural livelihood changes in rural households of coastal Bangladesh. An overview of the results is given in this section. For further details, refer to Wright et al (2012) from which this section is adapted.

The CCAFS baseline survey was carried out across diverse rural sites in 12 countries. In Bangladesh, the surveyed sites are located in the coastal zone, where salinity intrusion is prominent and crops are frequently lost due to floods or tidal surges. The survey was designed with the intent of developing simple, comparable cross-site household-level indicators, for which changes can be evaluated, of food security, household assets, agricultural production diversity, agricultural sales diversity, changes to farming practices (adaptation or innovation), mitigation and gender indicators (Kristjanson *et al.,* 2011). In Bangladesh, a random sample was taken of 20 households in each village, and seven villages within each seven sites meaning 980 households were surveyed in total.

Empirical evidence from the household-level survey of smallholder agricultural and fishing households was used to examine the relationship between assets, livelihood strategies, food security and changes to farming practice being made by households as they cope with various demographic, economic, and environmental changes. In summary, it was found that the least food secure households are making few, if any, changes in their agricultural practices, have relatively few assets, and are producing and selling fewer types of agricultural products than more food-secure households. The analysis found a strong association between a proxy measure of household adaptability - the total number of changes made in agricultural practices over the past ten years - and one for the degree of agricultural diversification of households in terms of the number of different products produced, suggesting agricultural diversification is a key strategy helping households to deal with climate and other changes.

The survey confirmed there are many highly food insecure households across coastal Bangladesh since 15% of households reported they struggled to feed their families for six or more months per year, and a further 41% face between one and five "food deficit months" in a typical year. In looking at household food security levels in relation to the number of assets a household owns (taken from a list of basic household assets, such as mobile phones or radios), the analysis found highly food-insecure households generally had few of these household assets. The Chi-square statistical test confirmed a strong association between the

number of assets owned by the household and the level of hunger reported (chi² = 140.5 (n=980), d.f.=4, p<0.001).

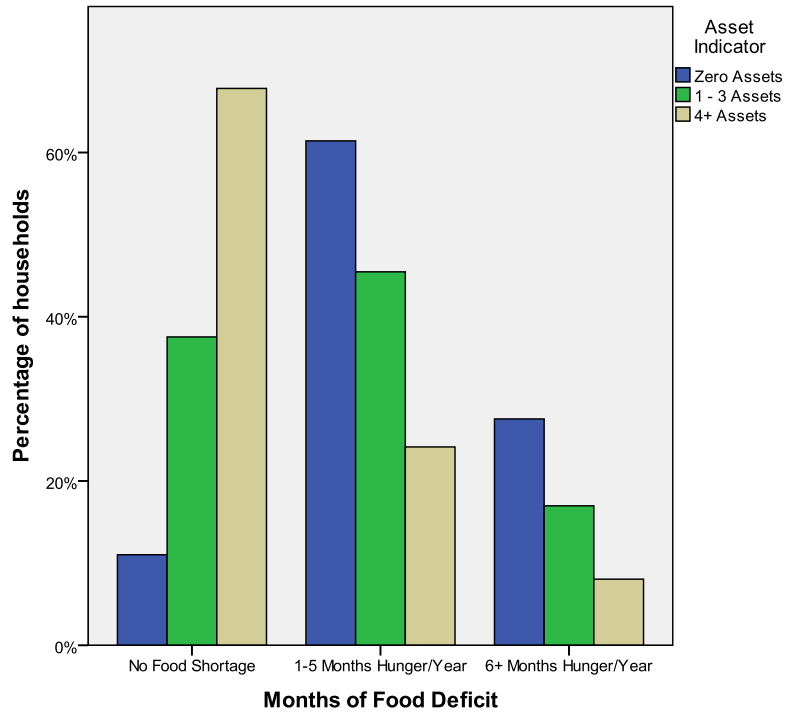


Figure 9.1 Relationship between Asset Indicator and Food Security

Rice was by far the most critical crop with 64% of households saying it was their most important. Coconut, bananas, garlic, papaya, lentils and betel nut were frequently mentioned as the 'second most' important crop. There was a strong statistically significant association between diversification in agricultural production and the level of food security (chi² = 76.4, d.f.=4, p<0.001). More diversified households had fewer food deficit months in a year; the converse was true for less diversified households. This may have been because wealthier households were able to diversify which also enhanced their income. Refer to Annex XX for the full table of results.

These results give support to the use of the Sustainable Livelihoods Framework (SLF) as a conceptual framework (see Annex V and Chapter 4). Knutsson and Ostwald (2006) argue it has previously primarily been used in a theoretical sense rather than a practical one where these relationships are tested empirically. The remaining relationships in the dataset were thus examined in light of the SLF. In the SLF, the vulnerability context has a direct impact on people's assets and livelihood options so climate change could be conceptualized as one aspect of the vulnerability context.

There was also a strong association between the market orientation of households and levels of food security reported ($chi^2 = 48.96$, d.f.=4, $p<0.001$). Households selling a greater range of products reported fewer food deficit months in a year; and the converse was true for households selling fewer products. Out of the 151 households surveyed that reported having more than 6 months hunger per year, 74% sold only 1 or 2 agricultural products. Being dependent only a few crops could have increased susceptability to climate shocks.

Land can be conceptualised as a form of 'natural capital' under the SLF, and there was also a strong and significant negative relationship between the amount of land owned and food security ($chi^2 = 164$, d.f.=6, $p<0.001$). None of the landless households reported having sufficient food for their families all year. This may suggest policies such as land reform could be effective to help landless households. Agricultural day labourers (who were often landless) were found to be likelier to suffer from food insecurity. Agricultural labouring might therefore be seen as a coping strategy for those without any or much land, but does not appear to be successful in terms of ensuring food security.

On gender, it was found that women play an important role in agricultural production, particularly producing vegetables, processing food produced on their farms, collecting fuel-wood, producing livestock products, and raising small livestock. For large livestock (such as cattle and buffalo, found in 44% of surveyed households), one-half of households reported men do most of the work. Fishing was primarily a male activity in coastal Bangladesh; 40% of households were producing fish and 88% said men did most of the work.

The survey data also explored changes households had made in their agricultural practices over the last ten years (including those related to crop varieties, crop types, soil, water, and land management practices, and livestock types and management), and the reasons for those changes. This aimed to explore agricultural adaptation and adaptability (or innovation). 78% of households had introduced a new variety of crop, mainly Aman Rice and HYV Boro rice. A majority of households had started purchasing more inputs, such as pesticides herbicides, and mineral or chemical fertiliser, with inputs commonly being applied to the rice varieties.

Interestingly, market-related reasons (like prices or yields) were more frequently given as the reasons for agricultural crop changes than weather or climate-related reasons. Better yields and better prices were cited by over one-half of households; higher salinity was mentioned by one-quarter, and emergence of new pests and diseases was cited by 21%. It may be primarily market forces affecting food security and livelihood strategies of households, rather than

climate changes. Yet virtually all households reported facing a climate-related crisis (such as cyclones, see Chapter 8) in the past five years with only 36% of them reportedly receiving assistance.

Overall, the analysis provides empirical evidence of enhanced food security being linked to more natural capital (land) and physical capital (assets) in particular. Human capital (education) was also found to be closely associated with adaptability (below) with a strong positive association between adaptability and the highest education level achieved by a household member ($chi^2 = 96.7$, d.f.=6, $p<0.001$).

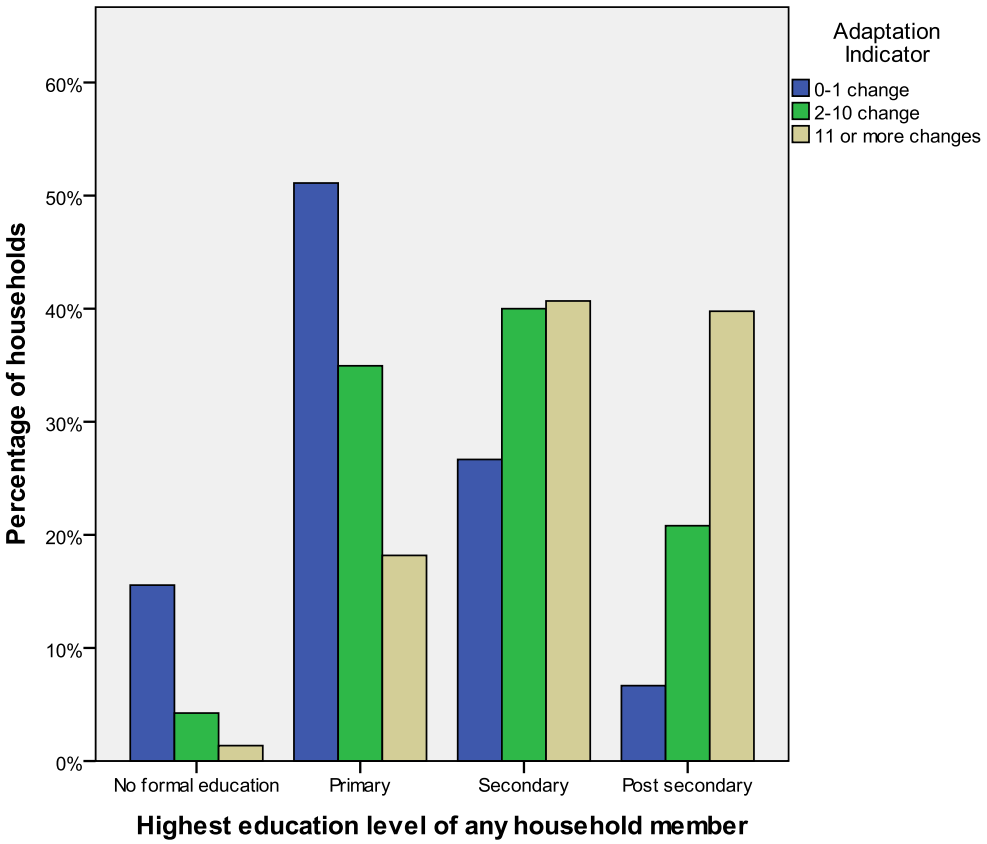


Figure 9.2 Relationship between Household Education and Adaptation

Although the analysis was not a causal one, the statistically significant association between adaptability and food security supports the view that poor households with high levels of food insecurity are forced to be more conservative in their livelihood strategies to avoid risk (Banerjee and Duflo, 2012). Such households are not in a position to adopt new agricultural strategies in response to climate or market-related changes, and may become stuck in a 'poverty trap'. It is also likely the causality goes both ways; those that are not changing their agricultural practices are increasingly likely to remain food insecure. This supports the

crucial role of public intervention and finance in facilitating adaptation for such vulnerable households. Clearly, poor households with few assets that are already suffering from food insecurity will be the most vulnerable to extreme events and average temperature increases. Differences between households in terms of assets, livelihood opportunities and adaptive capacity demonstrate why equity is such an important consideration in research and development efforts focusing on adaptation (Smit and Pilifosova, 2001).

The data suggest more immediate market and productivity drivers (higher prices, improved market opportunities) are dominant in shaping Bangladeshi households' agricultural adaptation strategies. This implies programmes and investments coming from new 'climate change' funds will be most effective if they do not falsely assume rural households' behaviour is influenced by climate change alone. Such vulnerability factors may require further research in order to explore appropriate adaptive strategies. For instance, there may be need for policies to reduce market risks for smallholder agriculturalists.

Overall, the analysis supports the use of the SLF as a conceptual approach for understanding household food security and agricultural adaptation. This may inform strategies and policies for increasing food security and adaptive capacity of households in the face of climate change. Although SLF has been shown to be useful, it is also limited in so far as it leaves out the role of power, including political power and women's empowerment, and cannot incorporate historical dimensions or dynamic changes (Adato and Meinzen-Dick, 2002). However the analysis suggests the SLF may form a useful basis for future work on developing metrics and indicators for measuring adaptation and adaptive capacity. It also lends to support to the LAC framework (Jones *et al.,* 2010) as a way of conceptualising adaptive capacity (see Section 4.1).

9.3. National-Level Semi-Structured Interviews with Key Informants

As described in the methodology, semi-structured interviews were undertaken with a range of national-level key informants in Bangladesh (24 interviews in total). Institutional mechanisms and channels for publicly-provided climate change finance are explored with the aim of exploring key issues surrounding adaptation finance and identifying recommendations for the kind of frameworks, institutions and policies to facilitate effective adaptation finance. As explained in 2.2, sub-questions included finding out what issues should be taken into consideration in assessing the effectiveness of international climate finance, and what frameworks can facilitate effective finance for food security under climate change. The principles and issues identified in the literature review were used as a theoretical framework to inform open-ended semi-structured interviews. Respondents requested their responses should remain confidential. Progress against the set of framework principles (Chapter 7) was evaluated qualitatively using the available evidence and is finally summarised in 10.7. As described in Chapter 2, an inductive approach was used to identify key emerging themes, discussed in Section 9.4.

9.3.1. Equity and Allocation Criteria

Several respondents reported that political influence in project selection was a problem for the BCCTF (government fund), but not the BCCRF (donor fund). One civil society organisation suggested that political influence was evident in Trust Fund since projects were approved in the home districts of the Environment Minister and the Prime Minister although these were not priority vulnerable areas. A donor argued there has been "too many projects in Chittagong where the Minister comes from" leading to speculation and allegations of political influence. The government official cited several examples, including finance going to "Chittagong – the home of the Environment Minister", and to the home of the Prime Minister (Gopalganj), but argued the coastal area should have been prioritised. The anonymous government official added this was a "serious problem" and the BCCTF "will be controversial whether it is really reaching the climate victims" as they were "receiving letters from people asking for projects" including from the "speaker" and these were "not priority but had to approve it because they were powerful to the system" [sic]. Another example of political influence was given from Khulna, where one respondent argued that "the major of Khulna City Corporation had some interest in building a water treatment plant in this area because on this place he had some land" [sic]… "the mayor is supreme authority and he

decided". Overall, the allegations by civil society of political influence suggested prioritisation of projects was not based on vulnerability, with implications for effectiveness and equity.

The World Bank respondent also confirmed that project selection was based on the projects that came forward (a demand-driven approach), meaning that prioritisation was "based on projects available" rather than being based on vulnerability, but they were considering doing 'a priori' prioritisation or issuing calls for proposals on specific issues. Overall, it seemed specific vulnerability criteria were not being used to target the most vulnerable.

Government highlighted the advantages of having flexible allocation criteria. A government official argued that "if the topic is urgent, the criteria is not a problem" [sic]. The respondent argued the BCCRF format is complex while the BCCTF has "an easy format... it is easy to apply and the form is simple". When asked why the BCCRF is only for larger projects, the official stated the stipulation came from development partners as they were "more happy in terms of transparency, etc" and because "development partners are more interested in donating to BCCRF". Thus, both development partners and government prompted the focus on larger projects; the former because they were deemed easier to monitor, the latter possibly because it was felt that would garner larger funds.

Similar to the BCCRF, seven practical project selection criteria were reportedly being used to select projects for funding under the PKSF-managed community component (CCCP). According to PKSF, the criteria used were: (1) A registered NGO (2) 5 years experience at community level (3) 3 years established presence working on that issue in that area (4) Spending of at least 10mTk every year for the past 3 years (5) Project in line with the BCCSAP (6) Implementation capacity (7) Location in the 49 selected Upazilas (flood-prone, drought-prone or saline-prone). The World Bank respondent said they had to ensure the NGO applying under the CCCP was financially solvent, had sufficient staff to manage the project, and also had consulted with the community.

It was initially discovered the BCCRF project selection criteria were that projects had to be above $15m in size and "close to implementation". One respondent made available additional documentation containing seven project selection criteria (see Chapter 5.5). The eligible project size under the BCCTF (government fund) is up to $3m, while the BCCRF would initially only fund projects of over $15m. It was therefore noted by the author there is a gap between project sizes of $3-15m which are not eligible for either national climate fund.

However, in a later interview with a multilateral organisation, it emerged the minimum project size was "not set in stone" and potentially could be changed in future. A government official stated the BCCRF project selection criteria were controversial and "every member has their own opinion of the criteria". When asked who developed the criteria, the official argued the "World Bank developed the criteria, but don't blame the World Bank, this is the system they have". However, the official also argued that "government overruled the criteria" suggesting the government ultimately had the final decision on project selection.

Vulnerability indices and tools were not being used to guide funding allocation in Bangladesh, possibly due to the constraints on time and resources for policy-makers, so it was not clear to what extent objective criteria guided funding allocation. Furthermore, there were concerns about the effect of structural flood defence works on the poorest landless communities, some of whom may be forced to move (see 9.4). Overall, there was mixed progress regarding equity because whilst project selection criteria under the BCCRF and CCCP included a focus on hazard-prone areas, there was also no specific requirement to target climate-vulnerable sub-groups (e.g. children or women).

9.3.2. Cost-efficiency

In terms of the overhead costs of World Bank management, some respondents were critical. One (from media representative) argued that the overhead was "supposed to be 2% only but on the document they already got 4-5% and going to 6%". This was also raised by another NGO stakeholder who argued there is a "hidden cost" and "they may increase this up to 10% - nobody knows" hence linking the management costs to the lack of transparency.

However, the donor official argued that the World Bank "definitely" provides value-for-money as they only have the "5% overhead" which is "maybe why they are not doing the soft policy stuff" as they charged the "bare minimum level". This suggests cost-efficiency was an important concern for donors. This comment suggests pressure for cost-efficiency had led to the focus on structural adaptation because there was an assumption that such projects provided better value-for-money, although this assumption was questioned by other studies (Haque, 2013). The World Bank appears to have mobilised co-finance, although this has also led to concerns regarding additionality (see section on additionality below). Overall the evidence on cost-effectiveness is balanced, and it appears insufficient information was available to make a comprehensive analysis on progress on cost-efficiency at this stage.

9.3.3. Monitoring Results/Effectiveness

Project results indicators were not yet available and one donor official stated in 2012 "for a solid 22 months I have been asking for a project-ised results matrix... no-one holds the vision, it is partly the donors fault". They also stated there was no annual workplan. When asked about the reasons for this, this respondent said this was due to capacity issues as the MoEF has not got the "staffing, time or space" or the "pressure to have results on-the-ground". However, another respondent from the same organisation stated there was "for each project, a clear results framework". Hence there was contradictory information. Furthermore, while the donor official implied the World Bank were preparing the results framework, another respondent from the ADB argued in 2012 that "DFID is preparing" the results framework and they hoped there would be a results framework "by this year". Interviews with the World Bank in April 2013 triangulated the information that a monitoring and results framework was not available yet and there had been delays as it was "slightly lagging behind" but it was argued this should be "finalised by mid-June [2013]". The World Bank stated the communication strategy was in draft and would be available after the results framework, and the strategic workplan would also be available after the results framework.

One media representative argued capacity for monitoring results was limited, stating:

"They try to say they have monitoring but they have two guys – and no visible process, manpower or infrastructure. They should build the monitoring process on universities and build a knowledge bank to work on these issues. They should give money to universities – connect universities, government agencies, local government and community people… it would make the whole process transparent. Instead the 'research' part of the BCCRF will be a consultancy business – they will rent it to these people and 'cut and paste'."

The lack of manpower for monitoring within government was triangulated by another NGO expert who argued there were only "3-4 people" monitoring the distribution of $300m in the Climate Change Unit (CCU). According to the same respondent, monitoring was not the full-time job of these staff and they needed someone with an "exclusive monitoring purpose" [sic]. However, at ground-level, provision for monitoring programmes and projects appeared to be in place. One World Bank official described how the construction of cyclone shelters was monitored by various stakeholders: including the LGED, World Bank, Project Coordination Monitoring Unit (PCMU), as well as the School Management Committee who

were also "given authority to monitor" and would report any problems to the contractor or LGED.

The CCCP appeared to have considered robust monitoring processes. According to PKSF this would be done by various bodies: NGOs, the PKSF management unit, a central unit of PKSF and the World Bank. They stated "each project will be visited physically by the project staff of PKSF". However, it was noted PKSF did not have experience managing NGO projects or experience in adaptation, but did have pre-existing monitoring processes (including an online system) used for their micro-finance activities. Evidence regarding progress on effectiveness was balanced, with more evidence of capacity for monitoring effectiveness under the CCCP than under BCCRF.

9.3.4. Urgency and Timeliness

One senior government official expressed frustration at the bureaucratic processes of the World Bank which they argued created delays in disbursement. The official argued "government have speeded the processes for urgent and immediate needs and requested the World Bank to do so", adding that "the World Bank needs to evaluate its own systems to address immediate need". As an example, the official argued that "you don't need to develop a guidance manual before building a [cyclone] shelter". These concerns were repeated by a respondent from a multilateral organisation, who argued the World Bank's "bureaucratic system for approval of projects is a major challenge" in terms of causing delays in implementation. These concerns reveal there seems to be a tension or trade-off between due diligence (robustness and oversight) and rapid implementation, as was hypothesised in the literature review. The same trade-off was noted by a donor respondent who argued that the World Bank is "very robust but takes time".

Moreover, the same respondent argued the frequent transfer of civil service staff was "hampering the project implementation works and quality of project works" because it "takes time for training them" [sic]. The links to the discussion on the capacity of the Ministry staff (9.3.9). In terms of overcoming these challenges, the respondent noted there are "12 climate change cells in relevant ministries and CCU unit in MoEF… it would be better to transfer between those". Overall, it was suggested by various respondents that civil service reform could improve implementation capacity and timely disbursement.

Cyclone shelters were identified as an urgent and immediate need, suggesting this is why the ECRRP project was prioritised. The government official described how they had streamlined

the approval process for rapid implementation by bypassing the Planning Commission. However, the donor respondent argued this was a "bone of contention" and the new system had yet to be tried. In summary, there was some progress in attending to urgent adaptation needs in a timely manner.

9.3.5. Flexibility and Robustness

Arguably, construction of cyclone shelters under the BCCRF can be considered a 'no regrets' adaptation as they were needed even without the projected impacts of climate change. However it is unclear to what extent these shelters could withstand the most extreme SLR scenarios (see section 9.4.2 below). One NGO expert argued they "didn't think" the adaptation options had been "rigorously tested against different climate scenarios". Moreover, some respondents expressed concerns that embankments can make communities' more vulnerable in the event of extreme storm surges as they provide a false sense of security.

When asked which climate models they were currently using for planning, the LGED official was not specific on this point but said the scenarios were "20 years ahead" assuming 200mm of extra sea level rise. Thus, presumably the infrastructure would have to be adapted later. Overall, there was balanced evidence about the extent to which flexibility and robustness were considered in adaptation finance in Bangladesh.

9.3.6. Adaptation/mitigation coherence

A donor official commented that governments' position was that 80% should go to adaptation, and they agreed, because Bangladesh is a "victim of climate change". Several respondents felt adaptation was more important for Bangladesh. It emerged there were some projects tackling both adaptation and mitigation together, including a coastal afforestation project, and a solar irrigation project awaiting approval from the Governing Council. Moreover, it was noted that the government allocated significant sums to mitigation under the BCCTF. Under CCCP, PKSF reported they were only accepting adaptation projects, but they would accept projects with mitigation co-benefits. Overall, there was some evidence that synergies between adaptation and mitigation had been considered.

In terms of trade-offs between adaptation and mitigation, a respondent from a multilateral agency reported that in Bangladesh they were not talking about mitigation but instead about "green growth" as there was a need for alternatives to fossil-fuel generation. However, an example of a cross-border contradiction between adaptation and mitigation emerged, as one

interviewee highlighted that construction of hydroelectricity dams in India had a negative impact on adaptive capacity in Bangladesh.

9.3.7. Gender equity

Gender and the specific vulnerability of women were raised several times in the national-level key informant interviews. For example, under the government's "food-for-work" programme launched by the WFP, women were targeted as key beneficiaries of the project for the extreme poor.

One NGO respondent explained:

"Women farmers have important lack of rights in the food chain. The government only counts 'farmers' as those who are doing the planting but this is only one small part of the whole food chain. Women are excluded from the same subsidies and agricultural extension services because they often look after the seeds, for example or do harvesting. They do not have the same rights. You need the right seeds to get the best crop. Equal rights for women farmers would promote adaptive capacity."

In other interviews, there was only a passing reference to the vulnerability of women. For example, one government engineer stated that in his project "women were handled properly". One NGO expert argued that the Bangladeshi government has mainstreamed and considered gender in government but "I am not sure about climate change specifically". Overall, there was little evidence that gender had been considered.

9.3.8. Practicality and feasibility

Under the BCCRF, management by the World Bank meant there were rigorous standards regarding the technical and financial capacity of applicants to handle finance and implement programmes. Similar standards were in place under the CCCP. However, under the BCCTF there was a concern by one NGO that a 'floating garden' programme had been approved without sufficient research to evaluate long-term sustainability or feasibility. Thus, progress against this issue can be classed as balanced with some measurable progress.

9.3.9. Capacity issues

The issue of monitoring results links to the topic of government and management capacity. There were suggestions from various donor respondents that the Ministry of Environment and Forests (MoEF) lacked capacity and staff. Another donor representative in 2012 explained the bank account for the BCCRF has not yet been set up. A donor respondent argued that

"readiness criteria" should not mean that a particular project would never get funding, but it may need capacity-building first. They also felt the MoEF was "thin on the ground with people" and had a "problem with retaining good staff" and suggested this may be a problem requiring civil service reform, not just an issue for climate change. This issue was raised in another interview with a multilateral organisation, who stated there was a "loss of institutional memory of technical staff" due to frequent staff transfers. The donor interviewee argued the World Bank was building the capacity of government and would then hand over responsibility. This information was triangulated in an interview with ADB.

The capacity of the World Bank was also highlighted by some respondents. On reflection, World Bank staff also seemed overburdened and lacking in staff capacity. It was noted by one interviewee from the World Bank that staff working on the BCCRF were mostly "not full time".

Government capacity was linked to the issue of national ownership and direct access to funding. In particular, one donor argued they "can't give direct because [Bangladesh] scores badly in fiduciary management". Hence, this appears to confirm the suggestion from the literature than corruption issues were linked to the resistance of donors to direct access mechanisms, and explains again why the World Bank was given an interim role in the BCCRF.

Capacity issues at the MoEF were also raised in interviews with the World Bank, including the difficulty of getting enough people or the right people, and "also they are not typically a spending Ministry – they are a regulatory one – so due diligence is quite new". On the issue of building up the government's own capacity, the work by GIZ on this was mentioned, and the World Bank stated they were "on track to handover to government" perhaps by 2017.

Capacity issues were also raised in an interview with a government official, who said they "need people with capacity on fiduciary management in the secretariat… from existing systems it is difficult to find people who know about fiduciary management of World Bank and to train them". The government respondent admitted the MoEF "is very overburdened… with forests and pollution" and suggested the need for a dedicated independent Commission or Ministry of Climate Change. However, the respondent added "we have the right people but they are not being used for the right cause – capacity is not real problem".

Capacity of the government staff was raised as an issue by a media respondent, who said: "CCU is a technical body to manage the climate finance – but they don't have any technical person – all are bureaucrats" [sic]. The media representative also criticised politicians and other climate experts for exercising a kind of climate 'tourism', saying: "climate change experts – travel to all the countries – it is part of tourism – all climate experts are like that". This comment implied that by undertaking extensive international travel, this was both hypocritical and counter-productive (in terms of emissions from travel) but also self-serving. This concern was reiterated by another respondent from a multilateral organisation, who argued that the MoEF had a limited number of staff who were often "busy for foreign conferences".

The capacity of the PKSF to manage the CCCP was also put in doubt by several respondents. One media representative argued the PKSF gave the community grant to "some NGOs that don't have capacity for this kind of project". This assertion was contradicted by a government official who said "the PKSF has the best fiduciary management in the country".

9.3.10. Maladaptation risks

One World Bank respondent argued uncertainty and selection of 'no regrets' options was not an issue, because "people can see the needs" whether that was for cyclone shelters, saline-tolerant varieties or drainage. The donor respondent also argued the BCCRF was focusing on "no regrets" options first like cyclone shelters. However when the issue of 'no regrets' measures was raised with another World Bank respondent, they did not understand the question.

A potential 'maladaptive' social impact of the embankment construction emerged during the research, in terms of resettlement of affected communities. Analysis of documents showed some people would be resettled during construction of embankments. A chance informal anonymous conversation with an informant from Netherlands (working for a Dutch construction firm) validated these concerns. The informant stated they had been working as a "de facto anthropologist" and were "responsible for resettlement" under an ADB project. On the issue of resettlement of affected persons, they provided the following insight:

"*Those who are directly affected by the embankment get compensation – i.e. those behind the embankment. But the landless here (in front of the embankment) do not get any compensation as the ADB won't pay".*

Therefore there was the potential for negative social impacts on vulnerable landless households in some places, with implications for equity. Furthermore, it emerged this informant, a recent engineering graduate, had no previous experience in work of this type.

'Floating gardens' emerged as a case study for possible maladaptation (see IPCC, 2014). It was promoted by government under their Trust Fund (BCCTF) as a technology to overcome land constraints and cope with flooding. However, an NGO respondent explained the main material for building floating gardens, water hyacinth, was dependent on the timing of rainfall. They explained "nobody has done research on floating gardens under climate variability… it is not a good option for everyone where there is waterlogging, because it will not survive wave action". Furthermore, water hyacinth absorbs heavy metals and cannot survive in salinity above 7 parts per thousands (ppt). Although the NGO respondent had advocated for a research component under the BCCTF, he argued it was difficult to advocate for this because "I'm from a different sector" and the project had already started, so "they might not be able to go out of that structure". Institutional momentum or 'path dependency' (see Hovi *et al.,* 2003) may therefore pose a risk for maladaptation. Overall, there was little evidence maladaptation had been considered.

9.3.11. Transformation/Scaling-up

There was little information about whether the climate funds required applicants to consider scaling-up beyond the scope of the project or programme itself. One government respondent argued upscaling was their "main priority" but they did not have a "master plan". One donor respondent argued it was too soon to look at scaling-up as they had not received all applications (under the CCCP). One NGO respondent argued it is crucial to do an evaluation before scaling-up a particular technology, but the BCCTF had not fully recognised this.

In terms of private sector engagement, the issue of loans provoked controversy. The media respondent argued; "loan is another crime" [sic]… "from Copenhagen Accord, it was said the finance should be new and additional". They argued politicians took the loans to "show for political achievements… to show in election to demonstrate development". Therefore, they implied decision-makers were thinking short-term rather than considering the long-term implications of debt for Bangladesh. They also argued; "climate change is going to be a loan business because the balance of payments of Bangladesh is very good".

The issue of loans appeared to be connected to both the adequacy of finance, as well as concerns regarding additionality (see 9.3.14). World Bank staff admitted the issue of loans

was problematic because of the "belief we didn't cause it [climate change] so shouldn't have to pay for it" – but they pointed to the reality that Bangladesh would not get all the grants they need. The loans were reported to have 0.7% interest with 40 years return, and a 10-year grace period. One NGO representative felt that loans are not suitable for adaptation because they may not generate an income. Under the recent Local Government Support Programme, for example, the NGO interviewee noted local governments had been taking a World Bank loan and distributing it as a grant. A donor official also argued the Bangladeshi government had lobbied for the loans (i.e. under PPCR) since they were concessional loans. Thus whilst loans appeared to have had a role in scaling-up adaptation finance, their use was tinged with controversy relating to equity (see additionality section below). In summary, there was little evidence scaling-up had been taken into consideration.

9.3.12. Ownership and Subsidiarity

It was argued by some respondents that the World Bank's role undermined national ownership of climate finance to some extent. One NGO expert argued while the World Bank claims they are only a trustee of the BCCRF, in fact they have a larger role "in the name of technical assistance". Similarly, this respondent argued there were internal plans to extend the role of the World Bank until 2018, "driven by the donor side". The respondent implied government could not afford to challenge the World Bank. Moreover, they stated that there were "allegations that people in government pushed for the World Bank [role] for their own interests".

One high-level government representative openly criticised the World Bank for being the most "highly bureaucratic organisation on earth". The respondent stated that within government, the Ministry of Planning was now being bypassed, with new modalities for a quick approval process within 3 months. The official said the World Bank should not be blamed because "this is the system they have" and they were having to find or train people with "capacity on fiduciary management in the secretariat" [in government]. The government official confirmed the prior finding that management of the BCCRF will be transferred from the World Bank to government after institutional capacity has been development.

A report by the Independent Commission for Aid Impact (ICAI) argued whilst "the World Bank needs to be held more closely to account for its performance" it was preferable to

directing flows to Government itself. The report stated; "no UK finance is given directly to the Government of Bangladesh. We think this caution is appropriate" (ICAI, 2011:18).

One government official argued the World Bank was preferable to other organisations. In particular, the GEF was "even more bureaucratic than the World Bank" and "doesn't have an independent office in other countries". Furthermore it was argued the World Bank also has "more technical capacity" than ADB.

In relation to ownership by local government, a multilateral donor reiterated the importance of local government as they are "handling vulnerable people" and it is important to build their capacity through "seminars, workshops, training– on-going work". Another interview with the CDMP revealed that there are now efforts to downscale climate impact scenarios to sub-district or union level and translate these into local languages.

It appears local government engineers had a pivotal role in terms of targeting of infrastructural interventions. For instance, in one interview it emerged the main point of contact with local government under the Coastal Climate Resilient Infrastructure Project was with the LGED engineer at Upazila-level who was responsible for project allocation:

"Information given by Upazila engineer – he knows vulnerable places of the area – based on the vulnerability he submits the knowledge to us and he sends consultant and then we get the number of sub-projects where we do adaptation works."

In the shelters programme under the ECRRP it was also clear the sustainability of the shelters was enhanced by the fact they had a multi-purpose function as schools (8.3), as well as through collaboration with local government and communities. According to the World Bank, maintenance of the cyclone shelters would be managed by School Management Committees.

By analysing project documents, it was observed that few local government projects were implemented under either climate fund. However, when asked about the role of local government, one government official argued local government can apply to either fund, as there is no bar to local government, and there are already a few local government projects "in Chittagong, etc…" This comment was contradicted by a donor official, who argued the BCCRF has "not much window" [sic] for local government but there are more opportunities under the CDMP. This assertion was again contradicted by a different donor official who

argued the CDMP project was "using NGOs to do it" and questioned the capacity of local government.

The same issue of weak capacity of local government and NGOs taking the place of local government functions had emerged during the literature review, and the local-scale analysis. One respondent linked the issue of local government capacity to long-term project sustainability, saying: *"Local government bodies don't have legal right to generate income at local-level – income goes straight back to the Treasury so there is little incentive to do the job properly. The way government is structured in Bangladesh makes things difficult"*.

Thus, at both national and sub-national levels, ownership and devolution of powers to local levels was undermined by concerns regarding capacity. Overall, there appeared to have been little progress in implementing principles relating to ownership.

9.3.13. Mainstreaming and Alignment

Efforts to mainstream adaptation into existing development programmes and projects were evident from the interviews with various respondents. However, it was not clear to what extent projects and programmes were integrating new climate risks or using climate change to fulfil pre-existing development needs (known as the 'development deficit' in the literature). For instance, in the Enhancing Resilience project, implemented by the WFP in collaboration with the Local Government Engineering Department (LGED) existing vulnerability to disaster risk was the focus, with a food-for-work programme for poor women. However, another government engineer argued addressing climate change was "not the job of the LGED".

One respondent noted there had been efforts to mainstream climate change cells in each Ministry under the CDMP Phase-I, but that once the project finished these have not all been sustained. Hence the sustainability of climate mainstreaming efforts was questioned. According to one government official, there were cost and awareness barriers to mainstreaming climate change into government planning. Under the LGED, it was reported the "cost goes up so many times they're reluctant to incorporate climate change into the design". Cost-efficiency appeared to be a crucial concern. Another barrier to mainstreaming was reportedly the availability of experts, as well as knowledge barriers and uncertainty. In the words of one government official:

"You'll be drowned under the ocean but stuck for a particular detail if not enough knowledge" [sic] *"…All knowledge is hypothetical knowledge and not tested. Sea level will rise 200mm but may or may not increase. People are reluctant to invest money to protect those adaptive works if it's not sure if it's required or not required."*

Hence, uncertainty was recognised as a barrier to mainstreaming climate change into government planning. Refer also to 9.4.2. Overall the evidence was balanced, with nascent evidence of mainstreaming climate change in some government projects.

9.3.14. Additionality and loans for adaptation

In terms of additionality to existing development projects (see 7.3.1), a media stakeholder argued the adaptation funds were "old wine in new bottles". It was argued by this respondent that projects like the coastal embankment (polder) and cyclone shelter project (the ECRRP) had been merged with climate finance, so they had "repackaged the money". This concern was also cited by one donor official, who argued the World Bank were "topping up" their already approved projects, but this led to additionality questions because "to what extent is it just topping up what it is doing already". However, the decision to channel climate change finance to a pre-existing project was defended by a World Bank official who argued; "supervision and monitoring were already in place" so it was "prudent to expedite it further". This suggests the project was given support based on issues of practicality. Furthermore there were synergies with other World Bank programmes, as teachers in the multi-purpose cyclone-shelters-cum-schools were "provided by another World-Bank funded project".

On the issue of additionality to development, it was noted it is often difficult in practice to differentiate adaptation from development activities. The respondent from PKSF argued that it is "sometimes difficult to separate development and adaptation" but the project selected the "most vulnerable areas – so it should be adaptation". It appeared ministries were viewing the climate funds as a source of finance for their pre-existing development projects. One donor official noted:

"Ministries that haven't got projects approved from development fund are now lobbying for funding from the climate fund. Instead they should be funding the climate deficit from the climate fund."

It appeared the lack of transparency made it difficult to track additionality. One civil society expert in this field suggested the problem was that disaggregated amounts were not shown.

On the balance between loans and grants, one government official revealed that under the PPCR project for cyclone shelters and embankment-building, out of the $150m, only $19.8m was as a grant and the rest was from a soft (concessional) loan. In other words, 86.8% was a loan. It terms of additionality of finance flows, several countries, including the UK, counted their Fast Start Finance as part of their ODA commitment. There was little evidence that additionality to either development finance or development programmes had been considered.

9.3.15. Harmonisation/Coordination

An NGO representative criticised the lack of coordination between the BCCTF and BCCRF; saying "the left hand does not know what the right hand is doing". In the interview with a donor it emerged the intention was for the government fund (BCCTF) to do smaller projects and the Donor Fund (BCCRF) to cover larger infrastructure projects, mainly because the World Bank is managing it and they find it easier to do larger infrastructure projects. This was verified in an interview with the World Bank, in which the respondent stated their processes were "quite intensive" so it was only worth getting involved if the projects are of a substantial size. This also suggests that any bias towards structural projects (see 9.4.1) was linked to the role of the World Bank.

A donor respondent argued they were hoping the World Bank would facilitate dialogue on coordination, but they have not done that. According to one donor, the capacity within the Ministry of Environment (MoEF) is low as it is a "junior ministry" and there is an "ad hoc" approach with "no formal coordination" with the PPCR. Hence, lack of coordination links to the issue of capacity. Delays were also linked to the lack of coordination. One donor expressed frustration that it took two years to get a list of projects on the government website, and staffing and implementation questions have yet to be answered. Refer to Figure 9.3 for a diagrammatical representation of these links.

One government official argued there was an indirect means of coordination between the BCCTF and BCCRF because there was a lot of similarity in the members of the committee and "6 members are the same". It therefore appeared the coordination between the two funds was indirect rather than explicit. Although both funds aim to implement the BCCSAP, one donor noted that there is no forum to discuss implementation of the plan, and this may be a "missing link". As well as coordination between the two funds, it appeared there was little coordination between these two funds and the PPCR. One donor respondent stated the

coordination was 'ad hoc' and "as and when it comes up" for example, under the "PPCR we said are doing embankments – so BCCRF didn't do that".

Coordination between donors emerged as another challenge. One multilateral organisation argued coordination is a "bit tricky" but that there was a Local Consultative Group on environment and climate change, chaired by DFID, to map and coordinate who is doing what. This was the only time the group was mentioned. In addition, coordination between ministries emerged as another challenge. Another interviewee from the UNDP noted that coordination in terms of multi-ministerial implementation was hampered by the "territorial" and "silo" mentality in ministries and sectors.

However, the CDMP and the CPP offer positive examples of coordination between stakeholders. Interviewees described the main challenge as "coordination of the response" between the various stakeholder groups (NGOs, civil society, and community people). A World Bank official also argued the cyclone shelter construction project (ECRRP) was effectively coordinated at ground-level by a PCMU under which all agencies responsible for implementation were involved.

Overall, there was little evidence from the interviews that coordination with other initiatives was ensured. However, respondents were hopeful of future improvement. One representative from a UK-based think-tank felt the Planning Commission had recently got more involved in coordination "they have been more active on that… they've taken the lead more energetically".

9.3.16. Adequacy and predictability

One prominent NGO respondent complained that donors often do not provide the money they have pledged. This issue of the gap between pledges and disbursement relates to both international and national climate finance. However, one donor official suggested the gap between pledges and disbursement was also a question of absorptive capacity, arguing Bangladesh has previously been given grants that it has not spent. One expert from a UK-based think-tank argued the adequacy of finance was linked to corruption concerns, claiming there was a "question of how much money donors will hand over with the corruption", and there was a "political crisis there – there is lots of problems". In the Bangladesh Chapter (5.5) the data from World Bank had estimated the current losses from climate change as up to $1Bn per year while the BCCRF has received $188m from multilateral donors. Furthermore,

this may not be additional to existing development finance (see 9.3). Overall, there is limited evidence that current climate finance flows are adequate.

9.3.17. Transparency and stakeholder engagement

In the BCCRF, the World Bank respondent confirmed there are civil society representatives on the Governing Council, which meets once a year. A World Bank respondent argued there is a "lot of community involvement" under the NGO window (CCCP) but relatively less at government-level. It also emerged that there was no formal forum where they would meet civil society regularly.

Some stakeholders suggested World Bank modalities were non-transparent. One NGO argued there were "hidden costs" of World Bank management. However, the World Bank respondent felt transparency was part of the reason the World Bank was selected to manage the BCCRF, with one respondent saying "that's our job, for transparency and fiduciary management". This raises the question of to whom transparency is available.

One NGO respondent was also concerned there are no clear criteria for prioritisation of climate finance in Bangladesh, and the three thematic areas of infrastructure, water and rehabilitation were all "highly vulnerable to corruption". The same respondent linked lack of transparency to the lack of specific prioritisation criteria or monitoring processes under the government's trust fund. The CCU was described by various stakeholders as under-staffed and lacking capacity for ground-level monitoring. The government official argued transparency was not a problem for the BCCRF, but it was for the BCCTF due to "political influence" (as discussed in section 9.3.1).

Two respondents stated they had used the Right to Information Act (2009) to request information from Government on climate finance. These respondents both independently stated that the World Bank is not legally obliged to disclose information under Bangladesh's Right to Information Act 2009, but they do have their own disclosure policy. A media stakeholder argued both the World Bank and Government were non-transparent and "they play with us" when asked to provide documents, saying "go to the Ministry, go to PKSF, go to the CCU". Hence, both sides blamed each other for non-disclosure of documentation. This was corroborated by another stakeholder, who said the World Bank was "claiming that without government consent they cannot release documents" but that there "might be a sensitive part of government that is not allowing the World Bank to release the information".

There was no consensus amongst stakeholders about which organisation was responsible for non-disclosure of documents.

One respondent working for a WFP project discussed the issue of corruption. In his view "officials are corrupt but not as corrupt as NGOs", at which point, he signalled out the window to the offices of BRAC. He argued his project had been assessed by WFP and leakage had been found to be "only 4%... even the cash-for-work programme you won't find corruption more than 4%". Direct transfers were used to ensure money goes straight to beneficiary accounts. He described how in one rural road project, a junior employee had been caught taking money, but it was detected, and now "70% of the money has been recovered". In his project, he stated there had been no corruption reported. Each beneficiary has a "national ID" card and cash grants for beneficiaries were directed to the "bank or the postal cash card… so we hope there's no leakage". This respondent openly discussed the transfer mechanism in depth, provided documents, and did not avoid any questions. Overall, the evidence on transparency appears to be balanced, with some progress on transparency.

While it emerged from one interview that Transparency International had been drafting a report about climate finance in Bangladesh, one NGO expressed concerns that the report is an "excuse to claim Bangladesh is corrupt as a tactic so that they retain control." Therefore, there were concerns that placing emphasis on lack of transparency could undermine national ownership. Transparency International Bangladesh (TIB) expressed concerns about the government's own climate fund (BCCTF), with less attention on the multi-donor fund. The government recently announced cuts to the BCCTF (see Trust, 2014) with critics citing this criticism as a contributory factor in this decision. Thus, criticism from TIB might have inadvertently led to reduced funding.

The media representative argued "both local and global is not transparent". This comment engages with an understanding of the multi-scalar global to local nature of climate adaptation finance flows (see Chapter 7).

9.3.18. Sustainability

Some adaptation funds and programmes in Bangladesh appeared to have considered long-term sustainability. In the CDMP and the early-warning system (CPP), sustainability of these programmes was integral, with ongoing training of volunteers to distribute the early warning signal. However, challenges for sustainability were highlighted during interviews, for example, many women left home when they marry, which led to renewed need to train

volunteers in an on-going process. Further challenges related to the practical problems of updating the early warning system and changing the signals (including with mobile phone technology), which required communication and awareness-raising about the changes to ensure lives continued to be saved.

According to one NGO stakeholder, finance under the BCCTF was being allocated on "first come first served" basis, not on a geographical or need basis, and "without proper EIA" (Environmental Impact Assessment). This respondent argued there was "politicisation of the project selection process". The respondent gave an example of one cross-dam project under the BCCTF (government fund) which included plans to cut down 40,000 trees without proper consultation.

Under the CCCP, each project intended to have a local government focal point. However, the PKSF respondent noted that since beneficiaries were not required to contribute financially, projects may be "difficult to sustain". The respondent stated they were still considering "sustainability framework" guidelines, such as establishing a "community bank account" with community people. Sustainability, long-term impact and community involvement were recognised as key challenges. However, while requiring in-kind contributions from communities could enhance project sustainability, such initiatives could come under criticism for placing a burden on communities. Thus, strengthening sustainability through leveraging community investment must be balanced with equitability.

Furthermore, since some of the initiatives under the BCCRF (embankments and cyclones shelters) were costly public goods, it would be difficult to justify mobilisation of private contributions. Thus, sustainability and maintenance of those initiatives are dependent on ongoing multilateral public finance. Overall, the interview data indicated that sustainability remained integral to adaptation financing in Bangladesh and the evidence points to measurable progress against this issue within the indicative framework (see 10.7).

9.3.19. Barriers and challenges

Under the ECRRP, the World Bank respondent argued the main challenges for cyclone shelter construction were practical barriers; the remoteness of vulnerable areas, problems transporting construction materials like stone aggregates, and the need to upgrade roads. The World Bank also highlighted the challenge of getting good contractors.

One political barrier highlighted was that the Bangladesh Meteorological Department (BMD) and Bangladesh Space Research and Remote Sensing Organisation (SPARSSO), responsible for monitoring agro-climatic conditions, come under the Ministry of Defence. Thus the World Bank could not fund meteorological services as there were rules against funding the Ministry of Defence. The BMD would only be able to apply for funds if it partnered with another department like the Ministry of Agriculture.

An additional political barrier mentioned by several respondents was the political context, with regular 'hartals' (strikes) occuring every few days. Respondents from multilateral development agencies reflected that it did not always affect their work, but it did affect travel and work with Government.

9.4. Emerging Issues

9.4.1. Structural Bias

A media respondent argued there was overt focus on construction-based projects because "the whole motive of development is construction-based – we need construction, but not the whole of development is based on construction". This comment suggests other types of development (and adaptation) project were needed. They argued; "the main development process doesn't acknowledge the people side… community-based adaptation is trying to do that". In fact, one NGO respondent strongly opposed embankment construction, saying, "in my opinion all the embankments should be knocked down to be honest".

However, the government official argued most people prefer 'hard' or structural adaptation, stating; "most development partners want software or policy-level changes e.g. Action Plans…" but "for people, they need hardware or infrastructure". They argued; "there is enough policy…if you want to do something, do it on the ground".

Some respondents suggested there was focus on structural 'hard' adaptation technologies because the implementing organisations have more experience in that realm. One academic argued that ADB was focusing on structural adaptation "because of corruption and transparency"… and they "have a natural bias to structural bias" [sic]… "because they're engineers they think they can solve it with that one" [sic].

Moreover, the 'structural' bias was linked to the issue of maladaptation. One academic argued that there is "more uncertainty for engineering approaches" and cited a recently-completed study on land market responses, which found that after structural flood defences

were built; “the land value changes – so the poor people get pushed out”. They added this occurred because most low-income settlers do not own their land. The respondent suggested; a “more holistic approach would avoid that sort of thing happening... be aware of all the impacts”… “a managerial approach would be less costly but would be more effort”. This directly contrasts with one donor respondents’ view that the World Bank provides greater value-for-money by leaving out “soft policy” changes.

The academic respondent also argued structural flood defence works “will benefit the poorest from employment and other issues but some have to move out from major locations and marginal areas”. This contradicts the view of the engineer responsible for the project, who argued “poor areas will completely benefit”.

9.4.2. Uncertainty

One government official argued “climate change is a big term but knowledge is very limited about that and everything is based on predictions, but whether it’ll really happen is not sure”. For instance, the official noted climate models were predicting 75-79cm of SLR by end of the century. They also stated that a storm during high tide might be 60cm higher, causing an even higher death toll. However, another colleague argued they were working on the basis of 200mm (20cm) of additional sea level rise. The official said “*sea level will rise 200mm*… but may or may not increase” As noted previously, uncertainty seemed to be a barrier to robustness and mainstreaming climate change into planning, and a barrier to funding additional investment.

9.4.3. Cross-border and international water management

One donor respondent argued India’s barrages were responsible for some of the issues relating to water scarcity and flooding, so in this sense there was a “lack of clarity of what climate change means”. They argued “90% of water flows across the border”. Another civil society respondent also commented that “upstream the dams being built are affecting Bangladesh negatively”. This confirms the literature review finding that many of the impacts classed as ‘climate change’ impacts were exacerbated by cross-border water management issues. Improved collaboration under regional initiatives such as the South Asia Water Initiative (SAWI) is suggested as a possible solution.

9.4.4. Microinsurance

The interview with the Institute of Microfinance (IoM) revealed they are piloting and designing micro-insurance products, incorporating research on household shocks (crop,

livestock shocks and mortality) as well as manmade and natural disasters. Most microfinance companies have credit insurance, but these are geared to protecting the insurer only. The IoM are trying to design micro-insurance for the urban and rural poor, and cited good examples including health insurance in a Dhaka hospital as well as livestock insurance (with inoculation) in partnership with PKSF. However, these mechanisms target extreme events rather than slow-onset climate changes.

9.4.5. Land rights

Land rights emerged as a key issue from various interviews as a barrier to adaptation. One respondent argued this was an "enormous nightmare" and there was a "backlog of cases in the legal system". The issue was exacerbated by river erosion, since land disappears in the delta. The elite capture of common property resources – like "community ponds" and "khas" land were cited by one respondent as on-going challenges with a long history that hinder adaptation to climate change. It was suggested these types of political economy issues were important, but under-studied. Land rights had also emerged as an issue during the analysis of national-level survey data (9.2) as well as in the local-scale analysis (Chapter 8).

9.5. Conclusions

In terms of the indicative framework for effective finance (Chapter 7), many of these identified issues appeared to be relevant and linked closely to the issues emerging from the national-level informant interviews. Ownership, coordination timeliness, additionality, mainstreaming and transparency were explored further during the interviews, while uncertainty, cross-border issues and land rights emerged during the interviews. Refer to 10.7 for a summary. It is also notable that many of the outcomes, for instance on adequacy or ownership, were not determined by Bangladesh itself but by donors.

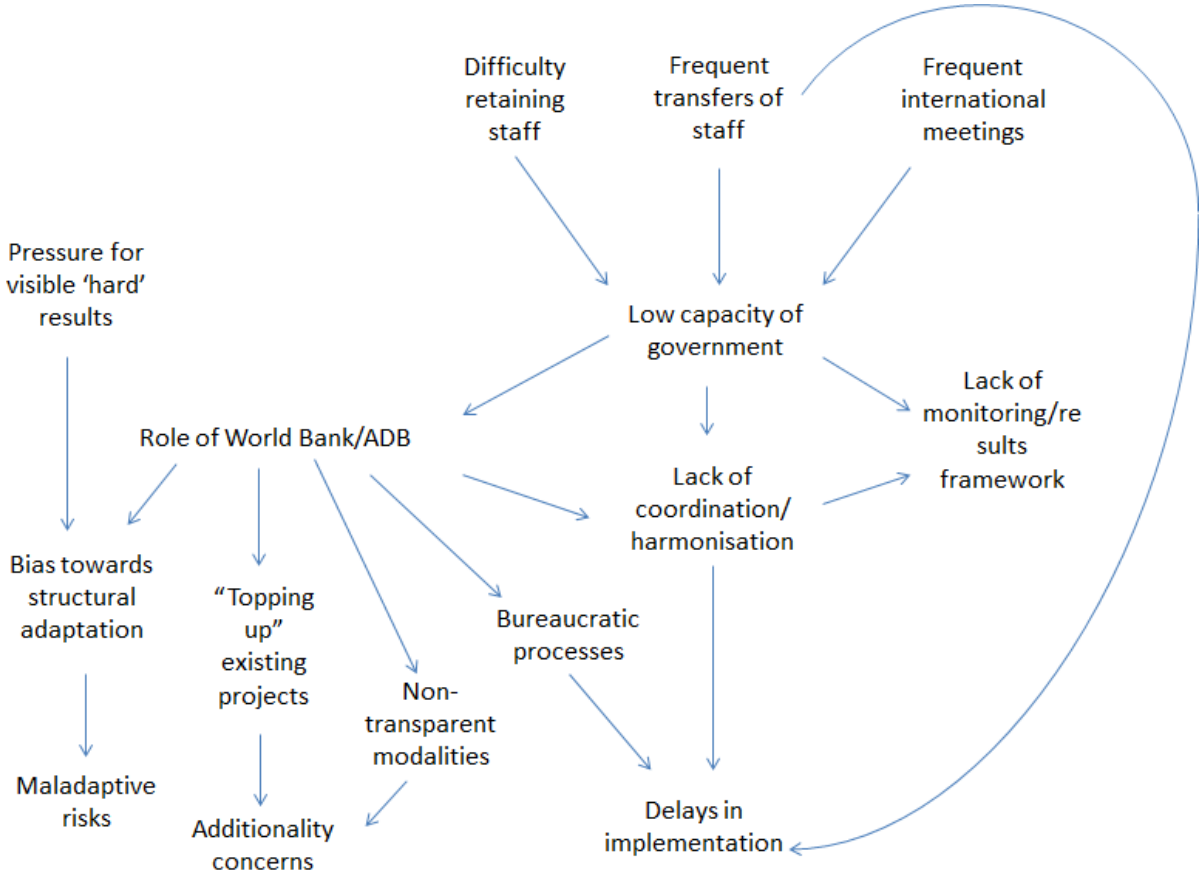


Figure 9.3 Linkages between various issues identified in key informant interviews

The diagram above shows linkages between various issues identified during key informant interviews, and in particular, demonstrates that various perceived issues were linked by key informants to the role of the World Bank, which in turn was driven by perceived low capacity in government. This diagram resonates with the need for effective climate finance to take into account the various criteria considered in the framework for analysis (Chapter 7). Policy recommendations could include civil service reform to ensure the government can retain quality staff.

In terms of the research question on the progress on effectively financing adaptation, the interviews confirmed gaps between the multi-donor BCCRF fund (for large projects) and the government's national BCCTF fund (for smaller projects). There was evidence allocation decisions were guided by political influence, rather than using objective vulnerability metrics. Furthermore, monitoring and oversight were difficult due to capacity constraints in government, donor agencies and the World Bank (including staff and budgetary limitations).

Since the interviews took place, recent developments included an announcement from Government that funding to the BCCTF will be cut, partially due to criticism by

Transparency International (see Trust, 2014). However if the BCCTF is weakened there are implications for capacity-building and national ownership of climate finance, especially given that the GCF may have used the BCCTF as a conduit. This might demonstrate that an emphasis by NGOs on critiquing early government-led adaptation efforts could undermine national ownership in the long-term.

The national-level survey data highlighted land rights as a major concern for the most vulnerable; an issue reiterated in the interviews as well. In the household dataset, it was found that landless agricultural labourers are a particularly vulnerable group, and that agricultural diversification has a positive strategy for enhancing adaptive capacity. The data also showed women have a vital role in agriculture. However, issues of land rights and women's rights in agriculture did not appear to have been adequately considered within national adaptation planning. Social safety net programmes like existing WFP-supported 'food-for-work' programmes may offer potential to increase adaptive capacity in Bangladesh.

9.6. Multi-Scalar Analysis: Local-National Linkages

This section analyses the various linkages between the local-scale (Chapter 8) and national-scale analysis (Chapter 9). Local government institutions, and informal groups such as the network of CPP volunteers, were vertically linked with national-level departments as illustrated in the diagram below, providing a conduit for climate-related information and resources flows, including the EWS and climate-tolerant seed varieties.

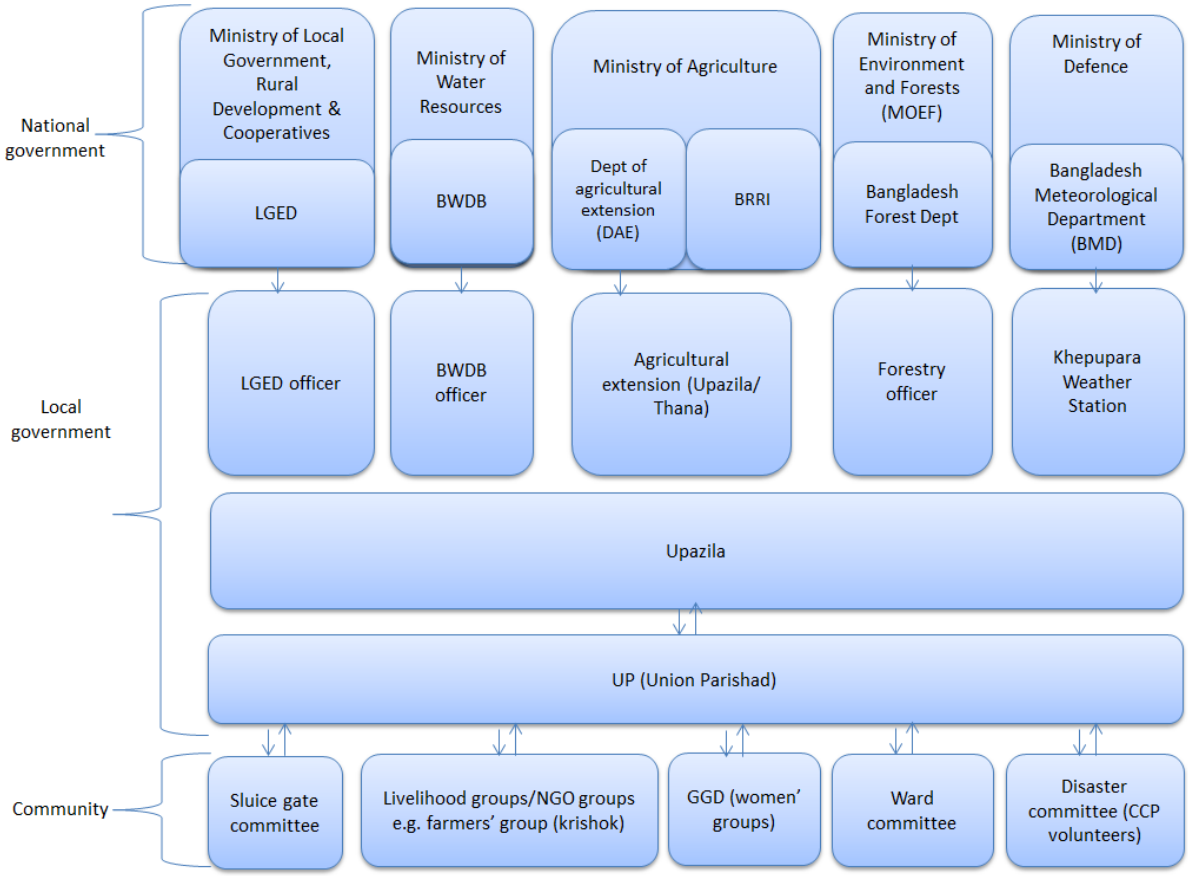


Figure 9.4 Illustration of the various institutions and groups at local government and community-level including the linkages with national-level departments.

The CCP spans the country and has been highly effective. The network of trained volunteers were linked vertically with the UP and Upazila disaster teams (see Figure 9.4), which were then linked to national networks which distributed the cyclone warning. However, meteorological services are a prerequisite and the local station at Khepupara appeared to be extremely under-resourced which indicates improving these services at national-level could have benefits for local adaptation.

Development of saline-tolerant rice varieties at national-level, particularly those developed by BRRI, appeared to be having a great impact at local-scale. However, awareness of these rice varieties did not appear to be widespread, as villagers confirmed they had not been aware of climate-tolerant varieties until the NGO intervention. Hence, strengthening extension services, along with provision of inputs, could enable these new varieties to reach more farmers, including use of the media in awareness-raising. However the extension officer at the local scale explained that rice price fluctuations still posed a risk for farmers, demonstrating the need to further examine agricultural trade and food security policies.

Analysis of the role of the World Bank linked the local-level to the national-level, as the World Bank was responsible for upgrading the polder (embankment) in the local village. It was confirmed that poor local residents gained employment in embankment construction work, and local people were monitoring construction in a participatory way. While there were criticisms about transparency and monitoring at national-level, at the local-scale there appeared to be active stakeholder involvement. However, this may not be true in other areas.

The Bangladesh case study clearly demonstrates an urgent need for additional climate finance. Evidence from both national and local-level verified urgent and immediate needs relating to food insecurity problems and inadequate cyclone protection. In the local-level analysis, the area had been severely affected by Cyclone Sidr and Aila, and local people felt embankments were urgently needed. At national-level, one government respondent had pushed for the ECRRP project to be prioritised and this decision seemed to be justified by the local-level analysis. Whilst there was a debate in the literature about the effectiveness of embankments, at local-level this discussion was not taking place and most households felt the embankments were essential for their livelihoods. This may also be because once an embankment has been built, its continued protection and reparation are paramount to ensure residents behind the embankment are protected.

Interestingly, priorities at local-level (cyclone shelters and embankments) aligned well with what had been prioritised for adaptation at national-scale. However the case study research was conducted with a small sample size in one village so the results are not generalizable to other areas. 'Hard' adaptation options were regularly mentioned at local-scale, suggesting local stakeholders' prioritised structural (tangible) adaptation. This was a counterintuitive finding, since national-level NGO respondents criticised a possible bias towards 'hard' technologies and structural adaptation.

Cyclone shelters, which were also being constructed under the ECRRP, formed another linkage between local and national-scale. The World Bank respondent at national-level said remoteness and inadequate rural infrastructure posed challenges for cyclone shelter construction. This evidence was triangulated at local-level. The national-scale World Bank official highlighted the importance of access roads for cyclone shelters, and of new designs for 'killah' platforms to protect livestock, and these issues were also raised by people at local-scale. However, it was not clear how the allocation and positioning of new cyclone shelters

was being managed. At local-level there were also suggestions of political influence in allocation of adaptation resources like cyclone shelters.

Whilst national-scale finance has been targeting particular climate hazards and directed to 'flood-prone', 'drought-prone' or 'salinity prone' regions, at local-scale these different climatic hazards are inter-connected and adaptation needs are closely linked to the development deficit. Market-related stresses like rising fuel and food prices also placed additional stresses on vulnerable people.

Agricultural labourers, many of whom owned no land, were identified as a vulnerable group at both local-level and in analysis of the CCAFS data. Insecure land tenure was raised as an important vulnerability issue at both local and national-level. Land rights were also raised in the context of structural adaptation projects. In addition, the particular vulnerability of women as well as their contribution to agriculture were emphasised in the national-level household data analysis, as well as in the local analysis. However, these issues do not appear to be adequately reflected in national-level adaptation strategies or the BCCRF and BCCTF adaptation funds. The study suggest land and gender issues need greater recognition at national (or international) scales, for instance through specific interventions targeted to women and landless households.

Several female day labourers suggested additional livelihood activities that could improve their opportunities to work, including selling handicrafts. Livelihood diversification had also been recognised as an adaptation strategy in section 9.2. Local employment opportunities were affected by policies at regional and national-level. For instance, as incomes increase in Bangladesh with economic development, Kuakata might develop into a hub for tourism, which could improve opportunities for selling handicrafts in the marketplace. NGOs might be able to support such initiatives.

The important role of local government in adaptation was underlined at both national and local scales, but did not appear to have been adequately reflected in the BCCRF/BCCTF funds. At both levels, the LGED engineer was identified as having an important role. Furthermore, working alongside and strengthening local government was highlighted as critical for project sustainability at national and local-level. In fact, the local-scale CBA project deliberately tried to strengthen the capacity of local government to increase its' adaptive capacity. However, local government officials complained the national government is often not receptive to their problems and does not provide sufficient support.

Furthermore, afforestation of embankments was suggested at local-level but has not so far been taken up in national-level programmes. The BCCRF has introduced a programme entitled 'Climate Resilient Participatory Afforestation and Reforestation Project' focused on "degraded forestland, marginal, fallow and newly accreted land" according to project documents, but the project does not specifically target embankments. It is suggested that a large-scale programme for afforestation of embankments could have a range of win-win benefits. Overall, ecosystem based-adaptation had been insufficiently prioritised at national-scale.

10. International-Level Analysis and Findings

10.1. Introduction

At international-level, climate finance was analysed through semi-structured interviews with expert key informants, and participant observation of climate finance negotiations at various UNFCCC meetings. The methodology (Chapter 2) gave an overview of the methods used for consultation with key stakeholders. The issues and principles discussed with expert key informants at international-level were similar to those discussed in national-level interviews, enabling linkages to be drawn between different levels of analysis. As detailed in Chapter 2, semi-structured interviews were undertaken with a range of expert key informants at international-level (18 interviews in total), selected from a range of stakeholder groups including international organisations (UN), relevant civil society organisations, and the media, ensuring representativeness of both donor and developing-country government officials, and major adaptation funds.

As with the national-level analysis (Chapter 9) the major focus was on public adaptation finance so private-sector stakeholders were not engaged. The international-level analysis was necessarily less comprehensive at this scale of observation. Principles identified in the literature review were used as a theoretical framework to inform open-ended semi-structured interviews. Hence, the sub-headings within this chapter are similar to those in the national-level analysis. The chapter provides a broad overview of issues at the international-scale but there was insufficient information within the scope of this study to compare different international funds in detail. Interview data has been used track progress against the indicative list of principles for effective climate finance (Chapter 7), to determine to what extent the evidence points towards satisfaction of those principles. The summary of progress at all three levels of analysis is then discussed in Section 10.7.

10.2. International Level Participant Observation

As explained in the methodology chapter, UNFCCC negotiations were attended by me as an observer delegate. In particular, the finance discussions were observed at the nineteenth session of the Conference of the Parties (COP-19) in Warsaw, Poland in November 2013. Specifically, discussions of the Standing Committee on Finance (SCF) were related to effectiveness of finance, so are taken here as a case study. The SCF was a body established as part of the Cancun Agreement at COP-16 in 2010. Under paragraph 112 of decision 1/CP.16, the SCF was established under the COP to:

"assist the Conference of the Parties in exercising its functions… in terms of improving coherence and coordination in the delivery of climate change financing, rationalization of the financial mechanism, mobilization of financial resources and measurement, reporting and verification of support provided to developing country Parties." (UNFCCC, 2010)

At COP-17 in 2011, Parties further defined the roles, functions, composition and modalities of the SCF. Under paragraph 121(d) of decision 1/CP.17 it was decided the activities of the SCF would include: "making recommendations on how to improve the coherence, effectiveness and efficiency of the operating entities of the financial mechanism". Under paragraph 121(f) the SCF would prepare "a biennial assessment, overview of climate finance flows" (Decision 1/CP.17, UNFCCC, 2012). Hence the activities of the SCF are deemed highly relevant to the purposes of this PhD research, and were observed at COP-19.

At the Warsaw conference (COP-19), discussions were observed on the 'updated guidelines for the 5th review of the financial review of the financial mechanism' (see Annex XXI). These guidelines were outlined in the Report of the SCF to the COP (see UNFCCC, 2013c), and these updated guidelines had to be agreed by the COP in Warsaw. Final guidelines can be found in document FCCC/CP/2013/10/Add.1 (Decision 8/CP.19, UNFCCC, 2013b). The annotated text is found in Annex XXI.

In the SCF meeting on 'updated guidelines for the 5th review of the financial mechanism' it was observed that initially the EU asked for clarification on the objective of updating the guidelines. The negotiator from Philippines, representing the G77 group of countries, explained there was a "progressive procedure" to follow on this. The dividing lines between developing and developed countries were evident from the start. For example, on the objectives of the review of the financial mechanism, Egypt (part of the G77 group) said clause A (iv) was important, which referred to; "its effectiveness in providing new and additional [and, as appropriate, adequate and predictable] resources to developing country Parties under Article 4.3 of the Convention". However, the EU delegate responded stating they wanted to remove this clause. In the final guidelines, the clause had been shortened and weakened to refer to "its effectiveness in providing resources to developing country Parties under Article 4, paragraph 3, of the Convention", a compromise solution without reference to adequacy or predictability. This short interaction demonstrates the importance of new and additional, adequate and predictable climate finance for developing countries, but respectively, the attempts by donor countries to limit their financial obligations.

The EU delegate also pushed for deletion of text referring to "direct access" (v) and deletion of clauses (vi) and (vii) relating to the "coherence and complementarity between the different operating entities of the financial mechanism in order to contribute to a global paradigm shift toward a low-GHG emission and climate-resilient development pathway" as well as "principles and practice for the allocation of funds". The EU wished to delete these clauses as they said "we also don't know what the GCF would have yet". This appears to be a common negotiating tactic at the UNFCCC - to delay negotiation on a particular issue by claiming that it will prejudge the outcome of similar parallel negotiation. In the final text, clause (v) referred to the "effectiveness of access modalities" for developing countries, while clause (vi) referred to "consistency and complementarity" with other "investment and financial flows". It did not, however, refer to a global paradigm shift.

The EU also wished to delete a clause relating to "examining the role of the financial mechanism in identifying pathways for scaling-up the level of resources". However, the delegate from the Philippines, representing G77, made it clear that this clause was important to them and said "we need this point". Again, the EU position appears to indicate that developed-country donors wished to limit their own financial responsibilities under the UNFCCC. In the end, this clause remained in the final text.

A subtle trade-off was evident in these negotiations between financial commitments (by developed countries) and environmental commitments (by developing countries). For example, when the EU said they wanted to delete the clause relating to a "paradigm shift toward a low-GHG emission and climate-resilient development pathway" (quoted above) then delegates from Philippines and Egypt responded that they agreed with this. Philippines said this could be deleted unless it included "in the context of sustainable development". Thus, the developing countries seemed to be effectively calling the bluff of the developed countries, and ultimately, made the developed-country negotiator realise it was in their interests to keep this clause (or a related clause) in. The developing countries' may be calling for additional finance by arguing that without this they cannot shift to a low-carbon pathway. The negotiations at times seem to become a bargaining game, in which deliberate disagreement can be used as a bargaining chip, or correspondingly, acquiescence to an opponent's demands will make the proposer cautious about the original demands they proposed.

With regards to section (B) of the guidelines on "sources of information," the Philippines said it was important to include the clause on "information provided by Parties on their experiences regarding the financial mechanism support *provided and received* in accordance with COP decisions" (italicised for emphasis) (B2(a)). For developing countries it is important climate finance actually reaches the intended beneficiary country. This concern likely comes from the awareness of the gap between pledges and disbursement. However, the EU, by contrast, wanted to delete the words "support provided and received". Perhaps the interests of the EU and other developed-country donors are more centred on presenting externally (for instance to their electorate) that they have made climate finance pledges, but it is less in their interests to ensure the finance is actually distributed to intended beneficiary countries. Another possible interpretation is that the words were felt to be superfluous. The clause was kept in the final text.

Secondly, the EU wished to delete text relating to the use of "expert inputs through independent reviews and assessments for the preparation and conduct of the periodic review of the financial mechanism" (B.2c). Egypt wished to keep this text. However, the reference to expert inputs was deleted from the final text. The motives of the EU were unclear at this stage but we might infer the EU was not keen on including expert inputs in the review of climate finance. In the reference to the 'GEF Evaluation Office' the EU was keen to insert the word "independent" so that the final wording referred to the "GEF Independent Evaluation Office". Perhaps the EU was keen to emphasise the GEF Evaluation Office was independent so that its recommendations would not be considered official guidance. Alternatively they may have felt it was important to emphasise its objectivity.

Next, the US made a suggestion to delete the reference to the 'Adaptation Fund', arguing it is not under the financial mechanism so there is no need to review it. The US wanted to "clarify legally if it is under the financial mechanism". The literature review found developed-country Parties have not been keen to use the direct access modality of the Adaptation Fund (Williams, 2012) while developing countries have viewed it as key to effective delivery of resources (see Muller, 2013) (see Chapter 7). The removal of the Adaptation Fund from the review was strongly resisted by developing countries. The Philippines responded that the "financial mechanism is the Protocol" and "under Article 7 of the Convention, 7.2 it says we need to review any related instruments including the Kyoto Protocol". They also pointed out the SCF had already agreed the Adaptation Fund would be included. The clause was kept in.

With regards to section (C) on the criteria against which the effectiveness of the financial mechanism will be assessed (see Annex XXI), the Philippines highlighted transparency in particular, and argued; "transparency of decision-making is very important… the Adaptation Fund is the highest transparency". Transparency appeared to be important for developing countries in terms of ensuring the legitimacy of climate finance. Philippines indicated they want to keep the words "provided and received" in C3(e) which referred to the "amount of [resources provided] [and received]" and wished to remove the mention of investment programmes. Again, this reflected a concern that pledged finance is not being disbursed, and the brackets indicate these terms were already under discussion. The Philippines delegate also stated they were "not comfortable" with criteria (g) to (l) (see Annex XXI) because they felt projects were already being monitored and they were unsure if it was necessary to assess the impacts. The clauses referred to issues such as the sustainability of results, paradigm shifts, innovative projects, and enabling environments. This appeared to reflect concerns by developing-country Parties that there is too much onus on developing countries to prove there are results from climate finance, rather than an obligation on developed countries to provide sufficient finance. In the final text (UNFCCC, 2013b), the words "resources provided [and received]" were cut so the clause in Section C only referred to the resources "provided". Transparency can be considered from the perspective of donors as well as receivers.

The EU responded with an attempt to remove the words "accessibility" and "equitability". In response to the Philippines' concerns regarding clause (e), the EU suggested putting brackets around the whole of clause (the clause referred to the "amount of resources provided" as a criteria against which the effectiveness of the financial mechanism is assessed). This may demonstrates the use of hard bargaining tactics by the EU, as they noticed this clause was important to developing countries' and the proposal to delete it could be used as a bargaining chip. The EU stressed the importance of clause (g) on the "sustainability of [the results and impacts achieved]" and then added an extra clause on results and impacts. The EU delegate pointed out; "*the whole thing is a means to an end; we need to have impact as well… we need to verify what we are spending money on otherwise there won't be money coming forward".* Again, this may demonstrate use of hard bargaining by presenting a 'take it or leave it' scenario, by saying there would be no finance provided unless the impacts could be verified. In the final text, the clause on sustainability was kept in, but instead of "sustainability of results" it referred to "sustainability of funded programmes," a compromise solution that might ultimately benefit developing countries as it could imply programmes will be long-

term. The other clauses, on "a global paradigm shift", "innovative projects" and "enabling environments" were taken out in the final text, which instead refers to "results and impacts achieved" and the "extent to which the resources provided are contributing to achieving the objectives of the Convention". As for section (A), Parties seemed to fall back on referring to the Convention when they could not agree on exact wording.

The EU was backed up by New Zealand who agreed "equitability" should be deleted. In the final text, equitability had been deleted, but accessibility remained. It is not clear why the EU wished to delete the reference to equitability (C(3)c) but it could have been because they felt it was not easily defined, or that 'equity' might put a greater burden upon donors. Finally, the delegate from New Zealand made an interesting point about transparency, saying "it can be quite useful not to have stakeholders involved in the process of who gets the money; if they have applied… sometimes it is quite useful not to have transparency". In this intervention, they indicated there could be a potential trade-off between transparency and an independent decision-making process.

At this point, concerns were raised about the decision-making process in this discussion, with Philippines (of the G77) raising the concern there was "only one from the LDCs" in this discussion so it was "difficult for us" because there were other simultaneous meetings going on. The Philippines delegate urged the secretariat "please don't do parallel meetings". However, the US argued there was a need for parallel meetings because "we're up against the clock" while the EU argued "the only option is parallel groups or we will work through the night". This demonstrates procedural tensions within the UNFCCC negotiations, as developing countries often suggest the process is more difficult for them in terms of capacity (UNFairplay, 2011). Setting time limitations could also have been a deliberate negotiation tactic. Simultaneous parallel meetings at COP-19 included those on long-term finance. Pressure for parallel meetings could be an example of use of 'divide and rule' tactics by developed-country Parties (like EU and US) to split the G77 and weaken the position of their political opponents in developing countries. Alternatively, it could have been a time-saving measure. Procedural inequity was linked to the issue of the UNFCCC budget, as the Bahamas added; "the issue of the budget has dropped off the radar but affects participation in this meeting". Finally, the Philippines argued "we are willing to work until late but we cannot have parallel groups". Thus, this particular discussion ended with on-going tensions over procedural inequity between developing and developed countries.

10.2.1. Summary

Overall, at the UNFCCC negotiations, tensions were continually observed between the interests of developing and developed countries over climate finance. In negotiations on the fifth review of the financial mechanism, it seemed developed countries (like EU and US) wished to avoid criticism over the adequacy and predictability of resources provided, although these terms did remain in the criteria (section C). EU tried to delete the reference to "direct access" – a modality that has been supported by developing countries and pioneered by the Adaptation Fund. For reasons that are not well understood, the EU also tried to remove clauses on equitability and expert inputs. In general, developing countries were pushing for additional climate finance whilst donors were trying to limit their obligations.

Drawing on the negotiation typologies from Bailer (2012), both 'hard' (conflictive or aggressive) as well as 'soft' (cooperative) negotiations strategies were observed. In the 'informal' smaller meetings on finance, however, 'hard' bargaining strategies were primarily used, suggesting the relative absence of media or NGO observers led to more aggressive negotiation strategies.

Although this was only a brief snapshot into the UNFCCC negotiations, the case study shows the climate finance negotiations are replete with use of bargaining tactics. The negotiations seem to be categorised more by (conflictive) strategies rather than soft (cooperative) strategies (see Bailer, 2012). For example the EU's threat that there would not be "any money coming forward" unless sustainability of results were verified. Ultimately, this may demonstrate the importance of these negotiations for many countries. Disagreement was not necessarily conflictive, but is a part of the process. However, use of hard bargaining might be seen as a barrier to reaching an optimal solution since countries' are not working together towards a shared vision of the global good (preventing dangerous climate change) but are instead focused on their own interests. One example of this was the removal of the clause on a "global paradigm shift toward a low-GHG emission and climate-resilient development pathway", which neither developed nor developing countries wanted to keep in the final text.

It appears 'real politik' was at play. The realism of these finance negotiations was, in general, invisible from the pressure of media attention since they occurred outside the main plenary. These meetings went on alongside various other parallel meetings. Interestingly, the EU also wished to delete the clause referring to information on support "provided *and received*". This might have been because the terms were redundant. However, it might have been because

while developed countries have an obligation to pledge finance, they might not have an interest in ensuring finance is disbursed. In addition, while developing-country representatives stated transparency was important, they did not wish for there to be excessive emphasis on whether the finance had achieved results. This reflects a concern that placing the onus on developing-countries to demonstrate 'results' could go against the 'polluter pays' principle under the Convention. Making climate finance provision contingent on demonstrated results, rather than an obligation, would go against developing countries' interests.

Finally, procedural tensions and inequity affect the negotiations, leading developing-country Parties to claim the negotiations outcomes are tarnished by the multiple parallel meetings, which limit the capacity of developing-country delegations. Procedural issues can also be used by Parties' to stall for time (see Chapter 6). In conclusion, it was difficult for Parties to develop effective criteria to evaluate the effectiveness of finance under the UNFCCC in these tense and conflictive negotiations. The overt focus on national interests could be contributing to a 'tragedy of the commons'. Perhaps a more collaborative environment needs to be engendered for negotiating in the global interest, and one way forward would be to enhance procedural equity at the UNFCCC.

10.3. International Level Semi-Structured Interviews with Key Informants

As explained previously, international-level semi-structured interviews were undertaken based on the principles and issues identified in the literature review. The data has been used track progress against the framework for effective climate finance (Chapter 7). All key informants requested to remain anonymous. Hence, interviewees are identified only according to stakeholder group (and/or broad geographical location, where necessary).

10.3.1. Equity and Allocation Criteria

One UN representative argued; "if disbursed, it [climate finance] doesn't reach the target group because of leakages". However, one African NGO representative argued funding was reaching the vulnerable, but only reached a handful of communities "while millions of farmers are suffering from it" so there was "still a gap" due to inadequacy of resources.

In terms of CBA, one donor representative argued it could be "resource-intensive because capacity-building is needed in some cases". Therefore, this donor representative argued "easy wins for UN organisations might not lie in CBA, even though it might generate huge returns". This highlights a potential tension between equity and efficiency.

The respondent from IFAD explained that their projects under the Adaptation for Smallholder Agriculture Programme (ASAP) are based on the needs of the recipient government and are defined by them, with the requirement that it "needs to focus on smallholder farmers, in rural areas, of developing countries". 'Climate risk analysis' is undertaken to identify risk hotspots, and then linked with poverty analysis. Their projects tried to identify how many people in a particular poverty bracket could be reached with a particular investment. However they argued there is not always a "perfect match" between the poorest groups and those affected by climate risks because "sometimes the poor people the project is targeting is a different group than the people hit by climate risks… the poor have different capitals" [sic]. They also identified an incomplete overlap between those who have access to the value chain and those affected by climate risks.

The interview with one Nepalese government official explored Nepal's LAPA, under which Nepal made a commitment to channel 80% of funds to local-level. Nepal is unique in implementing this form of commitment. It was revealed Nepal intends the LAPA to be gender-sensitive and inclusive. However, challenges were revealed in strengthening local capacity and fiduciary standards. For instance, the Nepalese government representative argued "until people are capable of handling resources there might be a service provider"; namely, NGOs or private sector stakeholders who will implement LAPAs.

The Adaptation Fund respondent linked the principle of finance reaching the most vulnerable to direct access (see section on direct access), as well as to review criteria. They argued going through government was more likely to meet people's needs than going through the World Bank or UNDP. In addition, the respondent described two equity-relevant review criteria under the Adaptation Fund. Firstly, each project includes thorough consultation with communities; and secondly, donors must demonstrate how initiatives bring benefits to the most vulnerable. The respondent emphasised that they did not tell applicants how to achieve that, as these are "high-level principles rather than prescriptive top-down criteria". However, the research revealed the demand-driven (direct access) approach led to challenges related to accessibility and capacity (see 10.3.11).

In the PPCR, one donor respondent argued the prioritisation criteria were "deliberately national and context-specific… especially because adaptation is context-specific". They proposed various generic prioritisation criteria including "targeting the most vulnerable; gender-sensitive; stakeholder process". However they also stated there were "no criteria for

community engagement" although there was for stakeholder engagement, "which in reality is varied".

Under the GCF, it emerged from one NGO interview that from a "high-level" perspective there was a proportion of funding set aside for the particularly vulnerable countries including the LDCs, SIDS, and African States. But in channelling from national to local-level, they argued "they haven't got to that yet". In terms of the GCF's initial result management framework, it was decided under paragraph 27 of GCF/B.07/04 there will be results-based allocation and "the level of expected results of the activity will be one of the key criteria for allocating resources". However, one NGO respondent argued on adaptation, the GCF: "did not really incorporate experts" on the results framework, and: *"The Adaptation Committee under UNFCCC were not even allowed to contribute to this and they sent a letter to GCF saying they wanted to contribute to those result areas. GCF is not looking so much to external organisations that could feed in."* Overall progress on equity appeared balanced, with some progress under the Adaptation Fund though it is too early to evaluate progress under the GCF.

10.3.2. Cost-efficiency and Private Action

As examined in Chapter 7.3, adaptation funds like the GEF leverage co-finance, including private sector finance, as a means to enhance value-for-money. However, several interviewees expressed concerns about this. One Pacific-Island NGO respondent argued adaptation is less suitable for loans that mitigation, because "adaptation is not a commercial venture," whereas mitigation is. However, they argued "the loan does force more concrete outcomes". One UN representative stressed the private sector "are the ones creating the problems" so they should be engaged.

The Adaptation Fund respondent said the private sector are "rarely" included and have limited participation in their projects. However, they gave a few examples of private sector involvement, including a cell phone agency involved in an EWS in Papua New Guinea, and co-financing by the hotel sector in Senegal who benefitted from a coastal project.

One African government representative argued; "private sector finance is not predictable, that is why we need public finance," thus linking private finance to unpredictability. They argued private finance could be additional, but, "we need a level of public funds to give a level of confidence, whereas the private sector they are profit-driven so it depends on performance".

On the GCF's Private Sector Facility, one NGO respondent argued it has a "split personality," with a mandate for supporting SMEs in recipient countries, and yet an "expectation and staff structure geared to mobilising large amounts of money from the international private sector". They said civil society was pushing the GCF to focus on the first mandate. One NGO respondent engaged with the GCF explained the "biggest problem" was the risk of counting private finance towards the contribution; "developing countries are worried that developed countries will say private sector investment counts as climate finance". Hence, the issue also links to additionality (see below).

A NGO respondent who was closely engaged with the GCF argued strongly for public rather than private finance:
"I think international climate finance for adaptation should be public money. It is unrealistic to expect to leverage huge amounts of FDI for adaptation for the most vulnerable people who are also the poorest. You might be able to get individual adaptation projects with ROI but the returns are going to be tiny – nothing of the scale to attract a big corporation… in terms of resource mobilization at international-level - it's got to be public."

In terms of mobilising private funds, one innovative mechanism was identified from UNCDF who are trying to help local governments to mobilise adaptation finance by issuing municipal bonds. Whilst 'climate bonds' are increasingly used for mitigation, their potential for adaptation is largely untested.

Another EU-based NGO respondent agreed all finance needs to be public. However, one NGO respondent argued "developing countries haven't been that confrontational yet in demanding public finance". It was unclear why this might be. There may be a collective action problem in that if finance is tied to mitigation commitments neither developing nor developed countries have a major interest in getting finance flowing. Developing countries may not wish to lose sovereignty by being compelled into action, whilst developed countries do not wish to tie finance commitments to mitigation ambition for fear it could increase their liability.

The IFAD respondent indicated; "for us smallholders are private sector entities… it is the presumption we work on… for us they are not victims". Thus, IFAD appeared to overcome the division between public and private, saying "we can mobilise innovation potential… we need to empower the little businesses in those communities". By considering affected smallholder farmers as entrepreneurs rather than victims, IFAD suggested they could

empower them and harness their innovation potential. They recommended the GCF adopt this philosophy and said; "No one has an idea how the private sector facility will look but we would want GCF to have a way to channel climate finance to smallholder farmers". They also suggested the GCF build on established mechanisms and learning; it "should not reinvent the wheel – we should identify the best established pathways to target smallholders".

At a conference in Bangkok in 2012, one NGO spoke of the risk the funds would be used as "subsidies for northern companies to make profit in the south". Several US-based technology firms discussed how they might access funding from the Private Sector Facility – a far cry from the 'smallholder farmers' civil society hoped would be able to access funds. Similarly, one media respondent argued engagement of the private sector "shouldn't be at the expense of public funds" but should be used to mobilise private funds.

One donor argued the PPCR had tried to integrate the private sector as a stakeholder, but in a PPCR meeting in Bangladesh "all groups were represented except the private sector"…"people were not sure who to invite from the private sector - there should have been private sector engagement all the way from the plan to the implementation". However, they argued it "depends on the context" whether there is "a permanent role for private sector company or not". On Bangladesh, one think-tank respondent argued many companies felt climate change "was a problem for the government". Another donor argued the government do not always see why the private sector should be engaged as; "they interpret it as thinking, you're giving money to the private sector". They added progress in this regard had been easier in Tajikistan, where the private sector was defined as the "hydro and energy industry". In Niger, the private sector was defined as smallholder farmers, but in the case of Bangladesh they were "not sure" about the definition of the private sector.

Overall there is balanced progress on cost-efficiency. One might ask; cost-efficiency for whom? There appears to have been value-for-money for donors as loans are widely used under mechanisms such as the PPCR, but many stakeholder expressed concerns about the equity implications.

10.3.3. Monitoring Results/Effectiveness

A donor representative pointed out each of the funds has different indicators and these differ from those of the national donors (e.g. UK, Germany). The fund-level indicators are dynamic, and they have to "map them" against national donor-level monitoring indicators. One donor argued the "capacity at country-level to get round complex logframes is quite difficult" [sic].

Another highlighted; "capacity-building is bigger than just the Adaptation Fund… it includes governments' ability to measure results". One developing-country NGO argued that in their African country, most of the monitoring had been done by civil society and "government is not doing so much".

In terms of measuring results, the GEF representative explained their new tracking tool for adaptation which involved "macro-indicators," as well as "project-specific indicators" which were all disaggregated by gender. They argued these types of measurable indicators provided "accountability to donors too" and they highlighted the importance of monitoring results to "provide this data to justify scaling up". According to GEF, their monitoring systems had been devolved to "local authorities at community level" so that "monitoring is mainstreaming in the way governments conduct their work". They emphasised it is important for monitoring and tracking systems to be "applicable and understandable to the communities as well".

At IFAD, the respondent said the ASAP programme has "10 outcome indicators" some of which are relevant for IFAD as an institution, like the amount of climate finance programmed in each replenishment cycle, which "indicates how well they are integrating climate issues – or is a proxy for that". Two indicators that were used by IFAD generally were the household asset index, and the prevalence of child malnutrition (food security indicators), which were used irrespective of ASAP. ASAP-specific indicators included the number of poor households with strengthened climate resilience. In terms of economic analysis of impacts; the IFAD respondent explained every IFAD project has an "economic and financial analysis" attached. However, they stressed this could be complicated and there is an economic burden attached to economic analysis itself. The respondent said they "cannot throw endless amounts of money at this" and economists charge high rates for in-depth analyses, so there is a need for "rough but sound" assessment.

Under the PPCR, one donor respondent argued it was a "complicated process" and the "CIF administration doesn't do quality assurance, so that falls to donors who are steps removed from the process". Overall, the donor respondent argued "quality assurance ends up resting with donors" who "have to rely on project documents". One donor argued they "really struggle with adaptation because there are not universal metrics". Overall, monitoring capacity appeared limited amongst both donors and governments.

At the Adaptation Fund, the respondent stated there are project-level indicators, as well as fund-level indicators to track and aggregate across all projects, ranging from "strengthening

physical assets, to number of early warning systems, to number of beneficiaries". They stated these indicators are going through some refinement "because we realise it is difficult for proponents to report on these". The respondent also mentioned they release the funds in tranches based on "performance-based disbursement" (see next section).

In terms of the GCF, a civil society representative confirmed a draft results management framework had been developed and there were performance indicators for those, but they were not publicly available. Overall, some progress was observed in developing indicators to track adaptation effectiveness, but stakeholders expressed concerns about the resource and capacity burden of monitoring. It was felt insufficient information was available to evaluate overall progress on effectiveness.

10.3.4. Urgency and Timeliness

It was agreed in the GCF Governing Instrument "the Fund will have a streamlined programming and approval process to enable timely disbursement" (Annex, Decision 3/CP.17, UNFCCC, 2012). However, various interviewees criticised the slow process through which the GCF has been launched as a new institution. One African representative who was closely engaged with the GCF said "institutions take time" and argued they were "not near" to talking about programmes and policies, as they were currently institution-building. One GEF representative hinted that setting up a new institution may have delayed implementation and argued, "it took a long time and what we built now [at the GEF] is precious – we cannot erase and think the GCF can do that". However, one donor representative responded to criticism of setting up a new institution in the GCF by saying: "I certainly think it [the GCF] should be learning from each of them [other funds] because there's value in each of them but none of them are perfect". Refer to the section on direct access (below) for the related discussion on disbursement.

The Adaptation Fund respondent stated that the Fund disburses money in tranches "as they report to you year-by-year", which is good for accountability, results, and credibility and avoids "moral hazard where they don't have to do it". The respondent said this way, funds were disbursed as fast as possible, and recommended the GCF to adopt this approach as well. Overall, several stakeholders expressed concerns about the need for urgent and timely adaptation finance, but there was insufficient information available to evaluate overall progress.

10.3.5. Flexibility/Robustness

One UN respondent pointed out the impacts of climate change are still very much uncertain as "we cannot quantify where and how much" so "no regrets measures are required like Integrated Water Resources Management". The respondent argued financing should look at 'no regrets' measures first because "these are certain needs for developing countries… e.g. appropriate housing design, water supply systems and agriculture – you will not regret those actions". They highlighted that many no regrets measures are not "high-tech".

IFAD was the only respondent who brought up the issue of climate change scenarios. They explained they would "contract a regional institution to analyse the climate-related risks and projections, for example, for coffee in Nicaragua". They also explained they were flexible and did not necessarily take a "value chain" approach to food security under climate change, because in some countries like Least Developed Countries (LDCs) "they have basic problems with infrastructure… you cannot always use value chains as entry points". Overall, several respondents raised the issue of 'no regrets' measures but insufficient information was available on the extent to which different scenarios were being used in planning.

10.3.6. Adaptation/mitigation coherence

One NGO argued "the more you mitigate now, the less adaptation requirement… the longer we go without mitigation the more will need to go to adaptation finance". An NGO respondent who engaged with the GCF argued that mitigation, adaptation and loss and damage are on a "continuum", with mitigation arguably the "most important". They suggested we are now at a point where we have "already failed to do enough mitigation… so there is a moral obligation to help people adapt".

A developing-country NGO respondent argued we must consider adaptation now because "even if we have zero emissions what we have now will impact over the next 30-40 years". They added; "projects should actually consider both [adaptation and mitigation] together as you cannot really isolate them" but that this was not currently being done. Another African government official called for greater synergies between adaptation and mitigation, arguing "NAPs and NAMAs should speak to each other so there are some co-benefits", for instance, in terms of forestry.

Respondents suggested that inter-institutional coordination is needed to build important synergies between adaptation and mitigation. One donor added that adaptation and mitigation funds were created in their own "silos" and the CIFs "don't speak to each other particularly

well". Another NGO, engaged with the GCF, also used the word "silo" to describe the adaptation and mitigation split, but argued at least the GCF is "thinking about" synergies and co-benefits.

One UN representative argued governments are pushing mitigation priorities because "that is the way it is being advocated". Similarly, one African government official argued whilst developing countries are interested in adaptation, other countries are focusing on mitigation "because it addresses their needs and interests". This delegate suggested a dedicated proportion of GCF funds should go to adaptation (an idea later adopted by the GCF Board).

The GCF's Sixth Board Meeting decided the Fund "will aim for a 50:50 balance between mitigation and adaptation over time" (GCF, 2014b:4). One NGO argued this is "appropriate since adaptation finance got a short shrift historically". Another EU-based NGO explained this decision reflected the main ask from the CAN, the civil-society umbrella organisation under the UNFCCC.

One Adaptation Fund respondent argued they "think it should be 50:50" however they admitted they had "not really thought about it" and it was "not an analytically arrived-at number just a principle". It might be that the decision within the GCF to split the finance 50/50 between adaptation and mitigation was similarly decided upon based on principles rather than any scientific or economic comparison of the global requirements for adaptation and mitigation. This hypothesis appears likely, given the lack of information available about how the decision was made.

One NGO from the EU argued the issue of adaptation and mitigation synergies "is not at all being discussed under the UNFCCC which clearly separates adaptation and mitigation, and this is a huge gap to be closed as there is a lot of potential [for synergies] especially in a field like agriculture". They added the GCF mandate said it would bring "transformational" change - an opportunity to combine adaptation and mitigation. However, separation of funding in terms of designating '50% for adaptation' separates the two again, as there is "not a mixed pool for synergies… at the moment".

Within funds, the Adaptation Fund respondent admitted they "haven't given much thought" to adaptation and mitigation synergies, although there are "a few examples" of co-benefits such as "ecosystem-based adaptation which captures carbon". However, they argued the majority of work they are involved is "urgent needs for infrastructural things like coastal,

water, livelihoods" which arguably did not produce substantial emissions so "co-benefits are not required".

IFAD's ASAP appears to have considered co-benefits for mitigation at the outset. The IFAD respondent explained, while adaptation was the focus, "mitigation is a side benefit… and we know we need to quantify the GHG effects of our interventions". They were currently working with CGIAR to look at 11 programmed investments and do a "quick and dirty assessment of what is the likely GHG reduction effect of the investment". However, the respondent expressed concern that IFAD targets for GHG reduction might have been set unrealistically too high. Interviews also revealed GEF has not undertaken any assessment of the emission impact of its adaptation projects. Overall, there was some progress under the GCF on the issue of 'balance' between adaptation and mitigation, but little or no consideration of the need for synergies.

10.3.7. Gender equity

Gender sensitivity was one of the generic prioritisation criteria suggested by a donor. The Adaptation Fund respondent explained one of the Fund's review criteria is that projects must demonstrate benefits for the most vulnerable, including women and youth. The respondent gave the example of Rwanda which had submitted a 'Gender Analysis' along with their project proposal (see AF, 2013, Annex 10). Results also have to be disaggregated by gender. However, the Adaptation Fund does not have a specific gender policy. The IFAD respondent explained IFAD has a 'gender strategy' involving gender-disaggregated baselines and gender-sensitive indicators.

One NGO respondent said GCF is "the first climate fund to explicitly include gender sensitivity in its governing instrument". The GCF Board commissioned a paper on how to operationalize gender sensitivity which included a "consultative process with civil society on gender" that would input into the proposed gender policy. They described this as a "bright spot" in the GCF and they were "hopeful" on this issue. Overall there is measurable progress on this issue at the level of documentation, but it is not clear to what extent gender equity is prioritised in actual international implementation.

10.3.8. Practicality/Feasibility

The issues of practicality and feasibility were not discussed directly by any respondents and there was insufficient data. However several respondents saw the need for project applicants to have sufficient implementation capacity. The issue links with the ownership issue (below)

as there is a need to balance stringent criteria with opportunities for learning-by-doing. A UN respondent also argued the "check and control should not be so stringent that it doesn't release any money" [sic]. They suggested a balance between stringent fiduciary standards and access.

10.3.9. Avoiding maladaptation

According to the definition of maladaptation from Barnett and O'Neill (2010) in Chapter 7, maladaptation includes actions which increase emissions or inadvertently burden the most vulnerable, linking this to the issues of coherence with mitigation, as well as equity and cost-efficiency. One NGO respondent argued there is "always a risk" with adaptation because we are not sure whether we will need to adapt to 2 or 3 degrees. Thus, there is a need to "be as flexible as possible… to top it up if temperatures rise above 2 degrees". Maladaptation was closely linked to flexibility in this case. The same respondent also explained this was "not really an issue at the UNFCCC" and has "not really been a discussion".

One of the eligibility criteria under the Adaptation Fund was that the project should support 'concrete' adaptation actions (see Chapter 7). Interestingly, one donor argued "concrete adaptation" was a misunderstood term, because "some people think it means it has to be with concrete". Few other respondents brought up maladaptation. An NGO respondent also expressed concern that diversion of development aid to adaptation might result in 'maladaptation' thus linking this issue to additionality. Overall, there was little evidence of progress in consideration of maladaptation at international-level.

10.3.10. Transformation and Scaling-up

The IFAD respondent explained they have a conceptual framework for scaling-up; thinking through the drivers, barriers and pathways for scaling-up successful elements of projects. The literature review revealed this was based on Linn (2012). The IFAD respondent explained this was not deployed mechanistically and they were not scaling-up projects but rather, "scaling-up successful results from projects" and avoiding things that have not worked, learning from both successes and failures. Interestingly, the respondent explained IFAD had held a "fail fair" in 2013 in which learning from failure was a key element (see http://www.ifad.org/events/failfaire/).

Learning from failure could facilitate learning on adaptation. However, it was recognised there could be a "political dimension" leading to failures being brushed over. The IFAD respondent explained it was challenging to learn from failure as "you have an unspoken

barrier that when you fail you basically have made a mistake… which restricts the amount of information being presented and this includes governments… For politicians, the stakes are much higher". Perhaps other funds could learn from IFAD's approach, as in the context of adaptive learning it was felt that increased openness about failures must be encouraged by funds engaging in adaptation.

The GCF is mandated to have a "transformational impact" and the governing instrument speaks of a "paradigm shift" (Annex, Decision 3/CP.17, UNFCCC, 2012). One NGO respondent who had been closely engaged with the GCF explained they have operationalized this so far by identifying "performance indicators beyond the discreet project-level stuff… at programme and policy level as well." However, they were "not sure how this will play out in practice". Overall, there was insufficient information on this issue at present.

10.3.11. Direct Access/Ownership

Challenges relating to accessibility of finance were recognised. One NGO stated "the countries most vulnerable are least able to access the funds". A developing-country NGO representative argued it was important for donors to "guide them and make it much easier to apply and to understand". This respondent questioned the capacity of government focal points on climate change, arguing; "in my country some of the focal points with responsibility to access these funds did not have enough capacity to understand about what the process is itself."

One UN respondent agreed climate finance is not easily accessible to many countries; "either they don't know the availability or how to access it". The GEF respondent explained the Small Grants Programme (SGP) has an innovative means of directing small grants for climate chance, but argued these funds have to stay small to ensure communities can handle the funds themselves, thus enhancing ownership. The GEF respondent argued GEF is starting to implement direct access modalities but "many cannot make it". One donor also suggested the "PPCR has some specific objectives for capacity-building, so countries might be able to meet the criteria for direct access".

The Adaptation Fund respondent argued; "direct access is great because it cuts out the middle man and the UNDP". The respondent suggested that for targeting the most vulnerable even more closely there could be "subnational direct access for cities and communities". There were challenges in accrediting the NIE in some countries (for example Bangladesh). The Adaptation Fund respondent argued that some countries "nominate the wrong entity" and

suggested they ought to have a process for selecting the entity before applying, because if countries' simply "choose one they like" it might not have the right ficudiary or transparency standards. The respondent also added;

"…Some entities are not cooperative with the accreditation panel. Those experts on the accreditation panel ask for audits for the last 10 years and grievance mechanism procedures – some entities don't give up that information quickly or in its entirety…Transparency is one [criteria] that is tough for entities to meet, even some regional development banks struggled on that – not because they're not transparent but they don't have the systems in place… or it is not documented."

One donor representative, who had also been engaged with the Adaptation Fund, argued it "would be easier if it [the Adaptation Fund] loosened its criteria for NIEs but quite rightly it doesn't do that". They argued; "personally I think they need to have capacity-building"…"the USP [unique selling point] is direct access and we need to be patient… the last board agreed it would explore the idea of a capacity-building programme".

More than half a year after this interview, the Adaptation Fund had launched a capacity-building programme known as the 'Readiness Programme for Climate Finance'. Under this programme, the Adaptation Fund respondent explained there was a plan to speak to accreditation experts and provide what is needed on capacity-building, as well as doing "south-south cooperation with existing NIEs to help other NIEs become NIEs".

At the June 2013 GCF Board meeting, the GCF decided in Decision B.04/06, paragraph (g) to consider "additional modalities that further enhance direct access". One NGO respondent from the EU stated that this "enhanced direct access goes beyond fund managers at the national level – enabling them to select themselves what they want to fund, and which communities are most vulnerable and should be prioritised".

One NGO representative who had been engaged with the GCF reiterated concerns about the difficulty of meeting direct access standards under the Adaptation Fund. In order to meet the obligations of direct access, ficudiary standards and social and environmental safeguards, they recommended a "strong readiness programme with capacity building to meet those standards" under the GCF. With the Adaptation Fund's readiness programme just launching, this NGO representative said it would be "interesting to see how it works and how GCF can learn from it".

In terms of the GCF, several respondents explained there will be 'National Designated Authorities' (NDA's) to facilitate direct access. However, one EU-based NGO respondent explained it is "not clear" how this will be done and "if the GCF has its own entities this will take a while", especially since under the Adaptation Fund "even some MIE's took 2 or 3 years to accredit". Thus, this respondent argued if the GCF wants its own entities "it will really be a bottleneck for disbursing funding". They also explained the Adaptation Fund's NIE's were only set up to handle up to $10m of funding for a project so "we are not sure if they are suitable for these sums of funding". This respondent pointed out the GCF is likely try to distribute quickly "by using multilateral entities which are used to handling those amounts" and developing countries "won't like to see that but it will speed it up".

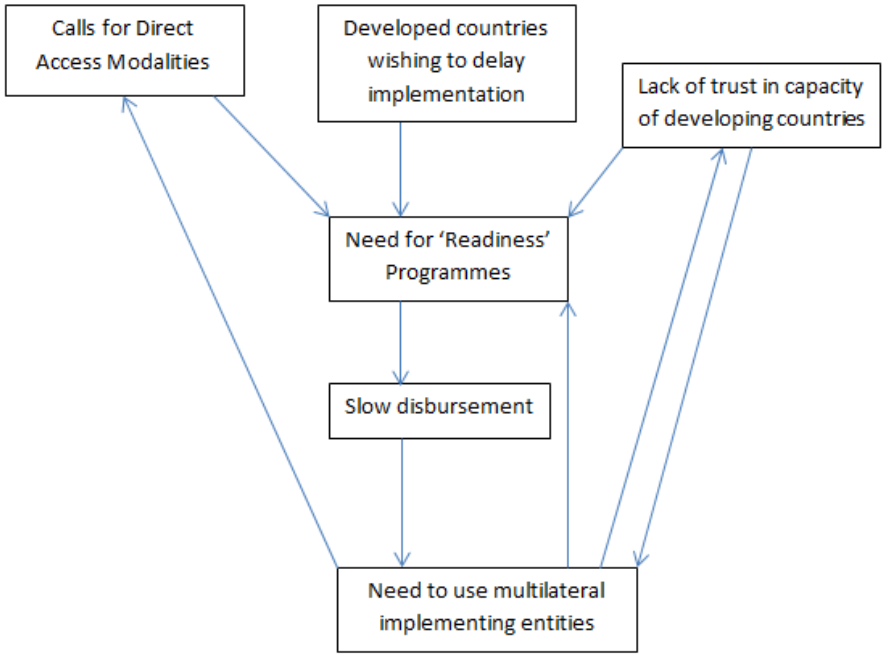


Figure 10.1 Illustration of potential negative feedbacks between direct access, lack of capacity and the use of multilateral implementing entities.

While the World Bank was not mentioned regularly during these interviews, some NGO respondents were outspoken on its role, which they felt could undermine ownership and access (see 9.3.12). One NGO respondent argued the "World Bank is a master of extracting resources from development partners and giving a glossy spin… the gravy train for them was the CIF [Climate Investment Funds]". Overall, the evidence pointed to balanced progress on ownership, with particular optimism regarding the potential for 'enhanced direct access' under the GCF.

10.3.12. Additionality and Mainstreaming

There are concerns adaptation finance has been diverted from development aid, so it is not 'additional' to ODA. Thus, whilst additionality and mainstreaming can be considered as separate issues or principles, they are considered together here to improve coherence. The literature review revealed concerns that calling for 'mainstreaming' climate change into development aid is a ploy to avoid providing additional finance (Klein, 2010). Furthermore, if funds are diverted from development aid and labelled as climate finance, the scope of activities they can be used for is narrower; meaning recipients are less able to use the aid for activities of their choosing (*ibid*). There can also be issues of 'double-counting' (*ibid*). One media respondent linked the issue of diversion of adaptation finance away from ODA to the lack of transparency in reporting obligations.

GEF required applicants to demonstrate 'additionality' to a counterfactual, and only fiances the "incremental cost of those adaptation activities that generate global environmental benefits" (Verheyen, 2005:98). Thus there are two conceptions of 'additionality' (see Chapter 7). One NGO argued applicants should "absolutely not" be required to demonstrate additionality to the development baseline and that driving a wedge between development and adaptation would be "creating a rod for your own back". One respondent from the Adaptation Fund pointed out; "most developing countries have a development deficit already, so speaking about an incremental approach is not useful". One African NGO argued "development and adaptation are similar and should not be separated as they are interconnected". However, another UN respondent argued there are 'budget substitution' issues where funds are lumped into national funds.

One UK-based think-tank stakeholder disagreed with the focus on additionality and said they were "not one who thinks that 'new and additional' is needed to solve things because we need all the money to solve things". They appeared to suggest there should be less focus on the obligations of developed-countries to provide finance and instead, even the finance from developing countries themselves (or development aid) should be aligned with the objectives of climate change.

An NGO respondent who was closely engaged with the GCF argued; "because climate finance, both adaptation and mitigation, are so linked to development it would make sense for them to be integrated into ODA - ideally the advocacy ask is that climate gets integrated into ODA and the target is increased". Thus, they proposed an ODA target of 0.8% with climate

change incorporated. However, they recognised "we cannot make that ask now as it doesn't make sense" because most countries are not even meeting the 0.7% target. Currently, they argued there is a "mismatch" because climate change and development are "separate at the top and then conflated at the bottom".

One NGO respondent framed it differently, saying that having a development component in adaptation is necessary to have legitimacy with communities on the ground. They argued; *"convincing those groups that climate change is coming is difficult so combining it with a development approach gives you much more legitimacy to implement adaptation*". However, they said mainstreaming adaptation into development also made it easier for countries to claim their development aid contributes to adaptation, particularly since development flows were above $100Bn per year; developed countries could say "this is adaptation" and "legitimise themselves by saying their development did have an adaptation component". Overall, this implies that committing 50% of funds under the GCF to adaptation might have made it easier for developed countries to meet their climate finance commitments by simply diverting funds from development aid. In summary, the evidence pointed to observable progress on mainstreaming, but little or no progress on ensuring 'additionality' of finance.

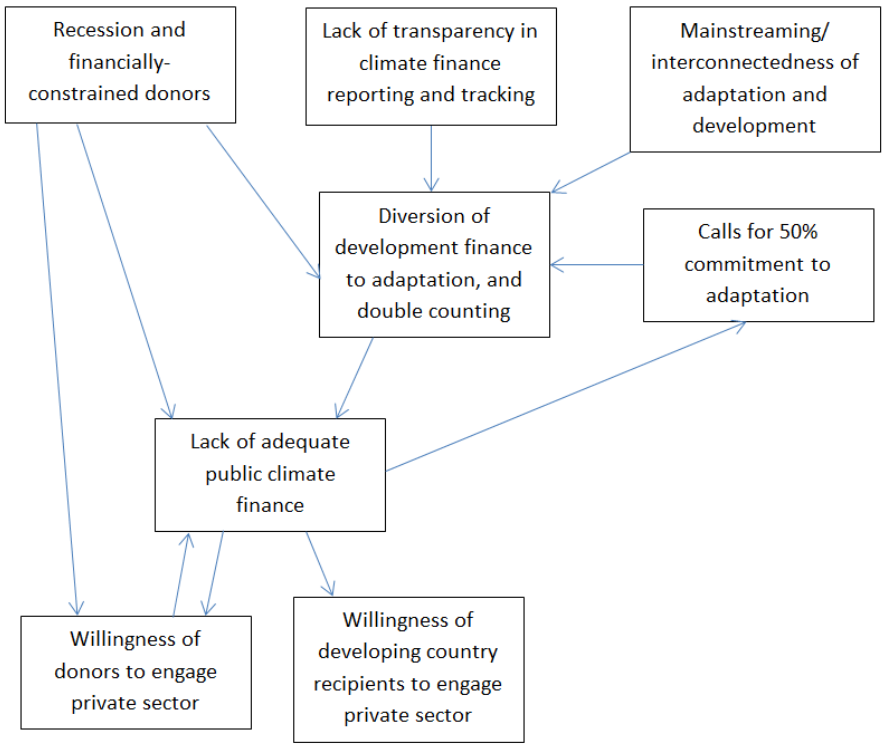


Figure 10.2 Illustration of possible feedbacks (reinforcing loops) between inadequate public finance and diversion of ODA, as well as between inadequate public finance and private sector engagement (from interviews and literature review, explained in text).

10.3.13. Harmonisation/Coordination

According to one African NGO, coordination was challenged by the fact there are "so many similar instruments" with "different criteria and technicalities". Some funds appeared to have procedures in place to coordinate and harmonise at national-level. The Adaptation Fund respondent explained one of the Fund's review criteria was that projects must avoid duplication and seek synergies, so a desk review of national and bilateral projects in the country was undertaken to "check to the extent possible that the project was additional and different" from existing projects. Similarly, the IFAD respondent explained stakeholder engagement was a major part of harmonisation and coordination, as ASAP design missions involve participatory processes including desk research on stakeholders in target areas who then become involved in the investment design (e.g. through project design workshops).

Coordination and harmonisation of the GCF with other funds seemed to be a gap. One NGO respondent who was closely engaged with the GCF argued;

"[GCF's] Secretariat is short staffed so they haven't done in depth consultation with other bodies…when they drew up the performance indicators they didn't talk to other funds at all. They have a capacity problem. It takes time to reach out to other bodies and they have a time crunch and staff shortage. They have not done as much as they need to. Staff at CIF's have complained 'they are not talking to us'… not learning from those failures. But it is getting a bit better as there has been disgruntlement on that front."

One EU-based NGO respondent agreed, and expressed concern that the Adaptation Fund should remain intact:

"I have perceived the GCF wants to be its own entity… it doesn't want to integrate the lessons from other funds over the last few years… We think the Adaptation Fund should run under the GCF –there should be transparency and majority of developing countries in the Board. It should not just be eaten by the GCF."

Overall the evidence was balanced; pointing to measurable progress on internal coordination but limited progress with regards to the GCF.

10.3.14. Adequacy and Predictability

In the semi-structured interviews with expert key informants the adequacy of climate finance was recognised as an overarching challenge, especially considering the lack of mitigation ambition, with one NGO saying: "what level can we actually stabilise the concentration at? It could be 600ppm or 4 degrees". An EU-based NGO respondent argued the finance was

"definitely not enough to keep climate change within manageable limits". It was felt inadequate climate finance (both adaptation and mitigation) would make climate change more expensive in the long term. Another UN respondent, touching on this point, argued the adequacy of finance had been affected by the recession, but pointed out "if you don't give it now, you have to give later in other ways". Moreover, it was also felt slow progress on finance was holding back mitigation ambition, with one media respondent arguing "countries won't do much mitigation until finance is on the table".

Another participant from an international organisation argued the "needs are so great that the GCF is a drop in the ocean". Other stakeholders, including a think-tank respondent, stressed the inadequacy of the funds pledged under the GCF, saying "$100 Billion is nothing", compared to flows of non-climate related finance every day. Thus, it was argued there is a need for "enabling pathways for global financial flows to shift". The respondent argued the financial commitments under the UNFCCC were more about "powering the process" in terms of the power it could have in shifting government spending decisions, rather than the flows themselves.

In terms of food security, the IFAD respondent explained "the availability of climate finance grants is still critical to integrating climate risk thinking into agricultural investment programmes" but there is a "need to avoid retrofitting". They argued climate change needs to be integrated early on in country strategies to avoid "bad design". Thus, public climate finance was felt to be crucial for mainstreaming of climate change into agricultural development.

One respondent from a UK-based think-tank, when asked about the adequacy of climate finance, responded that finance was "obviously not" adequate but highlighted barriers. For example Bangladesh "never spends all the money it is getting... due to lack of capacity in government". This respondent seemed to be apportioning some of the blame for the inadequacy of finance to recipients themselves.

The adequacy of finance on the table was described as making the issue of balancing adaptation and mitigation somewhat a moot point. One NGO respondent said there was "only $100Bn available on the table in 2020 and we know that is not enough – even if all goes to mitigation *or* adaptation". They felt there was not enough for either. However, as outlined below, the GCF prioritised the decision on the percentage going towards adaptation before confirming the levels of public finance.

It emerged from the interviews and literature review there had been little progress in scaling-up finance to 2020. One media respondent highlighted the "gap between fast start finance and the GCF". An NGO respondent expressed disappointment that submissions before COP-19 on "strategies and approaches for mobilizing scaled-up finance" (Decision 1/CP.18, paragraph 67) had ended up as "really vague" (see UNFCCC, 2014). Submissions only came in from 6 parties including the EU. Parties did not agree on mid-term targets for finance up to 2020. One NGO respondent said they were "pretty sure there won't be [targets]…realistically I don't think they will" even though "civil society is always asking for it". Some respondents hoped Ban Ki-Moon's Summit in New York in September 2014 would bring finance pledges, but a NGO respondent reported that the German government had told them; "if we don't' know where the money is going and how GCF will disburse it we don't want to pledge now". This emphasises that it is vitally important for "GCF to get facts on the table so that trust is built". However, Germany did make a pledge to the GCF in the end, demonstrating this barrier had been overcome.

It emerged from interviews the financial flows currently going towards adaptation under the OECD's 'Adaptation Markers' have been largely overstated. For instance, a key term search of more than 6000 projects listed in the OECD dataset revealed that roughly 65% of all activities listed in the original OECD dataset are "unrelated to adaptation or at least do not state adaptation as a principal (adaptation marker 2) or significant objective (adaptation marker 1) (Junghans and Harmeling, 2012:4). This observation relates to the discussion on mainstreaming and double-counting.

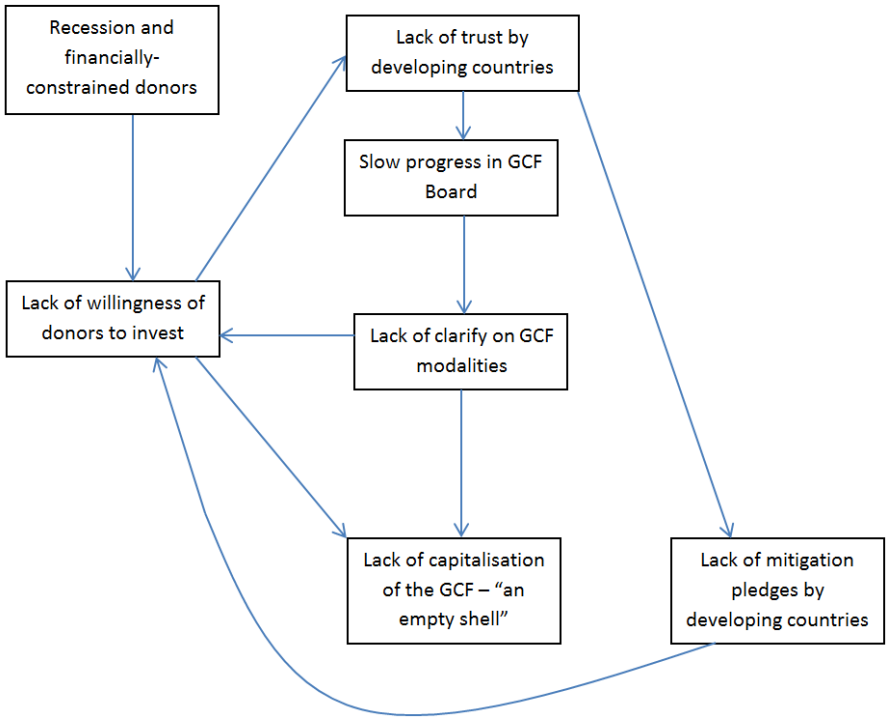


Figure 10.3 Illustration of possible feedbacks (reinforcing loops) between donors lack of clarify on GCF modalities and lack of capitalisation (drawn from interviews and literature review)

In terms of emerging issues requiring finance, one EU-based NGO respondent said they have not seen any discussion under the GCF around 'loss and damage' (see Chapter 3), even though the Warsaw International Mechanism has been established under the adaptation framework, and the implication is that the funding towards adaptation will also go towards loss and damage. Overall, there appeared to be little progress on increasing the adequacy and predictability of finance.

10.3.15. Transparency and Stakeholder Engagement

In terms of transparency within UNFCCC climate finance negotiations, one NGO argued it was "the most jargon-driven process on the planet"… "even I am still perplexed by some of the acronyms and terms". They argued the process has become so complex that "the average person would have no idea what is going on" and as a result it is "not articulated clearly to the general public". One media respondent argued; "there are few meetings open – most are behind closed doors" thus contributing to the lack of information for the general public. With reduced information getting into the public domain, governments may also be able to avoid pressure from civil society to make progress.

It was argued by one UN respondent there is a need for greater transparency in order to improve coordination on-the-ground. They suggested the "One UN" concept could help in this regard by pushing joint programming and joint modalities. Another UN representative argued communication barriers occur due to language barriers. It was noticed that where online information is available regarding climate finance, it is usually in English.

Transparency appeared to be an issue for the GCF Board. One NGO pointed out the GCF is "not at all transparent" compared to the Adaptation Fund where "all UN observers were accredited immediately and could participate immediately" while the GCF took a long time. One NGO representative argued the GCF "Board refused to allow webcasting at their meetings" saying it was too expensive at first, which was "absurd" and then they "said it would screw up political dynamics in the room". Another NGO agreed this might have some logic as the process is "really political" and if it was webcast the members would just be "saying political messages and cannot negotiate". However, the lack of transparency had repercussions for procedural justice, stakeholder engagement, and the fair participation of developing-country delegates in the GCF. One NGO argued the "lack of webcasting" meant "not only observers have to have money to travel to the meetings" but also they had to go through an accreditation process. It was a problem "not just for observers" but also for "board members – some of their advisors cannot go… webcasting would enable [them to have] more advisors". Issues relating to developing-country participation at the UNFCCC had already been highlighted in the literature review (Schroeder et al 2012; UNFairplay, 2011).

One NGO representative who had been engaged in observing GCF meetings argued there were major issues relating to transparency and stakeholder engagement, and "the problem is that we only have two observers in the room" . They said that observers were: *"only allowed to speak at the discretion of the co-chairs and have no decision making authority, unlike other funds… can only make verbal interventions if the co-chairs decide to let us".*

On decision documents, they argued; "*Secretariat drafts these documents – it is completely opaque to observers – we never see the drafts before. That is the biggest problem… Some funds have some way of engaging beneficiaries at the board level. GCF doesn't have that."*

Thus, GCF Board meetings were non–transparent, with little scope for stakeholder observation. The initial modalities of such structures are important as they establish the basis

of future work. One NGO argued there was time pressure and the GCF was "understaffed" so there had not been much time for a meaningful consultation process.

Furthermore, the National Adaptation Plans (NAPs) process under the UNFCCC was described by one respondent as a "top-down kind of arrangement". Extensive stakeholder consultation did not appear to have taken place as this was "optional" rather than mandatory. They implied community involvement meant holding a meeting where stakeholders could merely endorse the existing plans.

It was revealed from a donor interview that the Adaptation Fund had an enhanced process for stakeholder engagement: "Almost every meeting has a civil society meeting led by Germanwatch" and they were invited "to feed into the project proposals". By contrast, the PPCR had less frequent meetings, but does have a stakeholder forum. One donor representative stated the PPCR was a programmatic process that was "not supposed to be imposed from the outside but the reality is that it is quite a lot". Under the PPCR, the donor also confirmed they were not using civil society to monitor directly but they were "invited to the sub-committee meetings".

The GEF representative argued their funds (LDCF, SCCF) had a "robust policy on public participation early on the project cycle" and projects were "reviewed against public participation and stakeholder consultation". However, they recognised that even where projects were labelled as community-based they might not be: "it could be labelled as CBA but really a scam" so it was important to look at the quality of projects rather than the names. In terms of community ownership, the GEF representative recognised the benefits of smaller projects under the SGP: "formulation has to remain small to allow ownership of communities in implementation".

However, one international organisation representative highlighted the "problem of NGOs getting too involved… we need to ask, what is the role of civil society?" Another UN respondent argued "sometimes they [NGOs] are too vocal and sometimes not truthful… or governments are hiding something". They emphasised the need to balance governmental and civil society engagement.

Few respondents raised the issue of local or sub-national government engagement. One example suggested by a respondent was the 'LoCAL' initiative by UNCDF which purposefully channels adaptation finance to local governments with the idea of building

capacity to tap into these funds. Yet, one developing-country NGO argued; "most local governments some don't see climate change as a challenge as they have so many issues they are battling with".

Overall, there appeared to be little progress in transparency and stakeholder participation, with concerns expressed by all stakeholders including fund representatives. The exception to this was the inclusive governance of the Adaptation Fund.

10.3.16. Sustainability

One African NGO argued national ownership was crucial for sustainability because "people understand the peculiarity within their own constituency and when the country owns such programmes then it makes it sustainable as they see it part of them". The Adaptation Fund respondent stated one of the fund's review criteria was that applicants have to demonstrate how they will ensure long-term results beyond the project lifetime, including what government will contribute to maintain what is built, and how the project will be scaled-up and replicated. However, the respondent also explained it was "too early" to observe the results yet as no projects are fully completed.

Only the respondent from IFAD highlighted the role of Environmental Impact Assessment (EIA) in sustainability of infrastructural projects. For example, a climate-resilient road which is more robust or has better drainage could cause damage to the environment, so "you need to check its impact". They gave the example of submersible roads in Bangladesh. The respondent also argued that adaptation processes are more sustainable by design: "adaptation is about dealing with change and buffering external shocks and surprises – so adaptive systems are more sustainable than not adaptive systems". Overall, however, there was insufficient information to draw conclusions regarding the progress on sustainability.

10.3.17. Barriers and Challenges

One donor highlighted capacity-building as the major challenge in scaling-up effective finance. They also argued **education** was a barrier, and "it's also a behavioural thing - appetite for risk is a bottleneck… farmers don't want to do things differently". Thus, they emphasised cognitive (social) barriers to adaptation. The respondent also argued "**access to finance** is a barrier". One UN representative also suggested it was important to consider cultural nuances and look at adaptation "from the perspective of those who have different perspectives and cultures".

One donor respondent argued the main barriers and bottlenecks for adaptation financing were "**capacity**" and "**procedures**". The Adaptation Fund respondent argued; *"The main bottleneck is the legal people having to look at contracts before agreements are signed…Disbursement itself is very easy to do. You press the button and money goes. There is a 9-12 month delay where the World Bank legal team goes through the contract and the clauses".* Meanwhile, the IFAD respondent argued bottlenecks occurred due to **human resources;** "funds are disbursing very slowly… especially in cases where you have to establish a new project team". They stressed the need for a qualified project manager and M&E expert and for them to have training in processes like transparency procurement and reporting.

One GEF respondent said there are "…no great barriers in scaling up horizontally. If we have money, we can do it". They argued "we have so many examples, we only need the money". However, they said the major barrier was **political will**. Other barriers were "knowledge and information" which were "removable barriers". They gave the example of traditional technologies for sustainable and climate-resilient land management in dryland Africa which have "been around for centuries" and questioned why they were not being adopted. In that context, "**knowledge** is a barrier" and "**land tenure** issues may be a barrier to scaling up".

In terms of **structural barriers** to adaptation, a barrier that emerged unprompted from one interview was the issue of petrol subsidies in developing countries, with one UN official arguing "they need it". Another media respondent argued "subsidies continue to do damage," however the same respondent stated they had not thought about the issue of **subsidies** in relation to adaptation. The IFAD respondent understood structural and trade barriers as a key impediment. On the structural side, they felt people were investing in short-term gains at the expense of thinking long-term - a key barrier to sustainability. They also highlighted the role of agricultural subsidies in industrialised countries which are "certainly an impediment to the growth of the agricultural sector in developing countries – it locks people into growing a narrow bandwidth of crops as they have a barrier to other ones they cannot export".

The IFAD respondent also raised the issue of the water-energy-food nexus as an emerging issue, and stated "poverty is not segmented into silos" – these issues "materialise not at the sector level but at the livelihood level – problems are much more interlinked there".

One NGO respondent, who was closely engaged with the GCF, argued **trust** was the main bottleneck:

"The core problem is there no trust the developed countries are actually going to provide finance – they haven't given strong indications they will provide the money, and there's lack of trust by developed countries who want to retain control over their money. Ownership and direct access, and devolving the decision-making authority make donors really nervous as they feel they are putting their money into a black hole. A lot of what we are hearing [at this conference] is we have to trust communities to manage money effectively and that is a message to donors. Yes, have monitoring and evaluation, but trust that recipients can manage this money because without that you end up with top-down donor-driven funds."

10.4. Feedback on Indicative Framework

Following the international-level interviews, some of the interviewees were approached a second time to share the final refined version of the indicative framework for effective finance. The interviewees were approached based on their expertise in this regard, for instance, experts who were managing a major international fund. One respondent from a major international adaptation fund highlighted that some of the principles are general criteria for development projects (like harmonisation, mainstreaming, efficiency, gender and sustainability); whilst others are more specific (like maladaptation, flexibility and targeting the most climate-vulnerable). The propositions could also be seen as on a continuum from development to adaptation-specific. Thus, a shortened list could include adaptation-specific criteria as follows:-

- Equity and targeting the most vulnerable
- Effectiveness in reducing vulnerability
- Flexibility and robustness under different scenarios
- Synergy/coherence with mitigation
- Avoiding maladaptation
- Transformation
- Additionality to ODA
- Adequacy and predictability

In addition, one respondent suggested that resilience consists of robustness, recovering quickly and learning into a better state. Thus, they suggested adding 'building adaptive capacity' under effectiveness, and 'learning from failure' under the maladaptation criteria. They also suggested emphasising trackability under transparency. These suggestions were added to the propositional statements and examples for operationalization in Chapter 7.

Furthermore, the respondent noted 'urgency' could be considered on the part of the funder – or for the receiver. They pointed out that applied criteria are different from these normative criteria, and political criteria often feed into donor's allocation criteria, for instance, the donor's target countries or the performance of the country. This led to a trade-off with capacity-building.

10.5. Conclusions

Evidence of the use of 'hard bargaining' tactics were evident in the UNFCCC negotiations with conflicts between developed-country donors and developing countries recipients. This was to be expected from a realist interpretation of international relations. Developing countries were pushing for direct access, transparency and equitability, while developed countries were pushing to reduce their financial obligations by any means, avoiding "scaling up" finance, and putting the onus on developing countries to demonstrate the results of finance provided. Overall, political economy plays a major role at the UNFCCC and there was evidence of bargaining and negotiation tactics. The discussions involved both distributive and procedural justice (Paavola, 2005).

Different issues are interpreted differently by countries according to their interests. For example, on 'additionality', developing countries argued climate finance needs to be "new and additional" to development aid. However, due to a different conception of 'additionality' conception, the GEF's SPA only funds the "additional – or incremental" benefit of a project, thus making it more difficult for recipients to apply for funding.

In interviews with high-level stakeholders, it emerged the lack of progress in scaling up finance under the UNFCCC (including the delay in capitalising the GCF) could be driven by a 'vicious cycle' involving a lack of trust by developed countries, and concomitant lack of developing-country mitigation pledges. In essence, climate finance may be suffering from a 'chicken or the egg' problem. Which will come first, strong mitigation commitments or climate finance pledges?

One astute NGO respondent noticed that developing countries have not been vocally demanding public climate finance, perhaps for this very reason. It appears we are on the cusp of a global 'tragedy of the commons' – a collective action problem in which neither developed nor developing countries have sufficient interest in tackling climate change due to the associated costs of doing so.

Analysis of interviews and relevant literature also highlighted another possible 'vicious cycle' in which the more public finance that is demanded, the more developed-country donors divert development aid away from conventional development needs. However, it is quite possible this constrains the ability of developing countries to tackle the existing 'development deficit' as it narrows the possible scope of activities which can be funded (Klein, 2010).

The recent commitment for half of the funds under the GCF go to adaptation might have, ironically, made it easier for developed-countries to divert funds from ODA, since adaptation is more fungible with development. Possible solutions would be for developed countries to increase their ODA commitment from 0.7% of GNI, or for increased transparency in climate finance reporting.

The role of the private sector has also become central within discussions on the GCF, likely driven by the interests of donors to limit their public expenditure and count mobilised private investment towards their 2020 contributions. In the GCF, various respondents were hopeful about the potential for enhanced direct access and gender-sensitivity. However, accrediting NDE's for direct access may require implementation of a capacity-building "readiness" programme, much like that being rolled out in the Adaptation Fund. Paradoxically, developing countries might access less overall finance this way (see Chapter 7 discussions on the Adaptation Fund). There is potential for sub-national 'direct access' for cities or communities, although this might not be in the interests of the national state-actors negotiating at the UNFCCC.

In terms of the research question on the progress in effectively financing adaptation, various stakeholders expressed concerns about lack of transparency, stakeholder engagement and over-stretched staff within GCF structures. This may inhibit the ability of this politically-important institution to learn lessons from other funds or build the trust of external stakeholders. Respondents argued stakeholder engagement is vital for coordination and harmonisation, as well as sustainability and "scaling-up". If the GCF is to produce the mandated "paradigm shift" towards a climate-resilient low-carbon future, the research suggests it must pay greater attention to procedural justice.

This study was limited by time and resources constraints, and provides a broad overview of some of the main considerations for effectiveness of international-level adaptation finance.

Future studies could go into detail in analysing particular adaptation funds, such as the GEF or PPCR, using these framework principles as a framework for analysis.

10.6. Multi-Scalar Analysis: National-International and Local-International Linkages

There were many linkages between the international-level and other levels. This section explores the linkages between the international and national-level analysis, and to a lesser extent, linkages between local and international-level.

From the principles and components identified in the literature review, national ownership, coordination, urgency, adequacy, mainstreaming, stakeholder engagement and transparency of climate finance were discussed at both international and national scales. In particular, many of these critical issues were mentioned specifically in the negotiations of the UNFCCC's SCF. However, different issues received more attention at international and national-level. At international-level, the balance between adaptation and mitigation finance was a contentious debate, whereas at national-level in Bangladesh most key stakeholders supported the prioritisation of adaptation finance. At international-level, the adequacy, predictability and additionality of climate finance were particularly high on the agenda due to the perceived inadequacy of financial flows, while at national-level a certain level of finance had already been allocated to Bangladesh.

Various international-level respondents cited examples from Bangladesh, with one reflecting that the 'private sector' were not defined in Bangladesh's PPCR discussions, and another criticising Bangladesh's capacity to disburse climate finance. It emerged Bangladesh's NIE was rejected by the Adaptation Fund and since then, they have not submitted a new application. This could have implications for access to GCF funds, which involved direct access modalities. Interestingly, one of the international respondents called for sub-national direct access mechanisms, an issue mentioned at both national and local scales.

In terms of linkages of the local and national-level with the international-level, the issues of the difficulty of monitoring results, the prominent role of the World Bank, and the potential 'bias' towards structural adaptation emerged at all three levels. At international-level, the World Bank was selected as trustee of the GCF while at national-level the World Bank was overseeing the BCCRF.

International-level respondents highlighted social, resource-based, institutional, informational and structural barriers as barriers to adaptation and for scaling-up finance. Key issues emerging at local-level included barriers to adaptation relating to gender rights, land rights and local governance. However, as suggested in 9.6, these issues did not seem to be adequately considered at either international or national-scale. Subsidies and cross-border issues were mentioned as barriers at national-scale but hardly mentioned at international-level. This might suggest national and local respondents had more direct experience in implementing adaptation and were more adept at identifying barriers.

Furthermore, the local-scale case showed that whilst some protection is offered by adaptation, loss and damage still occurs. This suggests people may migrate if business-as-usual climate change projections continue, and demonstrates the importance of the emerging discussion on this issue at international-level.

10.7. Synthesis of Progress at all Scales

Following the research, an effort was made to assess the extent to which each of the criteria in the indicative framework for effective finance (see Section 7.7) was discussed at each level. Revisions to the framework were suggested in light of the evidence. The results (Chapter 8-10) explored to what extent there was progress in satisfying these criteria. This answers the research question posed in Chapter 2 in terms of what progress across scales in terms of adaptation financing. Finally, policy recommendations are to be proposed in areas in which there was less progress.

10.7.1. Discussion of framework principles at the three levels

Overall, issues of adequacy and predictability of finance, urgency and timeliness, and additionality and mainstreaming came up more at international and national-level than at local-level. However, it has to be recognised that just because a particular issue was not regularly discussed, it does not mean it is not important. For instance, local stakeholders did not discuss the adequacy of climate finance as they did not tend to have detailed knowledge about climate change, in general, or climate finance specifically. Other issues such as feasibility were perhaps not discussed by local stakeholders due to the technicality of the issue. The analysis and findings were used to guide and inform the revised framework for effective adaptation finance (see Chapter 7). Some indicators might matter more than others; this is discussed further under weighting.

Table 10.1 Discussion of framework principles at the three levels

Criterion	International	National	Local
Equity, targeting the most vulnerable			
Efficiency and cost-effectiveness			
Effectiveness in reducing vulnerability; results and monitoring results			
Urgency and timeliness			
Flexibility and robustness			
Synergy/ coherence between mitigation/ adaptation			
Gender equity			
Practicality and feasibility			
Avoiding maladaptation			
Need for transformation considered (scale, enabling environments, private action)			
Ownership and subsidiarity			
Alignment/ mainstreaming			
Additionality			
Harmonisation/Coordination			
Adequacy, precautionary, predictability			
Transparency, accountability, inclusive governance, stakeholder participation			
Sustainability			

Green = Frequently discussed, Orange = Rarely discussed/Marginal, Red = Not discussed.

This framework could provide decision criteria at fund-level or programme-level, in framing local-level programmes or as a set of exclusion criteria for determining whether a proposal is comprehensive. Naturally, other criteria would come to light in choosing between adaptation options at project-level, for example cost-effectiveness or equity. It is important to distinguish between project and option decisions. For instance, stakeholder-focused cost-benefit analysis is one tool for determining between options (Section 8.3).

10.7.2. Progress against the framework propositions at the three levels

Subsequently, an effort was made to retrospectively analyse the level of progress against the propositional statements at the three scales (local, national and international), as shown in the table below, based on a qualitative judgement using all the data and evidence obtained during the research (see Section 8.4, Section 9.3 and Section 10.3). This addresses the second research sub-question in Section 2.2. In several of the areas in which insufficient progress was identified, the discussion informed the resulting policy recommendations, which are to be outlined in the concluding chapter.

Table 10.2 Progress against the framework propositions at the three levels

Criterion	International (Section 10.3)	National (Section 9.3)	Local (Section 8.4)
Equity, targeting the most vulnerable			
Efficiency and cost-effectiveness			
Effectiveness in reducing vulnerability; results and monitoring results			
Urgency and timeliness			
Flexibility and robustness			
Synergy/ coherence between mitigation/ adaptation			
Gender equity			
Practicality and feasibility			
Avoiding maladaptation			
Need for transformation considered (scale, enabling environments, private action)			
Ownership and subsidiarity			
Alignment/ mainstreaming			
Additionality			
Harmonisation/ Coordination			
Adequacy, precautionary, predictability			
Transparency, accountability, inclusive governance stakeholder participation			
Sustainability			

Green = Satisfied the proposition, Orange = Balanced/Measurable Progress, Red = Little or none. White = not relevant/insufficient information available.

In summary, whilst there was more discussion of these criteria at the international than local-scale, perhaps due to greater familiarity with these terms, there was deemed more progress on satisfaction of the propositions at local-scale. This may be linked to insufficient information being available at the international scale. Yet, the information that was obtained at international-level (both interview and observational data) did point to concerns in relation to equity and transparency. Progress at national-level is also determined by international donors (see 9.5). It may be that vulnerable stakeholders were able to input their knowledge and experience into the local-scale adaptation finance, thus ensuring ownership and equity. Furthermore, local-level knowledge and commitment on value-for-money by implementers might be higher than at international level. However, one cannot generalise from the case studies, particularly since the local-scale case study was a CBA project, and results could be different with other case studies.

One media respondent argued; “both local and global [climate finance] is not transparent”. The study itself was therefore limited by availability of data and information on climate finance, including at the global level at UNFCCC and GCF meetings. Although ‘new and additional’ finance had been promised at Cancun, concerns were raised in both the literature and respondent interviews that this came largely from loans or re-packaged development aid, potentially limiting its effectiveness. Further detailed analysis and policy recommendations are covered in the forthcoming chapter.

10.7.3. Revising the framework

As discussed under 10.4, some interviewees were approached to provide feedback on the framework. The framework could be further adapted to include only the list of directly adaptation-relevant criteria. In addition to these suggestions, the results in chapters 8-10 can be used to revise the framework for analysis (Chapter 7) could be improved; or ascertain whether there were any criteria missing or superfluous.

Based on the prior analysis, the criteria on ‘practicality and feasibility’ can be considered as superfluous as there was little discussion on the issue at any of the scales. The criteria could also be considered as being implicit in the rest of the set of indicators. However, individual project-level decisions on adaptation infrastructure would require a feasibility study, where needed, as well as a ‘fit-for-purpose’ test to determine where implementers or applicants are well-suited.

At all scales, land tenure was an emerging issue in the results but was not incorporated into the framework. Based on these results, another additional criterion could be added to consider land-related risks. For instance, a criteria on ‘land risks’ could be included based on the proposition that to the extent that the project alters land tenure arrangements or poses risks for land-related insecurity for local communities, these risks should be taken into account. Furtermore, rather than being a separate criterion, land risks could also be incorporated under the operationalization of the equity criteria.

10.7.4. Weighting of criteria

The criteria could also be weighted to determine which criteria are most important at local-level. Decisions on local projects might have to weight some criteria higher than others, for instance, equity, cost-effectiveness, gender and sustainability. Furthermore, for ‘hard’ or structural project types such as embankments (given in Section 8.3), criteria such as practicality, robustness, cost-effectiveness and equity might matter most. At local-level,

additionality could be considered irrelevant as it is difficult to differentiate local-level adaptation from development (see Chapter 8). However, issues relating to gender and equity were particularly apparent at local-level.

At national-level, harmonisation and coordination could be particularly important as there may be several different sectors and funds working on similar tasks relating to adaptation (see Section 5.5). Mainstreaming adaptation into development has been proposed as a solution (see Section 7.3) which could be particularly welcomed at national-level. At international-level, it may be particularly important to consider issues relating to the adequacy and predictability of finance, as stakeholders highlighted the perceived importance of developed-country donors fulfilling their international climate finance obligations under the UNFCCC in order to build trust. The international-level case study gives some indication of how Parties to the COP would weigh the criteria. National ownership was particularly important for developing countries as this has been a major point of discussion in the GCF. TheThere were insufficient resources within the scope of this thesis to return to the case study areas to test these observations but this could be an area for potential future research.

Furthermore, the preferences for weighting criteria may be different for different stakeholder groups. For example, marginalised groups may particularly emphasise equity in a weighting system. There was evidence for this in the local case study (see 8.2.7) where several women interviewed were keen to discuss gender-related challenges. In weighting criteria, businesspeople might prioritise cost-effectiveness. Government officials may prioritise coordination in particular, as this is an institutional issue, but some officials might not put so much emphasis on stakeholder engagement as it requires additional resources. The weighting of criteria by different stakeholders would be an interesting topic for further research, which would require additional time and resources that were beyond the scope of this thesis.

10. Conclusions and Recommendations

The projected impacts of climate change pose significant risks for sustainable development and global food security, including availability, stability, utilisation and access to food (Schmidhuber and Tubiello, 2007). As detailed in Chapter 7, developed countries have agreed to scale-up climate finance to "USD 100 billion dollars a year by 2020 to address the needs of developing countries" (UNFCCC, 2009; Art. 8). However, it is not yet clear how these funds will be mobilised or how they can be most effective. This research thesis utilised an innovative multi-scalar and interdisciplinary approach to analyse climate finance for adaptation at global, national and local levels. Climate finance governance is occurring at multiple jurisdictional levels which interact with each other, while climate finance also involves flows of finance from international to national and local scales.

The adequacy of the existing flows of finance has been called into question. The literature review revealed climate finance volumes have decreased in recent years since the end of the fast start finance period (2010-2012). Similarly, there are concerns that fast-start finance was not additional to development aid, limiting the extent to which developing-countries can address their climate-related needs, as well as the development deficit (see Chapter 7).

Taking the local-level case of Kalapara (Chapter 8), where a community-based adaptation (CBA) project had been undertaken, it was found that climatic hazards are inter-related at local-level, making it difficult for people to prioritise between different adaptation needs. There was evidence of poverty traps resulting from climatic hazards: the cost of damage of Sidr was double an average household annual income. While interventions like constructing cyclone shelters (the first project under the national-level BCCRF) contribute to saving lives, there are clearly barriers to adaptation related to insufficient access resources. Landlessness prevented some households from benefiting from improvements in agricultural productivity. The case demonstrated the importance of local governance in ensuring the sustainability of interventions.

At national-scale (Chapter 9), Bangladesh provides an interesting case study as it suffers from food insecurity and is highly vulnerable to climate change, but has embarked on various adaptation interventions. Chapter 5 reviewed financial and policy responses to climate change in Bangladesh. The institutional set-up includes a nationally-funded Trust Fund (BCCTF) and multilateral Resilience Fund (BCCRF). There appeared to be limited progress

in addressing gender equity, maladaptation risks or in private sector engagement. However, there has been better progress in mainstreaming adaptation into development, and addressing urgent needs such as cyclone shelters, as perceived priorities aligned with local perceptions.

At international-scale (Chapter 10), the climate finance negotiations under the UNFCCC were characterised by hard (conflictive) bargaining strategies and continued divisions between developed and developing countries. In summary, developing countries were pushing for 'direct access', transparency and equitability, while developed countries were trying to generally limit their financial liability by removing references to 'adequacy' of finance, and placing the onus on developing countries to demonstrate results. The research demonstrates that the power relations exhibited in this context impact adversely on the negotiations. Transparency may be crucial for building trust between countries.

11.1. Research Questions

A number of sub-questions were asked in the methodology chapter in order to explore the primary research question: '*In what ways can climate finance across scales (international, national, and local) effectively ensure food security under climate change?'* Following on from 10.7, this chapter attempts to summarise the responses to these questions, which are answered implicity and explicitly throughout the thesis.

In terms of the first sub-question which asked *'what issues should be taken into consideration in evaluating the effectiveness of adaptation finance?'* it was found a broad range of key issues must be taken into consideration in assessing the effectiveness of climate finance (see Chapter 7). From the principles and components identified in the literature review, national ownership, coordination, urgency, adequacy, mainstreaming, stakeholder engagement and transparency of climate finance were discussed at both international and national scales. Many of these issues were mentioned specifically in the SCF negotiations at the UNFCCC (see Annex XXI). As outlined in 10.7, different issues received attention at different levels. Equity was considered crucial for effectiveness at all levels, including targeting the most climate-vulnerable stakeholders. At international-level, adaptation and mitigation finance were separate, whereas at national and local-level in Bangladesh several stakeholders identified synergies between the two priorities.

It was hypothesised that channelling climate finance in an appropriate and effective manner will be an institutional and governance challenge, as well as a logistical challenge. This hypothesis was confirmed in the national-level case study of Bangladesh, where issues of

national ownership, coordination, harmonisation and transparency appeared to be interlinked (see 9.5).

The second sub-question asked '*what progress has been made across scales (local, national, international) in effectively financing adaptation?'* Results chapters 8-10 answer this question. During the research it was found that at various scales, there was insufficient progress against certain criteria (see Section 10.7.2). Although it is not possible to generalise from these case studies, there appeared to be better progress in addressing issues of equity, gender, cost-effectiveness and ownership of adaptation financing in the local-level case study than at national or international-level (see Table 10.2). It may be that vulnerable stakeholders were better able to input their knowledge and experience into financing decisions at this level. Furthermore, more information was available in greater detail. Further research is needed to identify the unique or generalizable elements of this case study.

At national-level, there appears to have been considerable progress in addressing urgent needs (such as building cyclone shelters) and these needs were verified at local-level. There had been less progress in consideration of gender or maladaptive risks, or in terms of national ownership, as this was hindered by donors' capacity concerns. The study suggests international adaptation finance institutions like the Green Climate Fund (GCF) would do well to learn lessons from CBA initiatives and adopt bottom-up processes to better identify local or national needs.

11.2. Policy Recommendations

This section answers the final research question '*what kinds of frameworks, institutions and policies are recommended to facilitate effective adaptation financing across scales*?' In Chapter 1, the study set out to contribute to human knowledge in this field. Whilst the research did not go as far as it could have in fully examining the topic - due to time and resource constraints – the study did address three levels of analysis (local, national and international). The findings were used to inform the forthcoming policy recommendations. Overall, the research demonstrates a criteria-based framework such as the one outlined in Chapter 7 could be used to enhance the effectiveness of fund-level decision criteria or post-project evaluation.

Local engagement

As posited in the literature review (Chapter 4), local households in Kalapara tended to adapt to climate-related risks in an integrated way making it difficult to distinguish between

'adaptation' and 'development'. Due to uncertainty in climate projections, it is recommended that fund managers should assess adaptation proposals against local priorities in order to use resources effectively. At both local and national-level, local government engagement is important for project sustainability. It is recommended that national climate funds in Bangladesh engage more fully with local government, including capacity-building on financial management and DRR. Sub-national direct access to climate finance could assist in this regard, whilst national-level decentralisation could enhance local governance capacity.

Guidelines and criteria for international climate finance must not assume local stakeholders either do or do not have a preference for concrete (structural or 'hard') adaptation. The local-level case (Chapter 8) demonstrated households had an interest in 'hard' or tangible adaptation options. However, as the broken sluice-gate demonstrated, 'hard' structural measures must be backed by institutional support to enable long-term sustainability. For researchers, taking a systemic approach can help identify local barriers to adaptation.

Gender and Equity

In terms of gender equity, it is recommended that adaptation practitioners at all levels mainstream gender sensitivity into adaptation finance and planning. This could include application of gender analysis at project design stages, as well as gender-disaggregated results indicators, and participatory monitoring processes (see UNDP, 2010). In terms of equity, vulnerability indices were not being used at national-level to guide allocation of adaptation finance to the most vulnerable regions or groups. These should be used by policy-makers in future.

Ownership and Capacity at National-Level

Whilst direct access modalities have been praised for enhancing ownership, there are also challenges because vulnerable countries or groups often have a lower capacity to access funds (see 10.3.11). In Bangladesh, progress is needed in improving fiduciary standards, human resources and possibly civil service reform to ensure retention of skilled staff. Frequent travel to international conferences and workshops reduces the numbers of available in-country staff (see 9.3). It is recommended that international organisations make an effort to reduce the international travel burden on limited staff. Coordination between the BCCRF and BCCTF also remains challenging. At international and national scales, national or sub-national direct access to climate finance has been promoted. A programme of capacity-building is required to assist institutions to apply. Respondents initially suggested the GCF

should undertake a 'readiness' programme for National Designated Authorities (NDAs), and this programme is now underway.

Monitoring and evaluation

Monitoring and evaluation of adaptation initiatives are needed, but overall, a balance between oversight and flexibility is needed. Over-emphasis on monitoring of results can put a strain on limited resources. In particular, economic analysis can be burdensome, while the local-level case showed cost-benefit analysis can be simplistic because of the exclusion of non-economic factors. A flexible and stakeholder-oriented approach to cost-benefit analysis is therefore recommended (see Nay et al., 2014).

In terms of monitoring implementation, community monitoring of embankment construction is an excellent example of how to prevent corruption because community monitoring and oversight provides an evidence base for project execution throughout the project execution process. Furthermore, the analysis suggests the SLF may form a useful basis for developing metrics and indicators for measuring local-level adaptive capacity.

It is also recommended that the GCF pays attention to learning from the experiences of existing funds like the Adaptation Fund, CIFs and IFAD. Respondents expressed concerns that this is currently not happening. Since adaptation is a continuous process of learning, effective adaptation will mean learning from failures as well as successes in order to avoid maladaptation.

Mitigation and adaptation synergies

While adaptation and mitigation are divided into 'silos' at international-level, respondents at all scales suggested a need to build synergies between them, which could enhance cooperation and reduce duplication, as well as potentially increasing cost-effectiveness. At local-scale, an engineer in Kalapara noticed afforested embankments gave greater protection in the event of cyclones. Such projects (including ecosystem-based adaptation) have enhanced co-benefits, but are not prioritised at present by national funds. In Bangladesh, it is recommended the government considers integrating an afforestation element into embankment projects to enhance coastal resilience.

Multiple adaptation-mitigation synergies exist, as well as inter-linkages with global food security, for example in terms of management and enhancement of terrestrial and soil carbon. These synergies provide an opportunity to make better use of scarce financial resources. It is

recommended that bodies such as FAO, CCAFS and IFAD consider the economic, social and environmental benefits of such interface opportunities. Furthermore, there are synergetic opportunities for achievement and financing of SDGs on food security and climate change.

International funds like the GCF can benefit from enhancing adaptation and mitigation synergies. At international-level, the GCF's recent decision to allocate 50% of climate finance to adaptation "over time" (GCF, 2014b:4) is thought to have been arrived at based on principles and political expediency, rather than an evidence-based analysis of global mitigation or adaptation needs. Adaptation commitments are easier to meet from existing development aid and adaptation finance is restricted to a smaller set of activities than development aid (Klein, 2010), which could undermine adaptive capacity. Furthermore, the less we mitigate, the more we must adapt. It is therefore recommended the GCF use evidence-based research to estimate what proportion of the $100Bn commitment should go towards adaptation or mitigation, rather than making an assumption half should go to each. Furthermore, the GCF should maximise adaptation-mitigation synergies to ensure effective use of resources.

Transparency

Limited transparency within international climate finance governance could have enabled donors to avoid adequate provision of 'additional' finance. Transparency was highlighted as a cross-cutting issue at all scales. Thus, enhanced transparency on reporting and tracking climate finance is recommended, as well as clear policies related to governance to avoid corruption as this is vital for encouraging confidence in investments. In Bangladesh, criticism by Transparency International might be one reason the Government cut funds under the BCCTF (Trust, 2014). This could impact on Bangladesh's capacity-building efforts. For civil society, constructive criticism should be balanced with the need to support governmental adaptation efforts, giving them a chance to learn from failures so impacts can be monitored.

At international-level, within UNFCCC and GCF Board meetings, climate-vulnerable developing countries often failed to have their interests recognised. Enhancing procedural justice within the negotiations could enable these countries to convey their interests regarding the adequate and timely provision of climate finance, as well as building trust. It is recommended donors and civil society organisations continue to support developing-country negotiation capacity-building. Enhancing transparency at the UNFCCC could also enable

civil-society groups and media to be better informed and hence put additional pressure on developed-country decision-makers to provide adequate finance.

Additionality and adequacy

The slow progress in operationalizing the GCF may be rooted back to efforts by developed-countries to limit their financial obligations. This demonstrates the need for increased advocacy and media attention, as noted above. Diverting development aid to climate change could also limit adaptive capacity in developing countries. As well as improving tracking of climate finance as distinct from development aid, one proposed solution is for OECD countries to agree an increase their ODA from the target of 0.7% of GNI to a higher level, incorporating climate change. Mid-term targets to scale-up to $100Bn have also been proposed.

Transformational impact

The need for 'transformation' (see IPCC, 2014) demonstrates the need to mobilise private action, but civil society stakeholders expressed concerns this has become an excuse to avoid public finance obligations. However, public and private finance are not synonymous or interchangeable. Achieving the GCF's goal of promoting a "paradigm shift towards low-emission and climate-resilient development pathways" (UNFCCC, 2011b; Art. 2) will require an effective process, as well as increased volumes of climate finance. This research highlights the need for effective stakeholder engagement processes to ensure ownership by beneficiaries and ensure long-term sustainability of results. Fund managers must also ensure timely disbursement mechanisms are in place.

Overall, adaptation practices must be supported by an enabling environment (structural, regulatory or legislative environment) and the same applies to adaptation finance. The household survey showed landless agricultural labourers are a vulnerable and food-insecure group. Yet, these groups are not specifically targeted by funds focused on 'smallholder farmers' or agricultural productivity. Issues such as land tenure security, gender, and local government capacity were identified as determinants of vulnerability at local and national-level, but these issues cannot be addressed through a project or programme-based approach to adaptation. This emphasises the need for what the IPCC (2014) describes as "transformational adaptation" that is adopted at a much larger (national or international) scale. Policy-makers and development practitioners must consider structural and legal

measures that target landless groups, for example land reform or provision of enhanced social protection.

Finally, global structural barriers to adaptation, such as trade barriers, were identified in the literature review. However, interviewees from international climate finance community did not appear to have adequately considered these issues. There is a need to reconcile post-2015 goals with trade disciplines. In particular, renewed focus on the WTO's Development Round might have benefits for enhancing the adaptive capacity of climate-vulnerable farmers in developing countries. Both agricultural and fossil-fuel subsidies are cited as examples of important barriers to climate-resilient low-carbon economies which require renewed focus. To have wider, more sustainable and 'transformational' impact, the GCF must recognise the importance of broader 'enabling environments' as drivers or constraints to food security under climate change. These issues require structural, legal and/or governance interventions to enhance the adaptive capacity and food security of vulnerable groups, for example, strengthening local governance, gender equality, and land reform as a part of national adaptation planning. Transnationally, progress on reducing barriers to trade, and eliminating perverse subsidies should be taken forward by fora including the G7, OECD and WTO.

11.3. Research Limitations

As with any research, there were limitations and drawbacks. The case study methodology has particular limitations, as a small number of cases were explored from which conclusions were drawn. Thus, it is not possible to generalise to other countries or similar locations. Furthermore, time and resource constraints limited the number of observations that could be made. If the research had been extended over a longer period, it could have encompassed different geographical regions or cases. This is left for future research.

Another limitation related to data availability. Information on international and national climate finance was not always readily accessible or transparently reported. UNFCCC negotiations on climate finance were similarly opaque which limited access to information as an observer. For example, few meetings were webcast. This meant research had to be conducted using participant observation and semi-structured interviews. Another limitation was the potential for interview bias. Respondents, particularly at local-level, could have had an incentive to exaggerate the extent to which they were affected by climatic hazards with the prospect of enhancing future support. These limitations were acknowledged at an early stage and dealt with to the fullest extent possible (see Chapter 2).

To address challenges relating to local dialectical differences, it is recommended future researchers adopt the approach taken here of scoping and piloting local questionnaires prior to actual research, testing local nuances of terms such as 'climate' and 'livelihoods', as well as using local translators. Information was triangulated wherever possible. The methodological approaches were selected for the various benefits for the research, noting the trade-off with potential drawbacks, as discussed in Chapter 2.

11.4. Future Research Needs

Several interesting issues were raised during the course of the research which could not be explored further due to time and resource constraints. Interestingly, it was suggested there are maladaptation risks related to resettlement of landless people resulting from infrastructure projects. Further research is required on this issue. Emerging national-level issues like cross-border water management, land rights, micro-insurance, and local governance could also benefit from further research on 'transformational' adaptation options. At local-level, local issues dominate so further research is required in other cases to understand which issues have broader relevance.

Evidence-based research can enhance the effectiveness of adaptation finance disbursement, although, as one respondent noted, the resource and time burden of research must be taken into consideration. Furthermore, action must not be delayed by the absence of perfect data. The research suggests adaptive learning will be important for adaptation to climate change, including learning lessons from failures. Hence, further research is required to explore a broader range of case studies that appear less effective in enhancing adaptive capacity, enhancing the knowledge base for lessons for policy-makers on effective adaptation to climate change. Future research is needed explore how different stakeholders prioritise the criteria within the framework of analysis. As described in 7.7, objective tests for each indicator can be applied if sufficient information is available, for example, using cost-benefit analysis. Furthermore, the innovative multi-level methodology could be applied to other national or international funds, such as the Adaptation Fund, if data is available, which will provide useful lessons for the GCF.

Finally, further research is needed on synergies and interconnections between adaptation and mitigation to ensure the best use of climate finance. This emerged as a research gap which has not been fully considered by the international funds. Moreover, the GEF has not yet evaluated the mitigation co-benefits of their adaptation projects. With the post-2015

Sustainable Development Goals (SDGs) incorporating food security, climate change and resilience, as well as energy and water security, there are opportunities to understand how climate and development finance could contribute to multiple goals simultaneously, to enhance the effective use of finance and resources.

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Appendix:

Annex I: List of Publications

During the course of this research several publications were adapted from the material in this thesis. Relevant passages that have been adapted are clearly indicated and referenced in the thesis, and all incorporated passages were authored solely by me.

Journal Articles, Chapters and Papers published during the course of the PhD included:-

- Wright, H., Vermeulen, S., Laganda, G., Oluput, M., Ampaire, E., Jat, ML. 2014. Farmers, food and climate change: ensuring community-based adaptation is mainstreamed into agricultural programmes. *Climate and Development,* 6:4, pp.318-328, November 2014, DOI**:**10.1080/17565529.2014.965654

- Wright, H., & Chandani, A. 2014. Gender in scaling up community-based adaptation to climate change, Chapter 14, *Community Based Adaptation to Climate Change: Scaling it up*, Edited by Schipper, E.L.F *et al*, Routledge, 2014, pp.226-238. ISBN 978-0-415-62370-4

- Nay, J.J., Abkowitz, M., Chu, E., Gallagher, D., & Wright, H. 2014. A review of decision-support models for adaptation to climate change in the context of development. *Climate and Development*, 6:4, April 2014, DOI:10.1080/17565529.2014.912196

- Wright, H., & Pereira, R. 2012. A Legal Framework for Clean Technology Transfer and Finance, Chapter 4, *Environmental and Energy Law*, Makuch, K.E., and Pereira, R. (Eds). Wiley-Blackwell Publishing. ISBN 978-1405177870

- Glatzel, K., Wright, H., and Makuch, Z. 2012. Technology Innovation and the Law - the Example of Climate Adaptation Technologies, Chapter 5, *Environmental and Energy Law*, Makuch, K.E., and Pereira, R. (Eds). Wiley-Blackwell Publishing. ISBN 978-1405177870

- Wright, H. Kristjanson, P., and Bhatta, G. 2012. *Understanding Adaptive Capacity: Sustainable Livelihoods and Food Security in Coastal Bangladesh*. CGIAR Programme on Climate Change Agriculture and Food Security (CCAFS) Working Paper No. 32. Available at: https://cgspace.cgiar.org/handle/10568/24794

- Christensen, K., Sajid, R., Rubayat, A., Uddin, N., Chowdury, SA., and Wright, H. 2012. *Financing Local Adaptation: Ensuring Access for the Climate Vulnerable in Bangladesh.* ActionAid Bangladesh, September 2012.

Annex II: Theoretical Conflicts and Synergies between Adaptation and Mitigation

From the literature review, it was observed that at the global level developed countries are supporting mitigation efforts which could have detrimental impacts on the most vulnerable, for instance, if biofuel expansion leads to land grabs. In addition, agricultural development can result in slight increases in emissions that, but for reasons of equity, it is argued the most vulnerable should not be required to reduce emissions. The literature review was used to generate theoretical examples of policy inconsistences, in terms of conflicts between adaptation and mitigation, as well as synergetic examples of integrated solutions, as shown in the table below.

Level	Conflict between adaptation/mitigation	Opportunities for Adaptation/Mitigation Synergies
Global	• CDM or CSA projects that insufficiency consider local vulnerability • Large hydro dams that reduce downstream sediment deposition and thus exacerbate sea level rise • Biofuel demand impacts on food security • Agricultural subsidies in OECD countries with environmental justifications that reduce trade options for poor countries	• CDM projects with co-benefits for adaptation • Corporate strategies for supply chain sustainability • CSA projects that support the most vulnerable farmers • Green growth through international/regional trade or collaboration
National	• Mitigation costs impact on development capacities or reduce levels of ODA • Removal of energy subsidies might impact on poor (e.g. for agriculture impacts food security in short term); in long-term energy subsidies may increase vulnerability	• Climate-proofing development projects such as Hydro projects • Pro-poor mitigation policies and strategies or 'green growth'
Local	• Increased use of fertiliser/pesticides or over-irrigation for agricultural development (maladaptation) • Projects requiring vulnerable people to relocate, e.g. hydropower/land-grabs for bioenergy.	• Water and irrigation efficiency • Agricultural input efficiency/Sustainable intensification • Reducing food waste losses • Pro-poor mitigation technologies • Turning farm waste into energy • Energy-efficient stoves • AWD rice production

Annex III: Mitigation in Agriculture

In terms of mitigation, there has been particular emphasis on the production stage of the food chain. Options for agricultural mitigation include improved crop and grazing land management (e.g. nutrient use, tillage), and restoration of organic soils and degraded lands (IPCC, 2007a). Improved livestock and manure management also has significant potential (*ibid*). FAO has thus begun to promote 'Climate-Smart Agriculture' (CSA) (see 3.8). The global technical and biophysical mitigation potential of agriculture is a massive 5500-6000MT Co2e y-1, although this would never be realized in reality (IPCC, 2007a). 89% of the mitigation potential is from reduced CO2 soil emissions, 9% is from methane mitigation and 2% from N2O mitigation. In the production phase of agricultural systems, there are GHG emissions from fertiliser usage and other inputs. Fertilizer emissions are the largest single source of agricultural emissions, accounting for 38% (Stern, 2007b). Fertiliser production contributes to around 1.2% of global GHG emissions (Wood and Cowie, 2004). Livestock is the second largest source of agricultural emissions (31%), whilst wetland rice cultivation accounts for 11%, due to emissions from anaerobic digestion (Stern, 2007b).

Post-harvest GHG emissions per unit of consumption have been found to depend mainly on transport efficiency rather than distance travelled (Lybbert and Sumner, 2010). Although 'food miles' have been proposed as an indicator of food's environmental impact, and there have been calls to promote local food sourcing, studies have found transportation often makes up a small percentage of emissions in life cycle assessments (LCA) of food chains (Edwards-Jones *et al.,* 2008; Weber and Matthews, 2008). Dietary shifts away from meat products may make more difference than local sourcing (Weber and Matthews, 2008). There are also efficiencies from mass production (Coley *et al.,* 2009). Recent studies also link over-consumption and obesity with climate change (Furlow, 2013) highlighting the links between dietary choices and ecological impacts.

There is medium confidence there will be increases in agriculture emissions as diets change and population growth increases food demand (IPCC, 2007a). The share of animal products in the diet has increased in developing countries by over 5%/year from 1967-1997, whereas it remained roughly constant in developed countries (*ibid*). Conversion of plant matter into animal matter is inefficient in energy terms, with an efficiency of only ~10% (Godfray *et al.,* 2010). Currently, about 1/3 of global cereal production is fed to animals. Thus, more people could be supported from the same land area if the people adopted a vegetarian diet or lowered their meat intake (*ibid*).

Annex IV: Measuring Risk and Adaptive Capacity

Overall, risk is mathematically formulated as a function of both likelihood and impact:-

Risk = Likelihood x Impact

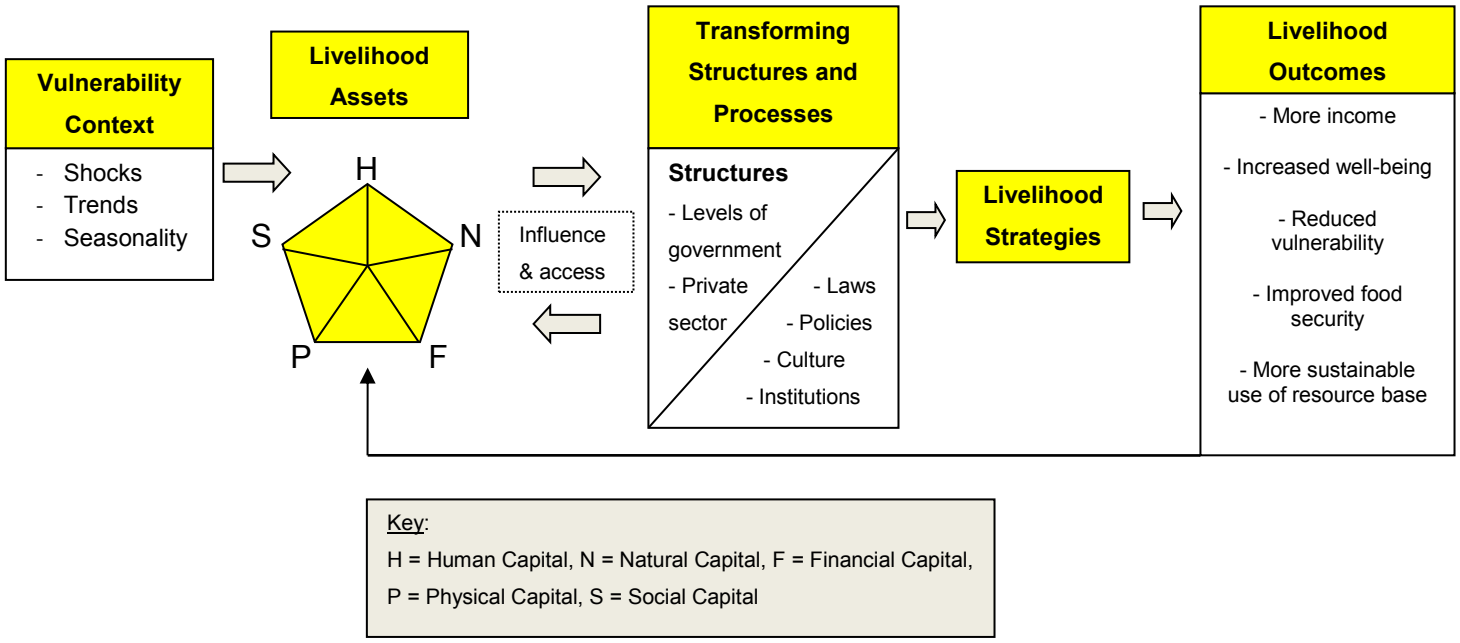
According to Luers et al (2003), one measure of vulnerability could be:-
Vulnerability = (sensitivity to stress/state relative to threshold) X prob. of exposure to stress

By contrast, the IPCC Vulnerability Index (IPCC-VI) uses the following formula:
IPCC-VI = (exposure index – adaptive capacity index) x sensitivity index
(Lamichhane, 2010).

Hence, methods to assess vulnerability vary. Lamichhane (2010) argues that the indicators used to calculate this vulnerability index can be specific to the research site and sub-components may be developed in collaboration with local people. Another method that has been used to assess vulnerability over an area is using GIS (Metzger *et al.,* 2004). In this case, the areas exposed to potential impacts are overlapped with the map of the areas with lowest adaptive capacity in order to produce a map of 'vulnerability'. An adaptive capacity index in this context can be based on a conceptual framework of socio-economic indicators, determinants and components of adaptive capacity, e.g. GDP per capita, female activity rate, income inequality, number of patents, and age dependency ratio (Metzger *et al.,* 2004). However, it can also be argued selection of these 'adaptive capacity' indicators is, by nature, somewhat subjective. It is not clear to what extent adaptive capacity can be quantitatively measurable, nor to what extent the indicators used to define adaptive capacity are cross-comparable across different locations and countries.

Annex V: Sustainable Livelihoods Framework

In the sustainable livelihood framework (below), adapted from DFID (1999), it is shown that the livelihood assets are made up of human, social, natural, physical and financial capital.



Source: Adapted from DFID, 1999.

The sustainable livelihoods concept was developed by Robert Chambers and Gordon Conway in 1991 as a basis for development programs and practices. Following on from this work the 'sustainable livelihoods approach' (SLA) was used by DFID. Knutsson and Ostwald (2006) argue that it has primarily been used conceptually. In terms of the vulnerability context, DFID (1999b) breaks the context down into the following three categories:-

1) Trends; including population trends, resource trends (including conflict), economic trends, governance trends and technological trends
2) Shocks; including health shocks, natural and environmental shocks, economic shocks, conflict, crop and livestock health shocks
3) Seasonality; of prices, production, health and employment opportunities.

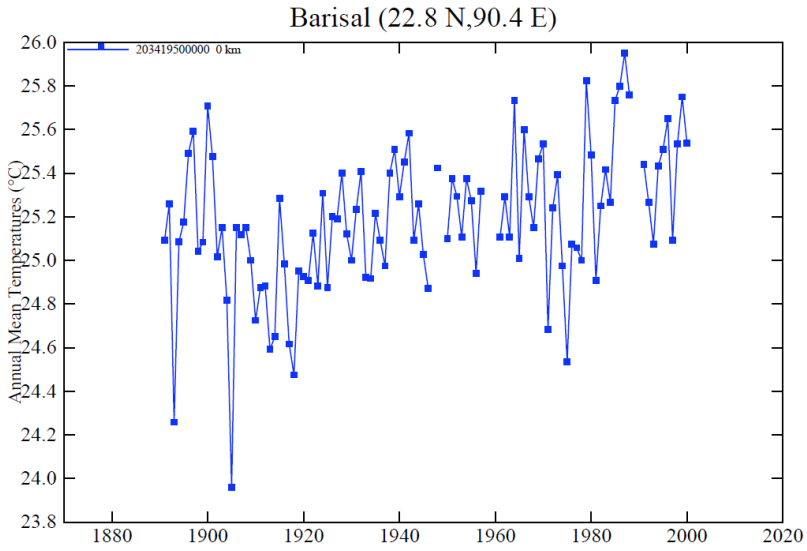
The approach identifies five main types of capital assets (Jones *et al.,* 2010; DFID, 1999b):-

Asset Type	Examples
Human Capital	Health, nutrition, education, knowledge and skills
Social Capital	Networks, connections, trust and support, formal and informal groups, common rules, collectives, extended family
Physical Capital	Infrastructure, shelter, tools, materials, energy, communications and technologies
Natural Capital	Access to land and produce, foods, water , biodiversity, trees and forest produce, vegetation, ecosystem services
Financial Capital	Savings, credit, income, pensions and wages

The vulnerability context has a direct impact on people's asset status and livelihood options and climatic change can be seen as one aspect of the vulnerability context.

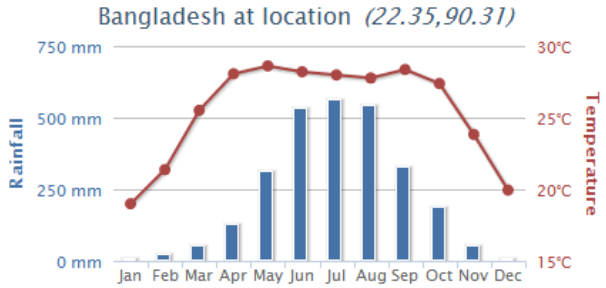
Annex VI: Observed Climate Data for Patuakhali

Historical Temperature Data (Source: http://data.giss.nasa.gov/)

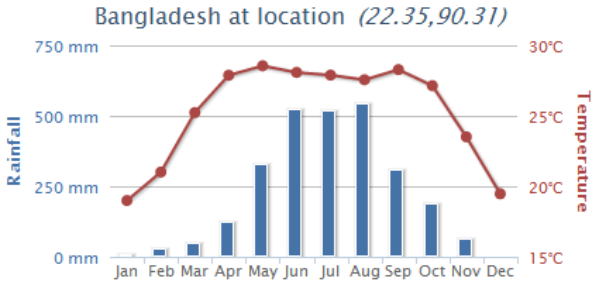


At the grid coordinates for Patuakhali (22.35 N and 90.31 E) in Barisal Division, the following data was obtained for average monthly rainfall and temperature from 1900-2009.

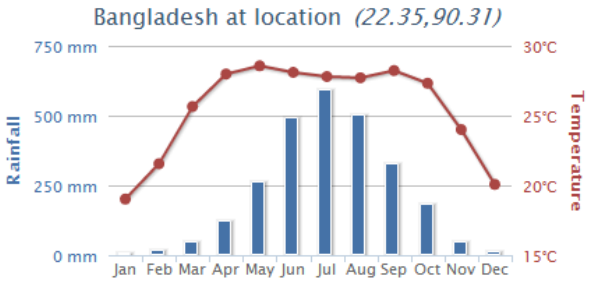
Data from 1900-2009:



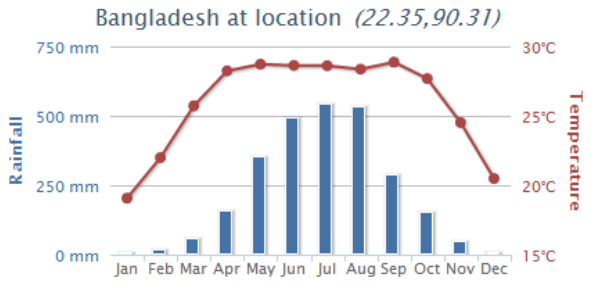
Data from 1900-1930:



Data from 1960-1990:

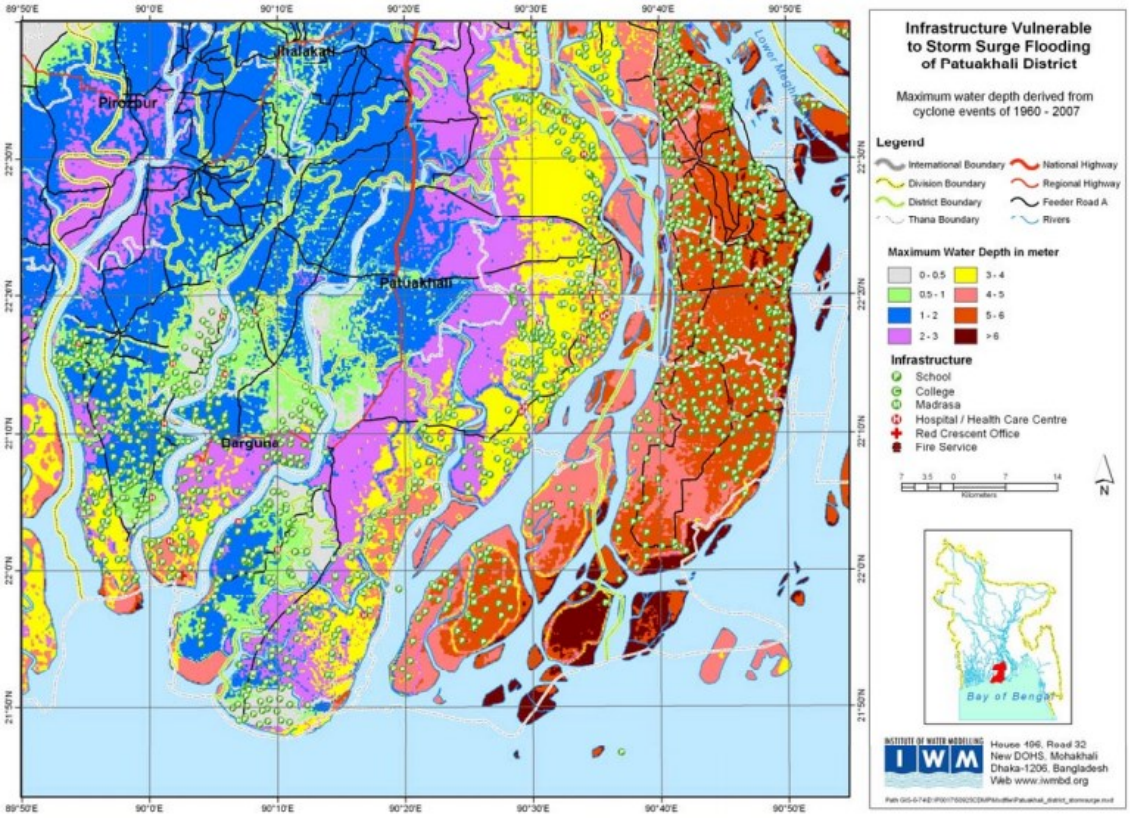


Data from 1990-2009:

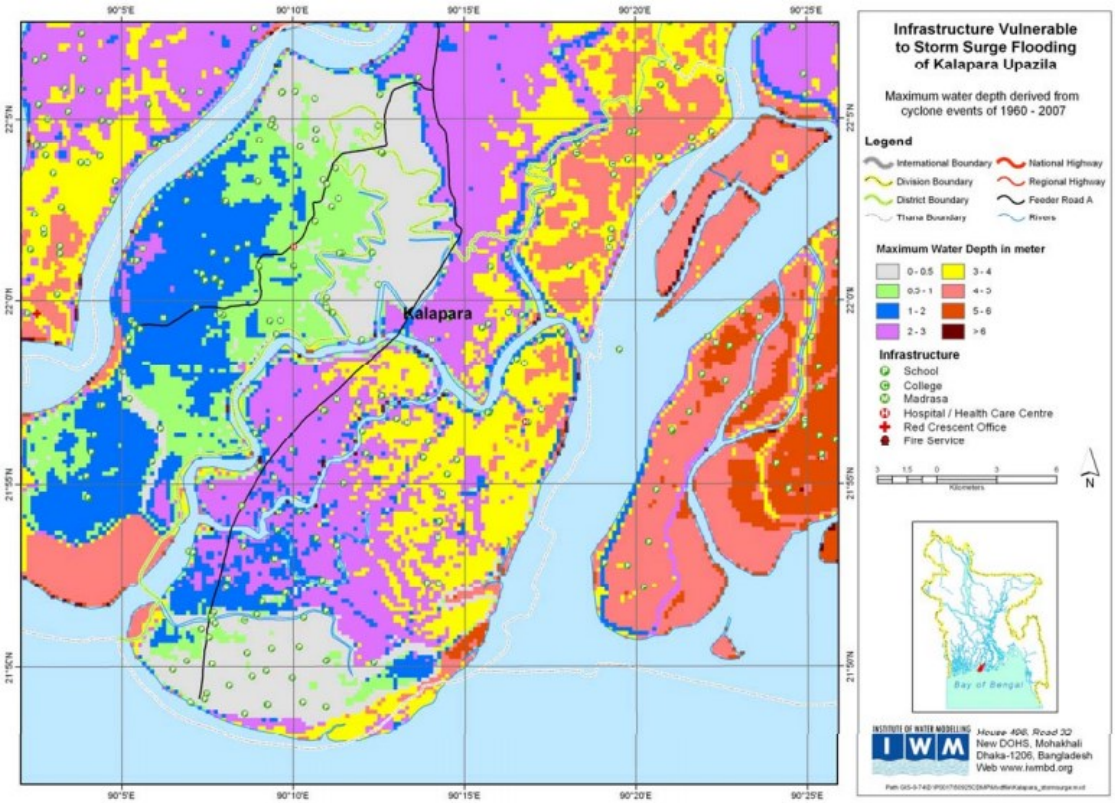


Source: World Bank, 2012

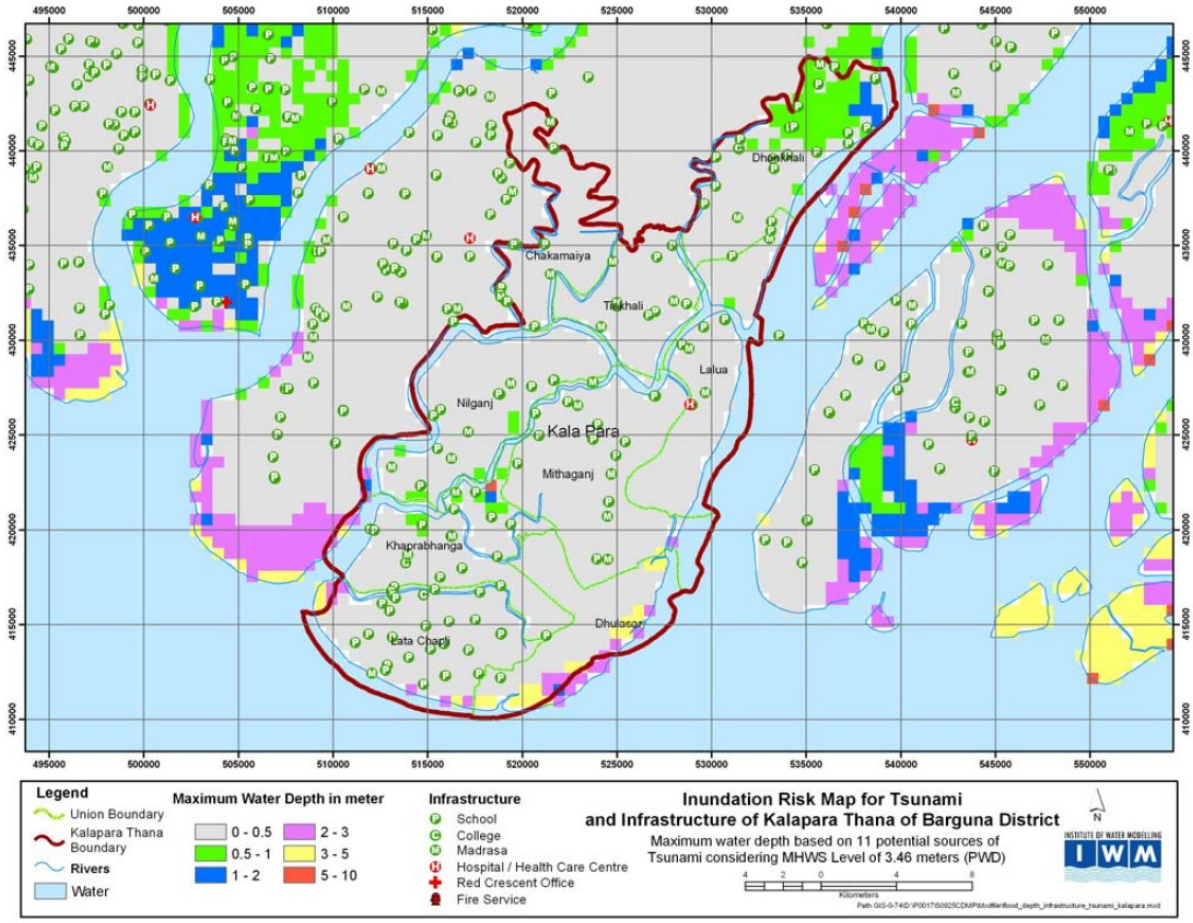
Annex VII: Vulnerable Infrastructure in Kalapara, Patuakhali



Vulnerable infrastructures in Patuakhali (Source: CDMPR, 2008)



Vulnerable infrastructures in Kala Para Upazila (Source: CDMPR, 2008)



Spatial distribution map of tsunami vulnerable infrastructures for Kalapara upazila (Polders 44, 46, and 47) Sources: http://www.cdmprm.org.bd/eq/8.pdf

During local interviews with BWDB, it was found the Polder number in the study village is Polder 47/5 Section 1.

Annex VIII: Sea Level Rise (SLR) Attribution

Shum and Kuo (2011) point out the currently observed SLR is approximately 1.8-2.2mm/ year from 1900 to the present day, higher than the IPCC's estimates, and geophysical contributors include glacial isostatic adjustment and anthropogenic effects from dams. Global SLR has been estimated by multiple-mission satellite radar altimetry (*ibid*). Khan et al (2000) found the mean tide level at Hiron Point (Sunderbans region) has shown a trend of 2.5mm/year increase in May and 8.5mm/yr increase in November, whilst in Cox Bazar there has been a positive trend of 4.3mm/yr in May and 10.9mm/yr in November. During the cyclone months of May and November, there is an increase in the sea level increment. In the region as a whole, SLR in South Asia (Pakistan and India) is reported to be about 1mm/year (Ali, 1996). The SLR (mean tide level) trend is more rapid in Cox Bazar, along the east coast, whilst magnitude of SST trend is slightly higher along the west coast.

Alam (1996) argues in the Ganges-Brahmaputra Delta, the area at the Hazipur Well was subsiding rapidly at a rate of 2.2cm/year while the Hatiya Trough, Faridpur Trough and Sylhet Trough may be subsiding at higher rates. Between 1959-82, there was a seaward growth (accretion) at the Noakhali coastline, perhaps due to increased soil erosion, deforestation or changes in the estuary circulation (*ibid*) but this accretion may also be caused by 'channel migration' meaning accreted land is offset by erosion elsewhere. The data taken from Hazipur Well showed the rate of subsidence in the basin was 2.2cm/year since the base of Holocene 10,000 years ago (Alam, 1996). The resultant rate of subsidence varies, and is found to be about 0.65mm/year around Dhaka City whereas it may exceed 20mm/year in the Sylhet trough and may be over 30mm/year at Hayita Trough (*ibid*). It is argued quantitative data can be difficult to find. Alam (1996) estimates that 1.33 billion tons of sediment discharge per year through the rivers is needed to balance the subsidence of Bangladesh, and that sediment balance is unbalanced.

Furthermore, certain records should be treated with caution, since the relative water level from some records can be contaminated by subsistence or other factors like tectonic land level changes (Watson, 2011). It is possible for gauges to be fitted with continuous global positioning system (CGPS) instruments, a precision-level technology to gain accurate data on vertical movement. The information is likely to become more accurate with further use of this technology.

IPCC data showed that in the upper range of projections, global SLR by 2050 would be 32cm, and by 2100 would be 88cm (Mohal *et al.,* 2006). Using this data, the NAPA team based at Bangladesh's Institute of Water Modelling estimated about 11% more land would be permanently inundated over the next century (Mohal *et al.,* 2006). However the model has its limitations as it is a fixed model that does not include processes of land subsidence, erosion or accretion (*ibid*). According to modelling by Tol (2007) using the FUND model, Bangladesh is one of the most vulnerable countries to SLR. 10% of the dryland in Bangladesh will be lost by 2100 which amounts to 5% of GDP (*ibid*). Wetlands in Bangladesh are more exposed, with 46% of wetland being lost by 2100. As with most studies, the study stops at 2100 although SLR will extend beyond this. The problem demonstrates adaptation and mitigation ought to be studied together.

World Bank (2010a) argue the impacts of cyclones will also be made worse by a potential SLR of 27cm by 2050. Dasgupta et al (2011) approximated 27cm of SLR and 10% intensification of wind speed by 2050. Mohal et al (2006) estimated an increase of wind speed over 10% of the 1991 severe cyclone would increase the storm surge level by 1.7m along the eastern coast of Bangladesh.

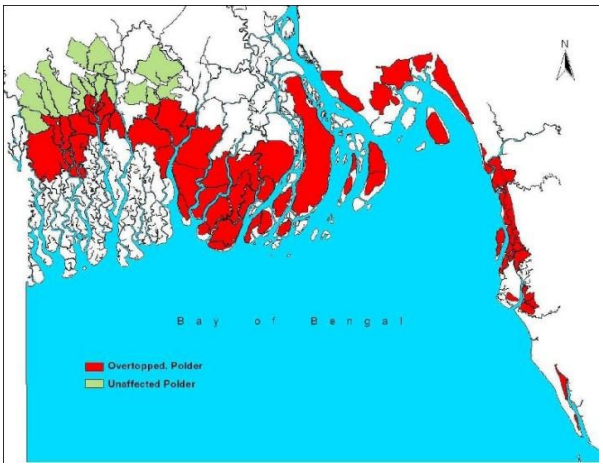


Figure showing the 33 sea-facing and 26 interior polders calculated by Dasgupta *et al.,* (2011) to be likely to be overtopped by 2050.

To identify which polders were likely to be overtopped by storm surges in a changing climate, the study used the differences between the crest level of the embankment for each polder and inundation depths projected for 2050 *(ibid*). The database of coastal polders is maintained by the BWDB.

Ericson et al (2006) found the effective SLR in megadeltas increases the populations' vulnerability to coastal erosion and land loss, combined with human pressure. They used a modelling approach to estimate the rate of SLR (*ibid*). Construction of dams and reservoirs, which intercept the suspended sediment flux, as well as groundwater extraction, decrease the net sediment load of rivers and led to land loss which is compounded by the predicted increase of SLR due to climate change (Ericson *et al.,* 2006). Crop farming and associated

erosion have actually increased sediment delivery. However, mining of aggregate for construction, as well as competition for water resources and irrigation both reduce the transport of sediment which has been a key contributor to coastal erosion. Therefore, coastal erosion is a complex process. Various factors are summarised below. 'Accelerated subsidence' also occurs due to the extraction of groundwater or petroleum which leads to compaction of sediment (*ibid*). As effective SLR increases, the delta becomes more vulnerable to cyclonic surge, salinity, inundation, flooding and erosion.

Factors leading to Coastal Erosion/Land loss	Factors leading to Seaward Growth (Accretion)
Natural subsidence due to sediment compaction	Natural growth (accretion) of sediment deposited by flowing water (alluvial sediment)
Natural subsidence of the sedimentary basin (tectonic subsidence)	Tectonic uplift/isostatic uplift (e.g. from glacial melt)
Mining of aggregate for construction	Upstream mining of aggregate leading to sediment delivery
Pressure on water resources/unsustainable groundwater use and irrigation	Channel migration as accretion is offset by erosion elsewhere
Construction of dams and reservoirs (e.g. the Farakka Dam) resulting in loss of fluvial input	Measures increasing water use efficiency so downstream river discharge increases
Local groundwater or petroleum abstraction	Deforestation (upstream) leading to sediment delivery
Measures to avoid soil erosion in farming	Crop farming and associated soil erosion leading to sediment delivery
Deforestation of coastal mangrove (e.g. to shrimp aquaculture)	Protection of coastal mangrove forest

Factors leading to land loss or gain. Source: Adapted from Ericson et al (2006), Alam (1996), Pokhrel et al (2012) and others.

The literature thus points to the range of anthropogenic and natural factors influencing coastal erosion, and effective SLR, and complexity in isolating the climate signal. The table above also offers innovative ideas for reducing some of the pressures leading to coastal erosion, such as reducing upstream dam construction and mangrove deforestation, which would counteract SLR in the face of climate change. The literature suggests that measures to encourage sediment accretion would protect against SLR, such as planting mangrove trees, since established mangroves hasten the rate of sediment deposition by forming sediment traps in their root systems (Pernetta, 1993).

Attempts have been made by economists in the realm of climate change finance to isolate the impact of climate change, and thus adaptation, from other factors in order to determine the costs. However, Watson (2011) explains the difficulty in isolating the climate signal from the range of other dynamic factors affecting ocean water levels. Costing climate change is made

difficult by the range of other environmental stressors involved. For instance, over a year the level can be affected by seasonal factors, weather systems, and variability of the ocean water temperature and salinity. Over long time scales of up to ten years, ENSO phenomenon also affects water levels. Difficulty therefore arises in attempting to isolate the climate change signal from dynamic influences, operating over different timescales and spatial scales (Watson, 2011). Longer records of over 25-60 years are recommended as guidance to eliminate such signals. Palmer et al (2007) similarly found that it was difficult to isolate the effect of climate change from other sources of variability on ocean temperatures. Other anthropogenic factors contribute to SLR, like unsustainable water use and groundwater extraction for irrigation, which Pokhrel et al (2012) argues have a greater contribution on SLR than climate change.

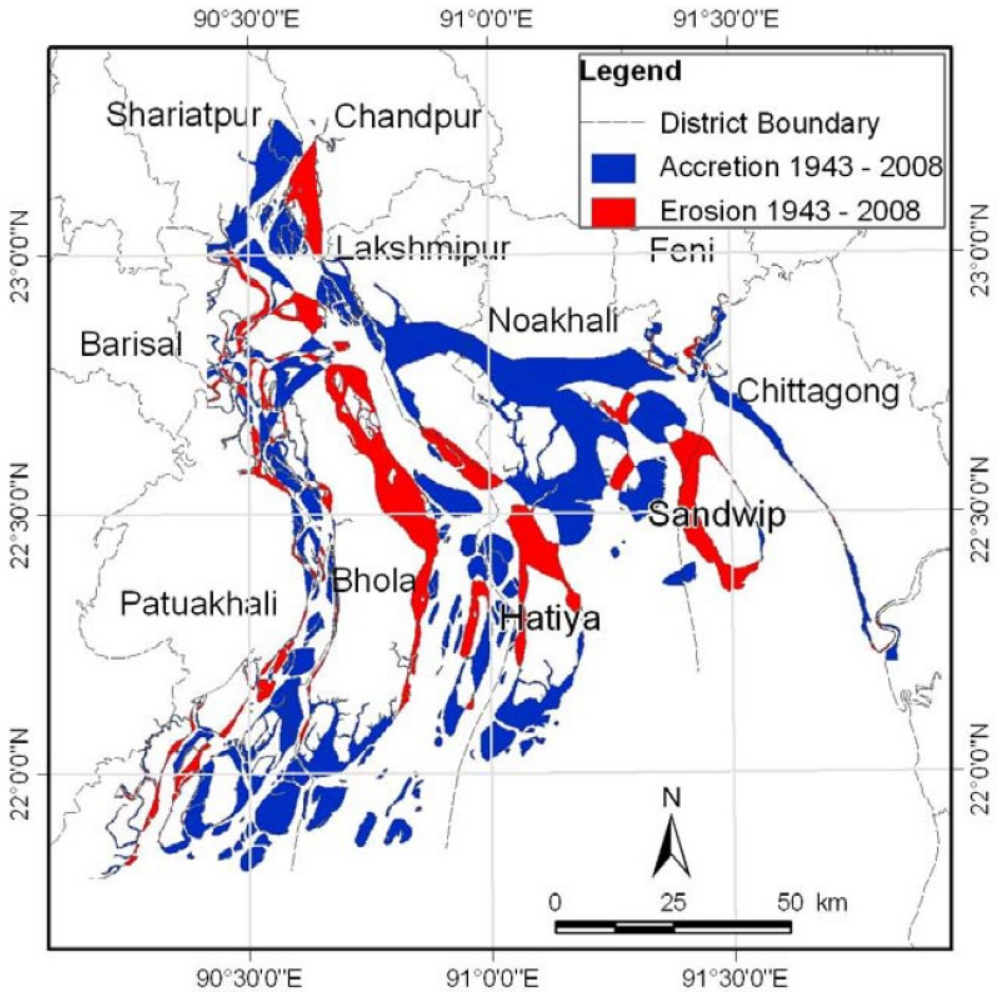
In 1990, a Bangladesh Task Force estimated sea level changes would be 90% due to SLR and just 10% due to subsidence (Ali, 1996). Ericson et al (2006) use the figure of 4.6mm/year as the mean effective SLR in Asia, but for the purposes of the model he assumed a uniform rate of subsidence in the basins. Asia has the highest rate of 'accelerated subsidence' (*ibid*) and it is found this is the dominant factor in estimating the baseline effective SLR, of which the dominant factor results from reservoirs and flow diversion which reduce the 'suspended load'. It can be difficult to disentangle the influence of climate change from that of other changes in a catchment condition but overall, "reservoir construction currently represents the most important influence on land–ocean sediment fluxes" (Walling and Fang, 2003:124). Ericson et al (2006:p76) find that, "because Asian deltas tend to be highly populated and demand for water resources is correspondingly high, accelerated subsidence resulting from groundwater extraction plays a larger role than in other regions".

Overall, SLR due to climate change is a certain percentage of the already existing subsistence level. IPCC estimates SLR will equate to 1-2mm/year, and by 2100 the global average SLR will have risen by 0.18-0.59m relative to the 1980-1999 baseline under a range of scenarios (Karmalkar *et al.,* 2010). SLR due to thermal expansion alone will be around 0.2m by 2100 under the A2 scenario (Meehl *et al.,* 2007). The A2 SRES scenario is at the higher end of the scenarios but has been described as realistic (DEFRA, 2005) and has sometimes been referred to as the baseline scenario. From 2080-2100, the rate of thermal expansion is projected to increase to 3.8 ± 1.3 mm yr–1 under the A2 scenario (Meehl *et al.,* 2007). Projected total average SLR also increases with melting of glaciers and ice caps as well as melting ice sheets, totalling 0.4m of SLR by 2090-2099 (*ibid*).

Estimates vary of the percentage of land loss and projections of the number of people affected. Milliman et al (1989) argue that due to the natural and accelerated subsistence, 34% of habitable land could be lost by 2100 due to 4.5m of SLR by the combination of factors including decrease fluvial sediment. Titus (1990) estimated that 17% of Bangladesh would be lost with 1 metre of SLR. Ali and Ahmad (1992) estimated SLR of 1.0 and 1.5 m would inundate 10% and 16% of the country, respectively. By contrast, Broadus (1993) estimated that 7% of habitable land in Bangladesh would be lost due to a 1m rise. Mohal et al (2006) estimated that 11% of land will be permanently lost to SLR by the end of the century. However, as noted above this model does not include land subsistence, erosion, accretion and other natural adaptations (*ibid*). It has also been projected that 1 metre of SLR could inundate 17.5% of the country (Salwar and Khan, 2007).

Overall, it has been estimated for the Bengal delta, 3.4 million people are at risk under the baseline SLR conditions extended from 2000 to 2050 (Ericson *et al.,* 2006). This would account for 1.78% of the population (incorporating the expected population increase). This is based on the estimate that 5.5% of the delta area would potentially be lost to climate change by 2050 (*ibid*). However, as described previously, rising sea levels may be compensated by the sediment flow from the Himalayas, and is also affected by other factors such as deforestation and intensive cultivation since the response of the delta depends on the sediment input (CEGIS, 2010). The figure below shows that the delta is highly dynamic.

Thus, since we know SLR caused by climate change is not the only factor that leads to the subsistence of land and the effective SLR, there are adaptation options which may have been previously overlooked. These may include, inter alia, preventing the effect of dams and reservoirs, reducing the unsustainable abstraction of groundwater and oil, and increasing mangrove forests and other buffering effects.



Progradation of the delta in the last 70 years. Source: CEGIS (2010)

Box: Impacts of Dam-Building on Coastal Erosion

Engineering projects can have severe environmental consequences that may have made Bangladesh more vulnerable to coastal erosion (Alam, 1996). For example, the 1960-1970's diversion of the Ganges River at the Farakka Barrage into the Bhagirathi-Hoogly river, to prevent Calcutta port from silting, led to severe consequences for South-West Bangladesh. Consequences included desiccation of tributaries, and setbacks to agriculture, fisheries, navigation and industry (Wolf and Newton, 2008) as well as problems of excess salination and reduced sedimentation (Alam, 1996). After protesting to the UN, India and Bangladesh signed the 5-year Ganges Water Agreement in 1977, however, tensions remained high and between 1988-1996 India granted Bangladesh only a portion of the Ganges flow with no special provision for drought years, until the new Ganges River Treaty was signed in 1996 (Wolf and Newton, 2008).

There is evidence that building reservoirs and dams, whilst they have advantages, are a cause of increased vulnerability to certain impacts of climate change, such as coastal erosion and land loss. Furthermore, planned reservoirs of the future indicate that the trapping of sediment will continue to be an issue (Ericson *et al.,* 2006). There are policy consequences for adaptation, since the adverse consequences of dams and reservoirs, as well as irrigation systems may come to outweigh the advantages and result in maladaptation. There are transboundary implications, as Bangladesh may be highly vulnerable to hydropower development in Nepal.

Case Study of Tipaimukh Dam – Exacerbating severe climate consequences?

Despite the historical experience of the results of upstream dam-building on downstream communities in Bangladesh, India is proposing and going ahead with building a dam at Tipaimukh, on the Barak River. The dam was initially proposed to curb flooding nearby, but hydropower capacity of 1500MW was later added. Political tensions have increased since it was reported India did not initially share the proposed water data and impact assessment with Bangladesh (Khalequezzaman, 2012). In fact a prior legal agreement between Government of Manipur and National Power Corporation of India Limited stated that no barrage or diversion would be built on the Barak River. It is arguably a violation of the UN Convention on International Watercourses for India not to provide data on their plans (Al-Mahmood, 2012) but India itself is not a signatory to that agreement.

The EIA in India reported the dam would reduce flash floods by controlling river flow in the monsoon by 30%, and increasing flow by 110% in the dry season but other experts in Bangladesh warn the opening of sluice gates in a severe flood, to save the dam, would have disastrous impacts (Al-Mahmood). Increasing the water flow during the dry (rabi) season could mean wetlands are not drained and instead become water-logged (*ibid*). In the rainy season, sluice gates are likely to be opened to protect the dam, increasing the impact of flash floods on downstream communities (Saikia, 2012). This may have consequences for agriculture, particularly in Sylhet where Boro rice is important for food security. Therefore, such dams may exacerabate problems for Bangladesh. Concern has continually been expressed by downstream communities.

In addition, the river carries sediment that is essential for the process of growth (accretion) of the flood plain in the face of rising sea levels (Khalequzzaman, 2012). Indian authorities have repeated assurances that they will not take steps that harm Bangladesh. However, it is unlikely that the impact of the dam on retaining sediment could be alleviated, and this has impacts on coastal erosion due to reduced sediment load of the river (Al-Mahmood, 2012). Impacts on fisheries and groundwater are also possible. Graf (2005) argues large regulated rivers can lead to a simplified geomorphology with less diverse ecosystems. Experts have argued dams reduce the natural ability of rivers to adjust to and absorb disturbances, and therefore basins impacted by dams could be more vulnerable to the impacts of climate change (Palmer *et al.,* 2008).

Annex IX: Flood Risk Management in Bangladesh

Bangladesh experiences regular flooding, which inundates 20.5% of the country annually on average and can reach 70% in extreme cases like the 1998 floods (Mirza, 2002). The 1998 flood caused an estimated $2-2.8Bn of damage; including 2.2-3.5m tons of crop damage which cost directly 5.5% of agricultural GDP and 1.5% of total GDP (with indirect effects of about 10% and 3% respectively) (Mirza, 2002). The impacts of sea surface temperature (SST) and sea level rise (SLR) due to climate change are projected to increase the flood risk area in Bangladesh. Karim and Mimura (2008) find that for a 2°C SST rise and 0.3m SLR there would be 15.3% increase in the flood risk area. The newly identified high risk zone (HRZ) would require an additional 320 shelters to protect people during extreme cyclonic events (*ibid*). For the Meghna basin (Eastern Bangladesh) the probability of a 20-year flood

occurring increases tenfold under 6°C of warming in the HadCM2 scenario (and a 20-year flood causes about 1.51m tons of crop damage) (Mirza, 2002).

Whilst embankments have been proposed to protect against flood, dams and levees can also increase vulnerability in the event of a breach during flooding (IRN, 2007) and thus it has been argued it is better to take a 'soft' approach to flood risk management, by slowing the river flow, in contrast to building 'hard' infrastructure for flood control. Wetlands can play an important role. In the Bengal delta 'normal' seasonal flooding has important benefits for ecosystem services including replenishment of the wetlands with nutrients. In Bengali, there is a distinction between the 'bonna' (abnormally severe floods), and the more frequent rainy season floods or 'barsha' which Bangladeshi villagers do not consider a threat, but rather a necessity (*ibid*). The English word 'flood' offers no distinction between these terms.

Historically, the BWDB is responsible for flood and salinity management, including construction of embankments. The BWDB was established in 1972 when the East Pakistan Water and Power Development Authority was split into two agencies (Salahuddin, 1995). After the severe flooding of 1987-88 it was recognised most of the flood control projects had failed to protect their area due to lack operation and maintenance (O&M), including lack of resources or systems for maintenance (*ibid*). Arguably, this was a problem facing both large and small-scale projects. Salahuddin argues that water sector investments in Bangladesh are primarily donor-driven and donor-dependent, thus, until the 1980s, the necessity of subsequent O&M was not a priority agenda, as donors focused on construction alone. There was also an absence of beneficiary participation in the form of mobilizing resources or active participation in systems operation and maintenance (Salahuddin, 1995). Originally, sluice gates in the coastal zone were managed by a 'khalasi' who was in charge of operating the gate but in most cases there is no longer any khalasi in charge (*ibid*). The East Bengal Embankment and Drainage Act (1952) states: 'sluices constructed in any public embankment shall be opened or shut only by or with the general or special of the Engineer or of the officer in the immediate charge' (*ibid*). Thus, it seems the top-down post-colonial governance structures did not leave any scope for decentralised governance in water management, and had not adequately considered maintenance of the water management structures.

Flooding has serious consequences for food security where it destroys crops. For example, the flooding of July/August 2007 affected some 11.4 million people and damaged 13% of the total rice crop in Bangladesh (FAO, 2008a). Crops are also affected by cyclones. However

floods are also involved in soil fertility of the alluvial soil as described above, as long as the deposit is not saline. This is why exclusion of river-borne sediment by embankments has been argued to be a potentially negative impact of flood control in Bangladesh (Hirst and Ibrahim, 1996).

Ahmad and Ahmed (2003) point out that existing flood warning and forecasting capacity would be greatly improved if data was available from upstream areas within the Ganges-Brahmaputra-Maghna catchment area with greater regional cooperation. The effects of increased SLR may also impact on riverbank erosion in Bangladesh, which combined with flooding could reduce the land available for crop production.

Box: Bangladesh's Flood Action Plan' (FAP)

The World Bank-coordinated project in 1988-89 called for 'hard' flood control but this could have caused displacement of people and damage to fisheries, so the plan was scrapped in favour of a process emphasising 'flood management' (IRN, 2007). Boyce (1990) questioned the wisdom of a 'structural solution' on environmental, technical and social grounds. The original plan was developed by French engineers and would have involved construction of tall embankments along the rivers costing $5-10bn (*ibid*). It was supported by the construction firms set to benefit from contracts. Softer 'flood management' measures were argued to be preferable, especially since the sudden failure of embankments can expose people living in protected areas to catastrophic floods (Boyce, 1990). Silt carried by floodwater plays a vital role in soil fertility and drought can be worse for rice farmers than flooding (*ibid*). As noted previously, building barrages also reduces the sedimentation rate resulting from sediment delivery, thus potentially increasing the severe impacts of SLR which increase coastal erosion, land loss, salinisation and other harmful effects.

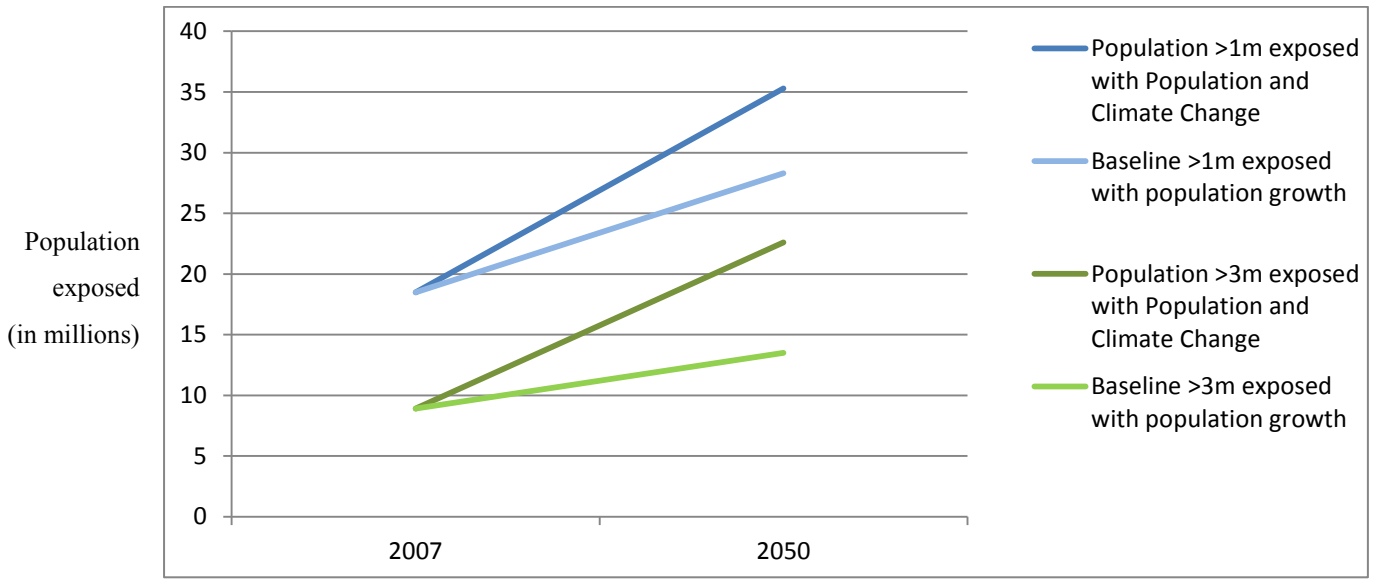
Furthermore, Brammer (2010) argues damaging flooding in Bangladesh is primarily caused by heavy rainfall at a time when rivers are running at high levels. Brammer questions the purpose of these embankments when the land behind them remains flooded in heavy rainfall. There were many social, institutional and economic barriers to the top-down FAP approach (*ibid*). 'Flood management' therefore became prevalent, and the FAP evolved into a softer 'controlled flooding' approach instead of total flood control (Weibe, 2009). Civil society groups challenged the concept that major rivers could be embanked sustainably despite their large sediment loads. There was eventual acceptance of the need for people's participation and these concepts were largely enshrined in the National Water Policy of 1999 and subsequent National Water Management Plan (*ibid*).

Population Pressure and inundation

Benson and Clay (2002) argue that due to population pressure, farming and other economic activity has been pushed onto much more marginal and sub-marginal land, where large numbers of people, particularly the poorest, are continuously exposed to the risk of crop damage, and loss of lives. This particularly concerns the unstable 'chars' which are temporary lands adjoining the major rivers which are formed by accretion of sediments.

Bangladesh's population is expected to increase by 130 million over the next 50 years (IPCC, 2007). Therefore it may be feasible to argue whether population pressure is a greater threat than climate change in some areas.

According to modelling from World Bank (2010a) on inundation risk exposure, it was found using GIS mapping that 18.5 million people are currently exposed to more than 1m of inundation during tropical cyclones and storm surges. Under the baseline scenario, with population growth this will increase to 28.3 million by 2050 (53% increase) (*ibid*). Climate change will increase this to an estimated 35.3 million by 2050 (*ibid*). Therefore, the impact of baseline population growth on vulnerability to inundation of 1m is higher than the impact of climate change. The exposure under projected population growth and under climate change alone has been placed in the graph below.



Graph to show the effect of population growth and climate change on the 18.5m people that are currently exposed to more than 1 metres of inundation (top two lines, in blue) and the 8.9 million people expose to 3 metres of inundation (bottom two lines, in green), using data from World Bank (2010a).

Annex X: Cyclones and Storm Surges in Bangladesh

Climate change increases the risk of storm surge inundation for two reasons; firstly because surges are elevated by rising sea levels due to thermal expansion and ice cap melt, and secondly because the warmer ocean intensifies the cyclone activity and heightens storm surges accompanied by strong winds (Dasgupta *et al.,* 2010). Bangladesh is particularly vulnerable to storm surges due to the high tidal range, shallow continental shelf, highly dense population and the triangular shape of the head of the Bay of Bengal (*ibid*). Storm surges of more than 10m are not uncommon in the area.

Sea level rise also combines with storm surges to make the population more vulnerable. Up to 2050, Ericson et al (2006) found that SLR increases the delta population exposed to storm surges from 44.9% to 47.3% and the area flooded from 47% to 49.8%; which seems like a small percentage, but represents an additional 4.7 million people living under conditions of vulnerability.

Dasgupta et al (2010) run a hydrodynamic model incorporating SLR of 27cm and 10% increase in wind speed. The results indicated by 2050 there would be a 69% increase in the vulnerable zone with 3m inundation and 14% increase in the vulnerable zone with 1m inundation (*ibid*). The estimates found 8.06 million people in coastal Bangladesh are vulnerable to storm surges greater than 1m and this will increase by 68% with population growth by 2050 without climate change, and 110% with climate change and population growth in absence of adaptation. The model also incorporated assumptions of 1% population growth p.a. and 6-8% GDP growth/year.

About 5-6 cyclones form over the Bay of Bengal and the Arabian Sea each year, and May, October and November are the most stormiest months (Khan *et al.,* 2000). It is also estimated 49% of the world's total deaths due to cyclones occur in Bangladesh (Khan *et al.,* 2000; Ali, 1996). There is grave concern that the frequency and intensity of tropical cyclones may increase as a result of climate change, especially sea surface temperature rise. The development of tropical cyclones is dependent on a warm ocean surface of over 27°C (Khan *et al.,* 2000). This occurs because as the SST rises, the saturation vapour pressure increases so more water vapour and latent heat are available. There is also a positive relationship with the maximum wind speed of the cyclones, and thus cyclone intensity. Ali (1999) also notes that the cyclonic storms and severe cyclonic storms show a 40-year oscillation period, although the reasons for this oscillation pattern are not clear, and there was a last peak in

1970 after which time the Bay of Bengal experienced a decreasing trend. Thus long time periods are needed to analyse the trends.

Ali (1999) calculated that the maximum surge height of the April 1991 cyclone was about 7.6m. Based on the effect of increased SST leading to a corresponding increase in cyclone intensity and wind speed, it has been calculated that, without including the effect of SLR, the surge height increases by about 21% and 49% respectively for 2 and 4°C, so would be over 3 metres higher under 4°C of warming (*ibid*). Previous simulations of storm surges were done by using a small set of historical storms and adding a mean sea level or increasing wind speeds by 10% to account for climate change, but the IPCC argues these methods may have used a biased set of storms and led to unrealistic projections (Meehl *et al.,* 2007).

There has been a recent increase in the frequency of intense tropical cyclones affecting Bangladesh with the highest positive trend occurring in November (Khan *et al.,* 2000). There has also been an intensification rate of the cyclones reaching the severe cyclone stage in November, which are increasing at the rate of 20% per hundred years (*ibid*). More disturbances have been reaching the 'severe' cyclone stage so the frequency of severe cyclones increased faster than weaker cyclones. Singh et al (2001) found by studying 122 years of tropical cyclone data (1877-1998) there has been an increase in cyclones in November and May. The highest increase has been in November where there has been a statistically significant twofold increase in frequency over this period (*ibid*).

Naidu et al (2011) explain Bangladesh has seen an increased cyclogenesis trend in November and May. The upward trend in tropical cyclone power dissipation index values is at least partly anthropogenic. Global climate models suggest an increase in intensities of tropical cyclones, though there may also be a decrease in frequency (*ibid*). Overall, Naidu et al (2011) find the SOI (Southern Oscillation Index) in April shows a signification positive relationship with cyclonic activity over the Bay of Bengal whereas NAOI (North Atlantic Oscillation Index) shows an inverse relationship. In the Global Warming era (taken as post-1970) there has been increase in NAOI and relaxation of SOI which has reduced the frequency of cyclonic systems in the summer monsoon season and likely reduced the summer monsoon rainfall on which agriculture is dependent. The IPCC also stated there was no significant change in cyclone frequency, but a large increase in the frequency of the highest storm surges (Meehl *et al.,* 2007).

About 60% of the storm surges hit the central coastal area of Bangladesh including Patuakhali, Barguna, Bhola, Barisal and Noakhali district (Uddin, 2012). Cyclone Sidr in 2007 caused an estimated $437m loss of damage in agriculture - about 90% of the total productivity of the sector (GoB, 2008).

Annex XI: Examples of Social Impacts of Climate Change in Bangladesh: Migration and Health

Impacts of Climate Change on Migration

Migration has been argued as a potentially severe impact of climate change, particularly since events such as flooding and climate-induced extreme weather events have increase displacement both within Bangladesh and neighbouring India. Roy (2011) argues there are no clear indications about how the issue of population displacement problems will be addressed in Bangladesh's policies on climate change; and that internally displaced persons are not adequately protected by existing legislation. Furthermore, environmental migrants to India face further challenges (*ibid*). However, it is argued that environmental migration also needs to be seen in the context of changing economic opportunities, urbanisation, rising aspirations of the rural poor, rules on land inheritance and an on-going process of land alienation (IPCC, 2007; Abrar and Azad, 2004).

McAdam (2012) argues the migration in Bangladesh does not live up to the alarmist predictions, as more migration is likely to be internal rather than cross-border, and furthermore migration may also be a means of adaptation with potentially positive benefits for human security, especially where it is able to be planned. The biggest cause is riverbank erosion and around 70% of those affected are landless, whilst the onset of cyclones means the migration is usually cyclical rather than linear in nature (*ibid*). The legal options available may include 'mainstreaming' of migration into policy, viewing it as an acceptable form of adaptation which may require the provision of planned rights-respecting resettlement schemes, and provision of lawful migration pathways involving participation of those affected (*ibid*).

Climate Change and Health in Bangladesh

There is also evidence that climatic events such as flooding and droughts can affect susceptibility to disease and health problems (IPCC, 2007; IPCC, 2014). Temperature and

salinity factors can impact on the concentration of cholera bacteria in water bodies. Floods and drought can also affect human exposure to pathogens such as cholera as sanitation is affected. Analysis of records from the International Center for Diarrheoal Disease Research in Dhaka found that the interannual variability of cholera coincides with the ENSO phenomenon in the region and identified a lag of 11 months between ENSO and cholera (Pascual *et al.,* 2002). Overall, in the highlands, cholera peaked during the monsoon, whereas in lowlands the opposite was the case (*ibid*). This may be because rainfall can also reduce cholera cases by diluting the concentration of the pathogen in aquatic environments (Pascual *et al.,* 2002). Lower salinity and decreased pH were found to provide unfavourable conditions for pathogens (*ibid*). Thus there is also a link between water salinity and disease.

Moreover, rainfall variability and increased temperatures have both been found to increase the incidence of hospital visits for non-cholera diarrhoea in Bangladesh (Hashizume *et al.,* 2007). The increased incidence in cases of diarrhoea was particular high amongst vulnerable individuals with a lower education levels, and those with a lower sanitation status (*ibid*).

It is also possible for climate stress to have an impact on food quality and crop nutritional value (DaMatta *et al.,* 2010; Porter and Semenov, 2005). Salinity stress frequently induces an increase in Na and Cl concentrations, but can cause a decrease in Potassium or Calcium levels (Lutts *et al.,* 1996). CO2 enrichment can lead to a reduction of grain protein in rice, wheat and barley, ranging from 10-15% of the value of ambient CO2 (315-400ppm) (DaMatta *et al.,* 2010). For rice, which is important for Bangladesh, there is an estimated 9.9% reduction in protein when grown at elevated CO_2 (540–958 μmol mol^{-1}), reflecting expected concentrations in 2100 (Taub *et al.,* 2008), which has implications for nutritional health. However elevated CO2 can also have some positive effects (*ibid*). There is a scarcity of research on this area and this would require further research.

Annex XII: Examples of Adaptation Options in Agriculture

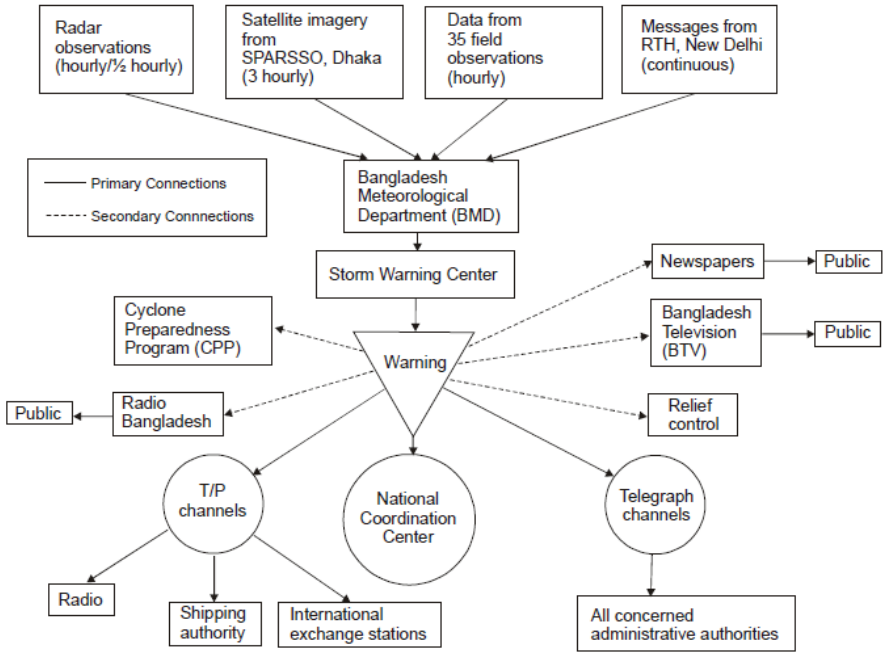
Sample adaptation options in the agriculture sector	**Profits/hectare *(ibid)***
Adaptation Option:	
1. Zero or minimum tillage to cultivate potato, aroid and groundnut with water hyacinth and straw mulch	$2068/ha (potato)
2. Zero-tillage cultivation of mashkalai, khesari, lentil and mustard	$631/ha (lentil)
3. Modified sojan system (zuzubi garden) with vegetable cultivation in char land	$3605/ha
4. Floating bed vegetable cultivation	$3867/ha
5. Cultivating foxtail millet (kaon) in char land	$365/ha
6. Parenga practice of t. Aman cultivation system	$413/ha
7. Relay cropping of sprouted seeds of aman rice in jute fields	$400/ha
8. Raising vegetable seedlings in polythene bags homestead trellises	$3781/ha
9. Zero-tillage maize cultivation	$435/ha
10. Chickpea cultivation using a priming technique	$463/ha
11. Supplementary irrigation of t.aman from mini ponds	$343/ha
12. Year-round homestead vegetable cultivation (20 decimal area)	$212-283
13. Pond-water harvesting for irrigation to cultivate rabi vegetables	$2021/ha
14. Sorjan system for cultivating seasonal vegetables, fruits and fish	$4541/ha

Adaptation options in agriculture. Source: Yu *et al.*, 2010

Annex XIII: Bangladesh Cyclone Preparedness Programme (CPP)

Bangladesh's cyclone preparedness programme has been recognised worldwide as a good example for disaster preparedness, as has been credited with saving thousands of lives during cyclones. Since inception in 1973, the project developed an early warning system (EWS) based on volunteers at village-level. In the system, meteorological data are collected from the Bangladesh Meteorological Department (BMD), which issues regular bulletins that are transmitted to the six zonal offices and the 30 upazila (sub-district) offices over high frequency radio (UNFCCC, 2013a). The upazila office passes it to unions through very high frequency (VHF) radios so that the unit team spreads out in villages and issues cyclone warnings (*ibid*). Each unit serves one or two villages with a population of around 2,000-3,000 people. The unit team leader and volunteers spread out in the villages and disseminate the warning door-to-door, including using megaphones, sirens and public address systems (IAWE, 2013). The EWS is now a collaboration between the Bangladesh Red Crescent Society and the GoB. The success of the system is demonstrated by the fact that although almost 300,000 people died during the 1970, with a wind speed of 224km/hr, only 3,363 people died during cyclone Sidr in 2007 which hit with a speed of 223km/hr (WMO, 2009).

The regulatory framework which supports the Bangladesh CPP includes the policy for the Cyclone Preparedness Programme which was enacted in July 1973 (WMO, 2009). In 2010, this was followed by the Draft of the Disaster Management Act, which provides the legal basis for the activities and actions undertaken during disasters, and the Standing Order on Disasters which describes in detail the roles and responsibilities of different committees, ministries and organisations in disaster-related organisations (*ibid*). The National Plan for Disaster Management is another related plan incorporating public awareness building and development of planning procedures from government to grass roots levels (*ibid*). It is evident that the EWS was in place before these laws, except for the CPP policy.



CPP information dissemination channels (from Haque, 1995 cited in UNEP, 2010)

In 2002, the finance for CPP was 54% funded by the GoB (WDR, 2002) with the remainder funded by IDRC. Local communities do not have to contribute to the running costs but do raise funds for the management and maintenance of cyclone shelters (*ibid*). In 2002, it was estimated the Red Crescent cyclone shelters costed around $78,000 to build and accommodated 1500 people, plus annual maintenance of about $780, so assuming these last 10 years there is a cost of less than $6 per head for each year of protection (*ibid*).

Annex XIV: The Climate Public Expenditure and Institutional Review (CPEIR)

The Climate Public Expenditure and Institutional Review (CPEIR), finalised in 2012, was undertaken to review the policy, institutional and financial management arrangements of agencies involved in climate-sensitive activity in Bangladesh, with a focus on adaptation. The study suggested strengthening of capacity and institutions should be focussed on the key mechanisms of climate finance delivery within government, namely the Finance Division, Planning Commission and technical functions associated with delivery of the BCCSAP (CPEIR, 2012). The institutional architecture to promote accountability has been identified as a central aspect of a 'Climate Fiscal Framework' that could be put in place. The MTBF (Medium Term Budget Framework) is presently being strengthened and deepened through a financial reform project under the Finance Division (*ibid*).

In relation to capacity issues, the need for increased human resource capacity in key ministries was highlighted. However, "whilst there is general agreement about the diagnosis, there is very little evidence yet of a coordinated prescription for action in respect of climate change skills" (CPEIR, 2012:60). Secondly, on institutional capacity, it was argued building capacity takes time. The Planning Commission is well equipped to assess projects and also coordinate effort across Government and the Finance Division has made good progress in recent years (*ibid*). Particular capacity issues were highlighted at the MOEF (Ministry of Environment and Forests), as it "does not have a track record as a spending ministry", and "the convening capacity of the MoEF is limited in part because it is not a high-ranking ministry represented in Cabinet" (CPEIR, 2012:61). The problems of frequent moves of key staff, and of externally-funded projects relying on consultants were both highlighted as these undermine processes of building organisational learning and institutional memory (CPEIR, 2012). In addition, Bangladesh's high-profile internationally ironically meant key staff were often "going or gone" to climate change meetings outside the country (*ibid*:61). Furthermore, the CPEIR study highlighted donor capacity issues. Comparatively few donors operate on a wide scale in Bangladesh, and most operate in well-established niches with their own various ways of working with governance and accountability challenges (CPEIR, 2012). It was argued donors are also grappling with problems about how to spend their money wisely (*ibid*).

Emerging challenges related to a competitive policy environment in which resources have been shifted to the power sector, with an increased in allocation under the Annual Development Programme of 33% between 2010-2011 and 2011-2012 (*ibid*). According to the

World Bank, power shortages pose a long-term risk for Bangladesh, with the cost of electricity shortages as much as 2 percentage points of annual GDP growth (World Bank, 2008). This creates a dilemma and potential conflict between mitigation and adaptation objectives. Government currently plans to reduce reliance on natural gas for power, and shift towards coal for both power generation and brick kilns, so it is understood a National Coal Policy is being developed (CPEIR, 2012).

Annex XV: Review of Related Policies in Bangladesh

There are a range of national policies, plans and programmes in Bangladesh that could be affected by climate change (Haque and Haque, 2009; Karim, 2011; Mallick *et al.,* 2012). Karim (2011) noted the following policies that are relevant for the agriculture sector in Bangladesh and thus for adaptation in agriculture:

- National Agricultural Policy, Ministry of Agriculture, 1999 following from the New Agricultural Extension Policy, 1996. National Agriculture Policy 2010 (draft)
- National water policy, Ministry of Water Resources, 1999
- Environment policy, Ministry of Environment and Forest (MoEF), 1992
- Land use policy, Ministry of Land, 2001,
- Coastal zone policy, Ministry of Water Resources, 2005
- National fisheries policy, Ministry of Fisheries and Livestock, 1998.

The National Agricultural Policy (NAP) of 1999 does not specifically mention climate change and its impact on agriculture, though 'environmental vulnerability' is mentioned. Under section 3.5, irrigation in drought-affected areas is noted as protecting against poor rainfall, while section 9.1 refers to target-orientated research and extension (Karim, 2011). Furthermore under section 1.5 it is recognised "agriculture is dependent on the vagaries of nature and is risky" (NAP, 1999). Section 2.1 identifies the objective of reducing "excessive dependence on any single crop to minimise the risk" as well as "environment-friendly sustainable agriculture (NAP, 1999). In 2003, the Plan of Action on NAP reviews NAP and its implementation, whilst the Actionable Policy Brief (2004) prioritised immediate medium and long-term policy measures with a view to increasing productivity (Mallick et al 2012). In a related initiative, the National Jute Policy (2002) aimed to keep jute production at desirable levels and accelerated privatisation of jute industries (*ibid*). The new National Agricultural Policy drafted in 2010 does recognise climate change specifically under sections 1.9 and 2.4, and "sustainable agriculture adaptive to climate change" is a specific objective under section 3.2 (NAP, 2010). Furthermore climate change is a focus for research under 4.3.3 and 4.6.2 (NAP, 2010). The National Agricultural Extension System, as articulated in the **New Agricultural Extension Policy** of 1996, is also closely linked to agricultural adaptation. The Department of Agricultural Extension (DAE) developed a Strategic Plan 1999-2002 with the intention to mainstream gender and social development issues into extension service delivery, while the Agricultural Extension Manual of 1999 intended to incorporate participatory technology development (Mallick *et al.,* 2012). The National Seed Policy of 1993 is likely to play a crucial role in adaptation in future as climate-resilient seeds are developed, under

which the Seed Certification Agency is the legal authority for seed certification (NSP, 1993) while the Seed Rules of 1997 delineates rules and regulations regarding the national seed board, registration of seed dealers, and seed certification (Mallick *et al.,* 2012). In the non-crop agricultural sector, the National Livestock Development Policy (2007) refers to livestock vaccination and insurance (*ibid*) which are activities which may enhance adaptive capacity.

The National Fisheries Policy (1998) also does not mention climate change but does refer to 'maintenance of ecological balance' (Karim, 2011) as well as EIA approval for dams or water drainage. The policy also states that 'Jalmohals' designated as fish sanctuaries will be transferred to the Directorate of Fisheries (*ibid*) to conserve biodiversity. Under this policy, fish culture is to be prioritised on areas with 50cm of inundation for more than 3 months (*ibid*). Furthermore, extension of shrimp culture is banned completely due to the widely-reported negative implications of shrimp aquaculture competing with agriculture.

The National Food Policy Plan of Action (2008-2015) was created in 2008 to outline the National Food Policy of 2006, including priority action areas for food security. Climate change is mentioned under the 'emerging issues' (Section I.1.2) which notes climate change poses an additional burden on food security particularly in areas "already under stress due to adverse meteorological conditions" (NFPPoA, 2008). In this context, technology development, input supply and access, rural financing and diversification are noted (*ibid*). The Plan of Action refers to continued inadequate funding for small farmers, even though agricultural credit disbursement increased eleven-fold between 1980-2003 (*ibid*). Under the Action Agenda, Intervention 1.9 delivers 'early warning system development' including methodologies for assessing impacts of climate change on natural and human resources (NFPPoA, 2008) as well as strengthening access to information on climate change.

The National Water Policy (NWP) (1999) makes no specific mention of climate change but does mention scarcity of water, bank erosion and, under section 4.6, the issue of inland salinity intrusion and River Basin Management under section 4.1. Section 4.2 considers procedures and guidelines for planning water use of agriculture, including preparation of local water management plans, whilst section 4.2 (j) mentions barrages and other structural and non-structural measures (Karim, 2011). Under section 4.2 (p) the government will designate flood risk zones to protect life, property and agriculture (NWP, 1999). In Section 4.3, government reserves the right to redirect use of water during natural and man-made

disasters (Karim, 2011). Section 4.5 calls for use of procedures such as risk analysis in public water investment (NWP, 1999). Section 4.7 (dedicated to Water and Agriculture) calls for the improvement of surface and groundwater utilisation such as irrigation but also recognises the need for tracking groundwater recharge (Karim, 2011). Section 4.13 recognises preservation of unique natural water bodies such as "haors, baors and beels" (*ibid*). 'Haors' are large swamps, 'boars' are oxbow lakes, whilst 'beels' are large lakes (Dey *et al.,* 2008). The **National Water Management Plan (NWMP, 2001)** again did not specifically mention climate change, but did mention the importance of climate-related risks, and flood control and drainage for agriculture.

The Environmental Policy and Implementation Programme of 1992 does not mention climate change directly, but consideration was given to the frequent flooding, cyclones and other environmental and climate-related disasters (Karim, 2011). This included provision for environmentally-sound flood controlling structures (Section 3.5.3), stating that such interventions should be removed if they have adverse effects. Conservation of wetlands and RAMSAR sites are considered (Mallick *et al.,* 2012).

The Land Use Policy (2001) also does not specifically mention climate change (Karim, 2011). However there are indirect overlaps with adaptation as the objective of reducing the number of landless people and preserving 'Khas' (common) lands could align with adaptation objectives and build adaptive capacity. The policy is under the Ministry of Land (Mallick *et al.,* 2012). Maintenance of existing water bodies would also be an adaptive strategy.

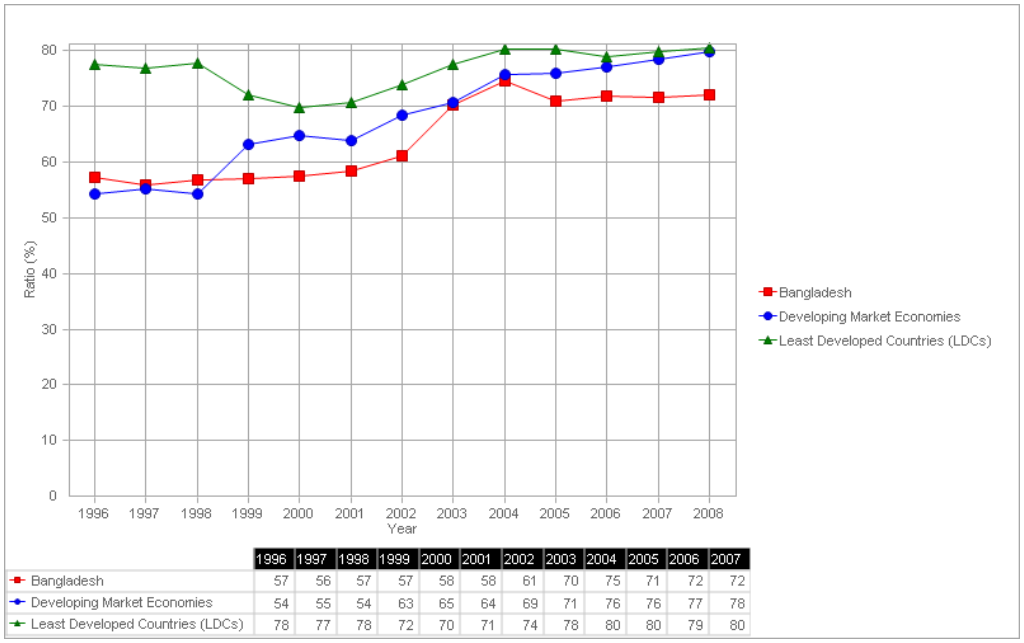
The 2005 Coastal Zone Policy specifically mentions vulnerability to climate change under sections 1 and 4 (CZP, 2005). Section 4.8.3 focuses on climate change in coastal areas, including; institutional arrangements, risk prediction, adaptive measures, sea dykes and contingency plans (*ibid*). Afforestation and conservation of the Sunderbans are noted as well as water management and salinity intrusion. **The Coastal Development Strategy (CDS) (2006)** takes into account "visible climate change impacts", recognises the NAPA process, and Section 3 covers man-made and natural disasters (CDS, 2006). Section 3.1.2 also recognises the establishment of the Climate Change Cell under the MoEF and initiates concept notes on "strengthening and rehabilitation of sea dykes" (CDS, 2006). Annex A, Section 5, states that "by 2100 rise of 88cm sea level rise would inundate 6,000 sq.km, which is about 16% of the total land area" and states "Patuakhali, Khulna and Barisal regions are most at risk from sea level rise" (CDS, 2006).

The **National Adaptation Programme of Action (NAPA),** created in 2005 and updated in 2009 was, as noted previously, specifically related to climate change. Better access to agricultural services was a priority, as well as social protection (UNFCCC, 2005). In the BCCSAP (see Chapter 5), food security also had a high priority (Mallick *et al.,* 2012).

It is therefore noted few of the national policies mention climate change specifically, except for the CZP (2005), the CDS, and the new drafted National Agricultural Policy (NAP, 2010) and NFPPoA (2008). Karim (2011) argues climate change has not been sufficiently mainstreamed into agricultural development and there is a need for greater integration, coordination and institutional interaction. Other relevant initiatives include the National Strategy for Accelerated Poverty Reduction II (2009) which recognises agriculture as a major contributor to pro-poor economic growth and nutrition, as well as the 'Vision 2020' plan which aims to reduce poverty to 15% by 2021 with a strong emphasis on disasters and vulnerability (Mallick *et al.,* 2012). Whilst the ADP is the cornerstone of national policy, there are weaknesses in the planning process. Karim (2011) notes that knowledge-sharing is fragmented and sporadic between the community-based adaptation projects being implemented, which risks the possibility of overlaps and undermines knowledge dissemination.

Annex XVI: Trade Barriers, Subsidies and Climate Adaptation in Bangladesh

It has been suggested that trade policies, including agricultural tariffs, can pose an international barrier to climate change adaptation (Glatzel *et al.,* 2012). Bangladesh still suffers from trade barriers that prevent free export of products to other countries. Under the MDG number 8 (indicator 8.6), countries are supposed to be increasing the proportion of total developed-country imports (by value and excluding arms) from developing countries and least developed countries, admitted free of duty. Yet the graph below shows a lower proportion of the imports from Bangladesh are admitted free of duty compared to other LDCs.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bangladesh	57	56	57	57	58	58	61	70	75	71	72	72
Developing Market Economies	54	55	54	63	65	64	69	71	76	76	77	78
Least Developed Countries (LDCs)	78	77	78	72	70	71	74	78	80	80	79	80

Proportion of imports (by value) admitted free of duty (excludes arms and oil) (Source: UNCTAD, 2011).

Furthermore, under MDG goal 8 (indicator 8.7), developed countries are supposed to be reducing the tariffs imposed on the agricultural products and textiles and clothing from developing countries. Yet data from UNCTAD (2011) shows while some products have preferential access, the average tariff imposed by developed countries' on Bangladesh's products remains at around 10%. Thus it is proposed trade and tariff reform could enhance capacity of countries like Bangladesh to adapt to climate change through enhancing trade.

In addition, it has also been suggested, including by the World Bank, that subsidies pose another barrier to climate change, and cutting subsidies would be a way to free up climate finance. Fuel subsidies could make up 19.1% of the GoB budget in 2012 without price adjustments (IMF, 2011) amounting to 3.4% of GDP. Subsidies are used to shield consumers

from price movements which are absorbed by state-owned enterprises such as the Bangladesh Petroleum Corporation, which receives loans and direct budget transfer from the government (*ibid*). Bangladesh Petroleum Corporation is the sole petroleum importer and distributor in the country, and in 2008 it had a deficit of $1.5Bn (World Bank, 2009). The IMF argues there is a high degree of subsidy leakage to the mid-to-upper income households and if these fuel subsidies were removed, they could be redirected towards safety nets for the most vulnerable. Leakage can also occur by fuel smuggling to India where prices were 40% more in September 2011 (IMF, 2011). Switching from diesel to greener compressed national gas has been encouraged as Bangladesh has significant natural gas reserves (World Bank, 2009). However, diesel subsidies are provided directly to farmers to assist with irrigation, so subsidy removal could have an impact upon such users. The Global Subsidies Initiative has found that once subsidies are in place they are notoriously difficult to remove, necessitating complementary policies to offset any undesired secondary impacts (e.g. welfare support for the poor, or programs to help industries diversify their energy supplies) (Laan *et al.,* 2010).

Annex XVII: Implications for adaptation evaluation criteria.

Source: Brooks et al 2011.

Criterion	Implications for adaptation evaluation
Feasibility	The feasibility of adaptation interventions will depend on a variety of factors, the most important of which are likely to be technical feasibility, the existence of sufficient management capacity for formulation and implementation, and cost (or benefit/cost ratio). In any adaptation context, once climate vulnerability assessments have been made the intervention is likely to begin with the identification of a number of potential adaptation measures or options, which are then prioritised. It is during the prioritisation phase that the feasibility of different options will be assessed.
Efficacy /effectiveness	The way in which the effectiveness of adaptation interventions is assessed will depend on the context in which such interventions are designed and implemented. However, based on the above discussion, effectiveness might be assessed based on (i) the impact of an intervention at the institutional level, e.g. in terms of preparedness, resilience or adaptive capacity, (ii) the impact of an intervention on the vulnerability of individuals, groups or other entities, or (iii) the impact of an intervention on outcomes, where such outcomes can be measured (e.g. on mortality, health or poverty outcomes). All of the above three ways of assessing effectiveness may employ indicators, related to (i) processes associated with institutional change (ii) factors associated with vulnerability to climate change-related hazards, and (iii) development (or e.g. disaster) outcomes. Where assessment of effectiveness is based on vulnerability or development indicators (and particularly the latter), the effects of changing climatic and environmental baseline conditions will need to be accounted for, and quantitative indicator data will need to be complemented by qualitative information addressing attribution of vulnerability or development outcomes to interventions
Efficiency	Efficiency is most likely to be assessed in terms of the ratio of benefits to costs, and this might be achieved by combining data relating to effectiveness (e.g. measures of the extent to which vulnerability has been reduced or outcomes improved) with financial data relating to the cost of any particular intervention.
Acceptability/ legitimacy	The acceptability of an intervention will be a subjective matter best evaluated through engagement with a range of stakeholders representing all those likely to be affected by the intervention. Issues related to transparency and accountability are particularly important in this context.
Equity	The extent to which an intervention may be seen as equitable might be assessed in a variety of ways, each of which will have objective and subjective elements. Equitable interventions might be seen as those that provide the greatest degree of assistance to the poorest. In the context of climate change and adaptation, equity might depend on the extent to which an intervention targets the most vulnerable populations or individuals. Equity will also require that adaptation interventions do not result in the (further) marginalisation of certain groups (e.g. those already disadvantaged or particularly vulnerable), or in increased inequality. These risks can be addressed through the incorporation of safeguards and screening processes into evaluation. Equity might also extend to considerations of responsibility for anthropogenic climate change, with populations and countries characterised by a combination of high exposure and vulnerability to climate change-related hazards, and low historical responsibility for emissions, being seen as most "deserving" of adaptation assistance. The subjective nature of this issue means that the manner in which it should be adopted within evaluation efforts requires careful consideration.
Sustainability	This evaluation criterion is commonly separated into technical and institutional aspects. To what extent the intervention maintains its technical relevance to the problem it addresses – crucial when there is a shifting baseline. But also, how well the institutions involved can continue to operate the intervention. In the context of adaptation to climate change, sustainability requires that: • Adaptation interventions are compatible with environmental sustainability as usually defined (i.e. are not environmentally destructive, or seek to minimise environmental disruption – this might

	also mean that adaptation should not contribute significantly to greenhouse gas emissions). • The benefits of adaptation interventions will continue after the termination of the projects and programmes under which they are implemented. • Interventions designed to deliver adaptation benefits in the near-term do not increase vulnerability or drive maladaptation in the medium to long-term. • Interventions can be managed by mandated organizations into the medium and long terms. The above risks can be addressed in a similar way to the risks associated with the potential for projects to result in marginalisation, via screening and the introduction of safeguards, which might be based on a set of criteria which must be met in order to minimise the risk of maladaptation or increased vulnerability. Institutional sustainability requires assessments of the extent to which mandated organizations are dependent on outside assistance to manage and implement interventions over an appropriate time period.

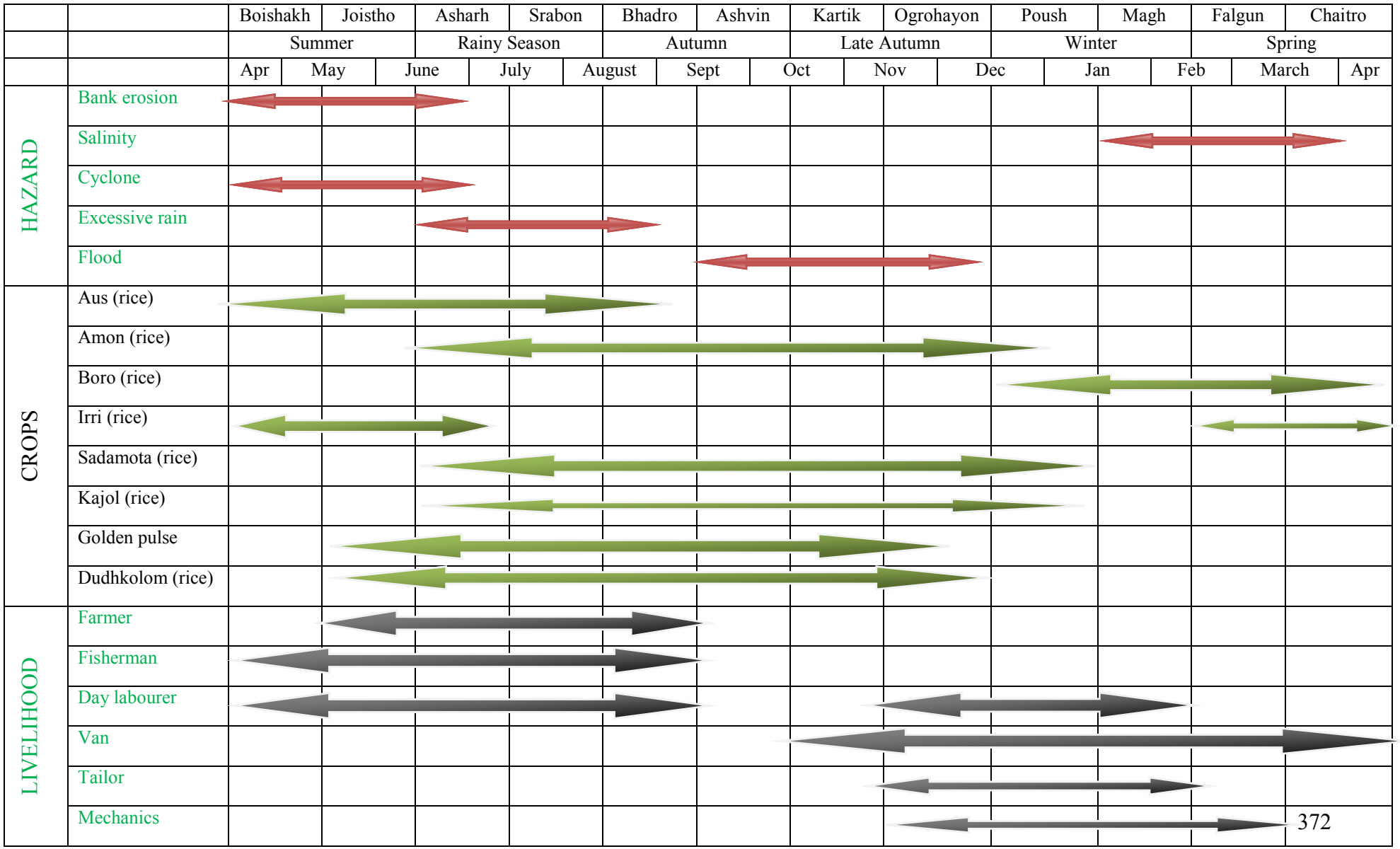
Annex XVIII: Operationalisation of indicative framework for adaptation finance (Authors' own)

Criterion	Examples of ways to operationalise the criteria	P	G	E	F	A
Equity in targeting the most vulnerable	• Ensuring the project benefits the most climate-vulnerable areas and stakeholders within those geographical areas (e.g. using surveys or expert judgement to identify the vulnerable) • Social and environmental safeguards/screening to ensure interventions do not marginalise disadvantaged groups • Involvement of target beneficiaries in proposal design and throughout project cycle	✓		✓	✓	✓
Efficiency and cost-effectiveness	• Minimising transaction costs • Leveraging co-financing contributions including in-kind contributions • Demonstrating a positive benefit-cost ratio (BCR) or return on investment (ROI)	✓		✓	✓	✓
Effectiveness in reducing vulnerability; results and monitoring results	• Budgeted M&E plan, participatory M&E process; independent post-project evaluation • Measurement of results against a baseline and 'theory of change' attributing outcomes to the project (e.g. benefit against measureable outcomes such as poverty, mortality and health) • Indicators at institutional/fund level and project/beneficiary level • Results-based disbursement year-on-year	✓		✓	✓	✓
Urgency and timeliness	• Rapid and timely disbursement mechanisms and processes at fund level (e.g. disbursement schedule with time-bound milestones)	✓			✓	
Flexibility and robustness	• Selection of 'no-regrets' adaptation options • Use of contingency funds, mechanisms or insurance to ensure resilience of intervention in event of climate shocks, and ensure adaptations are resilient under more extreme climate scenarios	✓			✓	✓
Synergy/ coherence between mitigation/ adaptation	• Ensuring synergy with mitigation objectives where possible; low-carbon and ecosystem-based adaptation options are considered at project design stage where relevant, and/or projects with mitigation co-benefits are prioritised	✓			✓	✓
Gender equity	• Gender mainstreaming across the project cycle, including results disaggregated by gender (see UNDP guidebook)	✓	✓	✓	✓	✓
Practicality and feasibility	• Check project applicant has financial/technical capacity to implement project ("fit-for-purpose" test) including trained staff, contingency budget, fiduciary standards in place and no record of criminal activities • Feasibility studies undertaken, where necessary	✓			✓	✓
Avoiding maladaptation	• Selection of 'no-regrets' adaptation options • Project risk management based on known unknowns and unknown unknowns • Pre-screening to ensure interventions do not reduce incentives to adapt • Consideration of long-term post-project monitoring processes to enable learning from failure	✓		✓	✓	✓

Need for transformation considered (scale, enabling environments)	• Project applicant has considered pathways, drivers and barriers for scaling-up (see IFAD guidance) e.g. engagement with government, research and media stakeholders	✓			✓	✓
Ownership and subsidiarity	• Use of direct access modalities (national or sub-national direct access)		✓		✓	
Alignment/ mainstreaming	• Close engagement or collaboration with national or local government to reduce duplication, and enhance mainstreaming and sustainability		✓		✓	✓
Additionality	• Mainstreaming into existing government planning/programmes whilst ensuring adaptation finance is not diverted from development finance • At international scale, commitment to the 0.7% ODA/GNI goal or measurement of the extent to which climate finance surpasses this goal		✓		✓	
Harmonisation	• Pre-project mapping out similar initiatives in the area/region of implementation to develop synergies where possible and avoid duplication of efforts		✓		✓	✓
Adequacy, precautionary predictability	• At fund/international level, measurement of extent to which volumes of finance meet costs of climate change (use of scientific/economic literature) • At fund/international level, provision or commitment to provision of long term finance		✓		✓	
Inclusive governance (Transparency, accountability, legitimacy and stakeholder participation)	• Transparent provision of all project documentation and reports online to enable trackability • Transparent internal and external complaint procedures or grievance mechanisms • At fund level, civil society/beneficiary representation at board meetings and public disclosure of meeting minutes • Involve beneficiaries as early as possible in project design and throughout project cycle		✓		✓	✓
Sustainability	• Environmental sustainability; use of EIA/SEA (for large projects), coherence with mitigation • Social sustainability; social safeguards • Economic/financial; considering long-term impact/maintenance of project results, post-project monitoring	✓		✓	✓	✓

Note: In the right hand columns, P = prioritisation principles; G = governance principles and E = evaluation (monitoring) principles. F designates criteria that could be applicable/required at fund-level; A denotes criteria that could be applicable/required at activity level (project or programme level).

Annex XIX: Hazard, Agriculture and Seasonal Calendar (Translated from Bengali)



Annex XX: Results on Association between Livelihood Assets and Food Security

Relationship tested	Proxy indicators used	Pearson's Chi Square Value	Cramer's V (measure of association)
Physical capital and food security status	Asset indicator (number of assets), and months of hunger	140.5***	0.27
Financial capital and food security status	Business-related cash income, and months of hunger	27.3***	0.167
Social capital and food security status	Savings group membership, and months of hunger	1.69	0.041
Human capital and food security status	Household education level, and months of hunger	100***	0.23
Natural capital and food security status	Land ownership, and months of hunger	164***	0.29

The table above shows the Chi Square Values obtained for the relationships and the measure of association (using Cramer's V = $\boldsymbol{\varphi_c}$). Cramer's V varies from 0 (corresponding to no association between the variables) to 1 (complete association)[2].

***p < 0.001

**p < 0.01

Source of data: CCAFS, 2013. Refer to Wright et al (2012) for further details on the methodology.

[2] A figure of above 0.25 indicates a very strong relationship, and a value between 0.15 and 0.25 indicates a strong relationship.

Annex XXI – Negotiation Text under the SCF at COP-19

NB: The text agreed in the annexes to decisions 3/CP.4 and 6/CP.13 is highlighted with the reference in parenthesis in bold.

Annex IV of the report of the Standing Committee on Finance

Updated guidelines for the fifth review of the financial mechanism

A. [Objectives

1. In accordance with Article 11.4 of the Convention, the objectives will be as follows **(3/CP.4 and 6/CP.13)**:

(a) to review the financial mechanism and take appropriate measures regarding **(3/CP.4)**:

(i) Its conformity with the provisions of Article 11 of the Convention and the guidance of the Conference of the Parties (COP); **(3/CP.4)** ;

(ii) The effectiveness of the activities it funds in implementing the Convention;**(3/CP.4)**

(iii) Its effectiveness in providing financial resources on a grant or concessional basis, including for the transfer of technology, for the implementation of the Convention's objective on the basis of the guidance provided by the COP; **(3/CP/4)**

EU wanted to delete

(iv) Its effectiveness in providing new and additional [and, as appropriate, adequate and predictable] resources to developing country Parties under Article 4.3 of the Convention; **(3/CP.4)**

(v) Effectiveness of access modalities for developing countries, in particular direct access;

(vi) The coherence and complementarity between the different operating entities of the financial mechanism in order to contribute to a global paradigm shift toward a low-[GHG] emission and climate-resilient development pathway;

EU wanted to delete

(vii) The principles and practice for the allocation of funds through the financial mechanism;

(b) to examine how to improve consistency and complementarity of the financial mechanism with other sources of investment and financial flows, including: **(6/CP.13)**

(i) Examining relevant sources, channels and means of financing, as indicated in Article 11, paragraph 5, of the Convention, availed of by developing countries to contribute to the achievement of the objectives of the Convention and conformity with COP guidance; **(6/CP.13)**

(ii) Examining the role of the financial mechanism in identifying pathways for scaling up the level of resources; **(6/CP.13)**

EU wanted to delete

(iii) Assessing enabling environments of all Parties for catalysing investment in, and the transfer of, environmentally sound technologies that mitigate greenhouse gas emissions, and for adapting to the adverse effects of climate change. **(6/CP.13)**

B. Sources of information

2. The review shall draw upon, inter alia, the following sources of information **(3/CP.4 and 6/CP.13)**:

(a) Information provided by the Parties on their experiences regarding the financial mechanism on support provided and received in accordance with COP decisions; **(3/CP.4)**

important for Philippines But EU wants to delete

(b) Annual reviews by the COP on the conformity of the activities of the financial mechanism with the guidance of the COP; **(3/CP.4)**

EU wanted to delete

(c) The annual report of the Standing Committee on Finance (SCF) to the COP on its activities and other relevant information documents regarding the SCF[, including expert inputs through independent reviews and assessments for the preparation and conduct of the periodic reviews of the financial mechanism];

(d) The annual report of the Global Environment Facility (GEF) to the COP on its activities as an operating entity of the financial mechanism, **(3/CP.4)** including the information on the Least Developed Country Fund and the Special Climate Change Fund, and other relevant GEF policy and information documents;

(e) The reports from the GEF evaluation office; **(3/CP.4)**

(f) The annual report of the Green Climate Fund (GCF) to the COP on its activities as an operating entity of the financial mechanism and other relevant GCF policy and information documents;

(g) The report of the Adaptation Fund Board to the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol and the outcomes of the initial review of the Adaptation Fund;

(h) The outcomes and reports from the United Nations processes, relevant bilateral and multilateral funding institutions, other intergovernmental and non-governmental organizations **(3/CP.4)** dealing with climate change financing;

(i) Relevant reports on private-sector financing and investment for climate change activities; **(3/CP.4)**

(j) Technical papers and reports prepared by the secretariat upon the request of the Conference of the Parties, which are relevant to the financial needs of developing countries under the Convention; **(6/CP.13)**

(k) Information contained in the national communications of Parties to the Convention, technology needs assessments and national adaptation programmes of action; **(6/CP.13)**

(l) Information on fast-start finance provided by developed country Parties and other information on fast-start finance;

Bolivia wants non-mkt mech's

(m) The reports of the work programme on long-term finance [and REDD+ finance work programme];

(n) The reports of the LDC Expert Group (LEG) and the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention (CGE).

C. Criteria

3. The effectiveness of the financial mechanism will be assessed taking into account the following: **(3/CP.4)**

(a) The transparency of decision-making processes **(3/CP.4)** of operating entities under the Convention and its Protocol;

Phil. v. important

(b) The level of stakeholder [involvement] in the decision making processes of operating entities under the Convention;

(c) The adequacy, predictability, accessibility, equitability and timely disbursement of funds for activities in developing country Parties; **(3/CP.4)**

(d) The responsiveness and efficiency of the GEF project cycle and expedited procedures, including its operational strategy, as they relate to climate change; **(3/CP.4)**

EU trying to delete

Phil. wants take out

(e) The amount of [resources provided [and received]][impacts achieved] to developing country Parties, including financing for technical assistance and investment projects **(3/CP.4)**, and the mechanisms for country allocation;

(f) The amount and the extent of accessibility of finance leveraged **(3/CP.4)** by and from different sources, including from the private sector, and modalities of co-financing when applicable;

(g) The sustainability of [the results and impacts achieved through] funding operations in developing country Parties; → the inserted

(h) The extent to which the financial mechanism is contributing to a global paradigm shift toward a low-[GHG] emission and climate-resilient development pathway [in the context of sustainable development];

(i) The extent to which the resources that flow through the financial mechanism were used to identify innovative projects that could be used for dissemination and how lessons learnt from projects were generated and distributed;

Phil. concerned

(j) The extent to which projects presented by recipient countries for financing are consistent with low-[GHG] emissions development strategies and national adaptation plans developed pursuant to decision 1/CP.16;

(k) Progress by all Parties in improving enabling environments for catalyzing investment in, and the transfer of, sustainable technologies that mitigate greenhouse gas emissions, and for enhancing resilience to climate change;

? (l) The relative effectiveness and operational efficiency of Convention funds in delivering support compared to other multilateral climate finance channels.]

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