

Final Report
Not to be quoted or cited

Economic and Financial Impacts of Natural Disasters: an Assessment of Their Effects and Options for Mitigation: Synthesis Report

Charlotte Benson and Edward Clay

Overseas Development Institute,
111 Westminster Bridge Road,
London SE1 7HR, UK
e-mail: cbenson321@aol.com
e.clay@btinternet.com

This study is undertaken at the Overseas Development Institute, London, as part of the program of the Disaster Management Facility, World Bank with financial support from the Conflict and Humanitarian Aid Department, DFID. The opinions expressed are those of the authors and do not necessarily represent the views of the World Bank or DFID

May 2003

Contents

Preface

Abbreviations and Acronyms

1. Introduction	1
1.1 Background	
1.2 Objectives	
1.3 Selection of countries and issues for investigation	
1.4 Concepts and definitions	
1.5 Method of investigation	
2. Disasters and the macro-economy	6
2.1 Dynamic nature of vulnerability	
2.2 Factors determining vulnerability	
2.3 The macro-economic impact of disasters	
2.4 Lessons learned	
3. Public finance and disasters	35
3.1 Background	
3.2 Broad fiscal impact of disasters	
3.3 Disaggregated re-examination of public finances	
3.4 External aid	
3.5 Is reallocation an appropriate solution?	
3.6 Longer-term budgetary impact of disasters and related risk management activities	
3.7 Lessons learned	
4. Information on Natural Hazards and Disaster Reduction	55
4.1 Information and Public Action	
4.2 Hazard information as a public good	
4.3 Climatic forecasting in Southern Africa	
4.4 Tropical Storms	
4.5 Failures in the provision of information as a public good	
4.6 Findings and conclusions	
5. Financing the cost of future disasters	66
5.1 Introduction – risk transfer mechanisms	
5.2 Potential obstacles	
5.3 Creative Solutions	
5.4 Promoting mitigation	
5.5 Conclusions	

6. Findings and implications for policy and research	76
6.1 Findings	
6.2 Policy implications	
6.3 Directions for future research	

Annexes

A. Dominica: Natural Disasters and Economic Development in a Small Island State	85
B. Bangladesh: Disasters and Public Finance	94
C. Climatic Variability, Economic Performance and the Uses of Climatic Forecasting in Malawi and Southern Africa	106

References	115
-------------------	------------

Boxes

Box 1 Measuring vulnerability	22
Box 2 Saying it does not make it so: poverty reduction strategies	24
Box 3 Funding rehabilitation: long-term growth implications	28
Box 4 Fiscal impacts of drought in Sub-Saharan Africa	38
Box 5 Evidence-based volcanology - application of Bayes' Rule to the Dominica situation in 1998/99	63
Box 6 WINCROP Banana Crop Insurance Scheme	70
Box 7 Uncertainties in post-disaster forecasting in Bangladesh	100

Figures

Figure 1	Dominica – real annual fluctuations in agricultural, non-agricultural and total GDP 1978-1999.	9
Figure 2	Bangladesh – real annual fluctuations in GDP, agricultural and non-agricultural sector product 1966-2000	12
Figure 3	Malawi real annual fluctuations in GDP, agricultural and non-agricultural sector product 1980-2001	13
Figure 4	Southern Africa – cereal production and El Niño events 1972-1999	16

Preface

As part of its efforts to promote disaster prevention and mitigation as an integral part of development activities, the World Bank's Disaster Management Facility (DMF) has undertaken a study on the economic and financial consequences of natural disasters, with the support of the United Kingdom's Department for International Development (DFID) provided through its Conflict and Humanitarian Aid Department (CHAD). The principal researchers for this 3 year study, beginning in February 2000, have been Charlotte Benson and Edward Clay of the Overseas Development Institute (ODI) in London. Study team members from the World Bank's Disaster Management Facility include Alcira Kreimer, Margaret Arnold, Jonathan Agwe, Hager Ben-Mahmoud, and Maria Eugenia Quintero.

The study comprises a state-of-the art review and three country case studies. The first case study was conducted on Dominica, a small island economy (Benson and Clay, 2001). The second study was on disasters and public finances in Bangladesh (Benson and Clay, 2002). The third case study focused on climatic variability in Southern Africa, including a country study of Malawi (Clay and others, 2002). This final synthesis report draws together the new evidence with that from the researchers' previous studies and other relevant literature.

This report was prepared by Charlotte Benson and Edward Clay with editorial assistance from Alice Baker on Annexes A, B and C. Those who have contributed to the three country studies include Enrique Blanco de Armas, Louise Bohn, Jim Dempster, P. Dalitso Kabambe, Franklyn V. Michael, Clement Peris, Alistair W. Robertson and Hardwick Tchale. Mavis Clay has provided editorial and bibliographical assistance throughout.

The authors have benefited considerably from comments on the draft of this report by Willie Aspinall (who also contributed Box 5), Stephen Biggs, Hugh Brammer, Paul Freeman, Rodney Lester, Simon Maxwell, John Roberts, Malcolm Smart and Dirk Willem te Velde.

The study team also extends its thanks to the Country Directors and members of the World Bank country teams for Bangladesh, Dominica and Malawi for support and collaboration on the study. The full collaboration of officials of the Governments of Bangladesh, Dominica and Malawi was also essential to the successful completion of the three country studies. They and many others who provided information and advice are mentioned in the country study reports.

There is scope for further work on the subject of the economic consequences of natural disasters, and it is hoped that this report will provoke discussion on both analytic and policy issues and also stimulate others to undertake further investigations. The authors, of course, accept full responsibility for all errors and omissions in this report.

May 2003

Abbreviations and Acronyms

ADMARC	Agricultural Development and Marketing Corporation (Malawi)
ADP	Annual Development Programme
BRAC	Bangladesh Rural Advancement Committee
CARICOM	Caribbean Community
CDERA	Caribbean Disaster Emergency Response Agency
CGE	Computable General Equilibrium model
CHAD	Conflict and Humanitarian Aid Department (DFID, UK)
CRED	Centre for Research on the Epidemiology of Disasters (Belgium)
DFID	Department for International Development (UK)
DMF	Disaster Management Facility (World Bank)
DMS	Department of Meteorological Services (Malawi)
EC	European Commission
ECLAC	Economic Commission for Latin America and the Caribbean
EEA	Equatorial East Africa
EM-DAT	Emergency Events Database (CRED)
ENSO	El Niño Southern Oscillation
FCDI	Flood Control, Drainage and Irrigation (Bangladesh)
FDI	Foreign direct investment
FY	Financial year
FYP	Five Year Plan
GDP	Gross domestic product
GNP	Gross national product
GoB	Government of Bangladesh
GoCD	Government of the Commonwealth of Dominica
HIV/AIDS	Human Immuno-deficiency Virus/ Acquired Immune Deficiency Syndrome
IADB	Inter-American Development Bank
IDA	International Development Association (World Bank)
IDNDR	International Decade for Natural Disaster Reduction (UN)
IFPRI	International Food Policy Research Institute
IFRC	International Federation of the Red Cross and Red Crescent Societies
IIASA	International Institute for Applied Systems Analysis (Austria)
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPG	International public good
MFI	Microfinance institution
mph	miles per hour
MTEF	Medium term expenditure framework
NGO	Non-governmental organisation
O & M	Operations and maintenance
OAS	Organization of American States
ODA	Official development assistance
ODI	Overseas Development Institute (UK)
OECS	Organization of Eastern Caribbean States
PML	Probable maximum loss
PRSP	Poverty reduction strategy paper
R&R	Relief and rehabilitation
RMSM	Revised Minimum Standard Model
RPG	Regional public good
RS	Richter Scale
SADC	Southern African Development Community

SAP	Structural adjustment programme
SARCOF	Southern Africa Climate Outlook Forum
SEA	Southeast Africa
SOE	State owned enterprise
SRU	Seismic Research Unit, University of the West Indies, Trinidad
SSA	Sub-Saharan Africa
SST	Sea surface temperature
Tk	Taka (Bangladesh currency)
UNDP	United Nations Development Program
UNISDR	United Nations International Strategy for Disaster Reduction
VAT	Value added tax
WINCROP	Windward Islands Crop Insurance Ltd
WMO	World Meteorological Organisation
WTO	World Trade Organization
Z\$	Zimbabwe dollar

Summary: impacts, policy and research

Economic and financial impacts

Major natural disasters can and do have severe negative short-run economic impacts. Disasters also appear to have adverse longer-term consequences for economic growth, development and poverty reduction. But, negative impacts are not inevitable.

Vulnerability is shifting quickly, especially in countries experiencing economic transformation - rapid growth, urbanization and related technical and social changes. In the Caribbean and Bangladesh there is evidence of both declining sensitivity to tropical storms and floods and increased resilience resulting from both economic transformation and public actions for disaster reduction. The largest concentration of high risk countries, increasingly vulnerable to *climatic hazards*, is in Sub-Saharan Africa. Risks emanating from *geophysical hazards* need to be better recognized in highly exposed urban areas across the world because their potential costs are rising exponentially with economic development.

*Natural disasters cause significant **budgetary pressures**, with both narrowly fiscal short-term impacts and wider long-term development implications. **Reallocation** is the primary fiscal response to disaster. Disasters have little impact on trends in **total aid flows**.*

Public policy implications

A full reassessment of the economic and financial impact of a major disaster should be made 18 to 24 months after the event that is then taken into account in reviewing the affected country's short-term economic performance and assistance strategy.

Governments need appropriate *risk management strategies* for future disasters that include *medium-term financial planning* for 8 – 10 years. The basis of funding has to be broadened, applying a combination of mechanisms at different layers of loss coverage to help overcome the obstacles to increased coverage of insurance and capital market tools.

Natural hazard risk management should be *integrated* into *longer-term* national investment policies and development strategies and appropriately reflected in the allocation of financial resources.

Quality, reliable *scientific information* is a necessary condition for effective disaster risk management. The international community should support global and regional research and information systems on risks. It should also ensure that there are adequate complementary monitoring and dissemination programs at the national level. Priorities include climatic variability, regional and national flood forecasting and geophysical hazards.

Economic research on natural disasters

Vulnerability to natural hazards is determined by a complex, dynamic set of influences, such as economic structure, stage of development and prevailing economic and policy conditions. To understand and assess the economic consequences of natural hazards and the implications for policy, it is necessary to consider the pathways through which *different types of hydro-meteorological (climate-related) and geophysical hazard* impact on an economy, the different risks posed and the ways in which societies and economies adapt to or ignore these potential threats.

The *eclectic approach* adopted in this study, employing largely qualitative *methods*, is particularly useful in exploring the many complex and dynamic pathways through which extreme hazardous events influence an economy and its financial system and also for identifying areas and issues where further investigation including quantification would be worthwhile.

Chapter 1

Introduction

1.1 Background

The reported global cost of natural disasters has risen significantly, with a 15-fold increase between the 1950s and 1990s. During the 1990s, major natural catastrophes are reported to have resulted in economic losses averaging an estimated US\$66bn per annum (in 2002 prices). Record losses of some US\$178bn were recorded in 1995, the year of the Kobe earthquake – equivalent to 0.7 per cent of global GDP (Munich Re, 2002).

Such widely cited figures have triggered a growing awareness of the potential damage natural hazards can cause. However, there is a more limited sense of their broader macroeconomic significance or the problems they could pose for longer-term development. This is partly because most assessments of the economic impacts of disasters have concentrated on the most easily measured *direct* losses - that is, the financial cost of visible physical damage. This focus on losses, in turn, arises from the concerns to meet the short-term humanitarian needs of affected people in the aftermath of a disaster, and pressures to determine replacement investment requirements and insured losses. It also reflects the practical difficulties of isolating and measuring the *indirect* and *secondary* impacts that result from the transmissions of a disaster shock through the economy. Such impacts could include, for example, effects on the *flow* of goods and services, balance-of-payments and budgetary consequences and ultimately changes in economic growth, income distribution and the incidence of poverty.

A further limitation of the existing body of evidence is that most of the relatively few studies to have examined indirect and secondary impacts focus on the impact of a single, recently occurred event. The longer-term, cumulative consequences of a series of disasters on a particular country's development are more difficult to determine and are typically ignored, apart from speculative comments on possible detrimental effects. Yet, in reality, most disasters, being linked to atmospheric and hydrological processes, are recurrent, striking a country at infrequent intervals. Such recurrent shocks potentially have cumulative effects on both the rate and pattern of development (Benson and Clay, 2000). Earthquakes and volcanic eruptions, which are very uncommon and better fit the idea of a one-off catastrophic event, accounted for only 11% of reported natural disasters in the 1990s (IFRC, 2002). This potential difference in the economic consequences of different types of natural hazard is considered further in this study.

These biases and limitations of economic assessment have severely restricted the information available to policy-makers on the nature and scale of the vulnerability of many economies to natural hazards. This could in turn have contributed to what many see as a widespread failure to address natural hazards as a potentially serious threat to sustainable development, and a general lack of appreciation of the potentially high economic and social returns to disaster reduction. There are clearly many issues that merit fuller and more systematic review about the way disasters are conceptualized, and impacts are assessed within the framework of economic analysis that justify this investigation.

1.2 Objectives

The broad objectives of the study have been to increase understanding of the wider economic and financial impacts of natural disasters through the detailed analysis of the impact of disasters, factors determining the vulnerability of hazard-prone economies, opportunities for

improvement in the management of risk and factors inhibiting their adoption. The study focuses primarily on developing country experience. Findings are intended to contribute towards the development of guidelines on the assessment of vulnerability to natural hazards from an economic perspective. However, it was recognized at the outset that the subject is complex and multi-faceted and thus that the study would probably highlight many areas worthy of future, separate investigation beyond its scope.

This investigation adopts a country case study approach for exploring economy-wide disaster impacts. In doing so it builds on previous research by the primary investigators and related evaluations, including drought in sub-Saharan Africa (SSA) (Benson and Clay, 1998; Clay and others, 1995; Thomson, Jenden and Clay, 1998) and five studies of the country impacts of disasters in the Asian and Pacific and Caribbean regions – for Fiji (Benson, 1997a), Vietnam (Benson, 1997b), the Philippines (Benson, 1997c), Zimbabwe (Benson, 1998) and Montserrat (Clay and others, 1999). Three new country studies on Bangladesh, Dominic and Malawi were completed. So this synthesis report reflects the findings and cumulative experience of undertaking, over a period of 10 years, 8 country studies and regional investigations on the economy-wide consequences of natural disasters.

1.3 Selection of countries and issues for investigation

The three case study countries were selected to provide a range of hazard experiences in economies of varying size and complexity from different regions of the world, and also to explore distinct but complementary methodological and policy issues. The first study focuses on Dominica, one of the highly hazard-prone, small island Caribbean states, providing an economy-wide study of the impact of disasters (Benson and Clay, 2001). The second considers Bangladesh, a large hazard-prone Asian economy, concentrating particularly on public finance (Benson and Clay, 2002). Malawi, a low income Southern African economy, forms the subject of the third study, focusing on the use of scientific information, particularly short term climatic forecasting, in disaster mitigation and its value from an economy-wide and sectoral perspective (Clay and others, 2003).

Dominica: Natural disasters and economic development in a small island state

This study explores the overall vulnerability of an economy to natural hazards. It considers the complexity of factors determining broad sensitivity and the dynamic nature of that sensitivity, focusing on the disaggregated impacts of natural hazards on different sectors of an economy. It is an interesting case, exemplifying the experience of many small open island economies. Such economies face a number of special disadvantages associated with their size, insularity and remoteness (Briguglio, 1995), making them highly sensitive to economic shocks of any form, including natural hazards. Indeed, they are often perceived to be among the countries of the world most vulnerable to natural hazards.¹

Bangladesh: Natural disasters and public finance

Disasters can have potentially significant implications for public finance, increasing expenditure and simultaneously reducing domestic revenue, potentially resulting in increased domestic and/or external borrowing, substantial alterations to existing investment and recurrent expenditure plans or monetary expansion. Natural hazards also impose additional pressures on public finances to the extent that governments undertake mitigation and preparedness measures.

In reality, data on aggregate revenue and expenditure typically do not reveal the extent of severity of the budgetary impact of disasters, as previous work by the principal researchers

¹ See, for example, Atkins and others, 2000; and the authors' case studies for Fiji (Benson, 1997a) and Montserrat (Clay and others, 1999).

has clearly highlighted. Yet the public financial consequences of natural disasters are seldom explored systematically, except in the narrow context of a single major disaster.² After exploring these issues for the open, structurally less complex Dominican economy, it was therefore decided that this theme should be the central focus of the second case study, shedding more light on these issues.

Malawi: Climatic variability, economic performance and the uses of climatic forecasting

The extreme region-wide Southern African drought in 1991/92 quickly followed by droughts in Malawi and Zambia in 1993/94, and in 1994/95 were associated with an extended and intense global climate El Niño event. These droughts had severe agricultural and wider social and economic impacts. The concern engendered by these experiences, and awareness of the scientific evidence linking events in Southern Africa to global climatic variability and possibly climatic change, created a widespread disposition in favor of strengthening climatic forecasting. At the same time ways would be found to promote the use of such information to support food security, agricultural and wider resource management throughout the region. It was also envisaged that climatic forecasting and information could be used to assist in increasing resilience to longer-term global climatic change, and the likely associated increase in frequency and severity of extreme events. Recognition of the severity of economic impacts of drought simultaneously raised interest in taking the risks of climatic shocks into account in the management of national economies and in undertaking structural adjustment programs (Benson and Clay, 1998).

The third study reassesses in the light of experience during the 1990s the economic consequences of climatic variability at a regional and country scale and examines the current status of and progress in climatic research and forecasting as these relate to regional and country scales. It reviews the range of potentially useful products in the light of recent experience; re-examines meteorological and other institutional capacity to utilize potential forecasting capacities to their full; and reassesses the financing issues posed by strengthening climatic forecasting. The study focuses both on Malawi and also the wider southern Africa experience.

1.4 Concepts and Definitions

Natural disasters are an area of multi-disciplinary research and policy analysis. There is therefore a problem of discourse, because basic terms in the language of disaster research and practice are apparently common, but often reflect subtle differences of conceptualization amongst natural scientists, social scientists and practitioners. This problem of discourse is common to most development issues (Apthorpe, 1984; Harriss, 2002). It makes it necessary to state very clearly at the beginning of an investigation such as this, which covers less explored aspects of natural disasters as an economy-wide or macroeconomic phenomenon, what the authors mean in the use of specific terms and concepts. So far as possible the report seeks to adopt widely accepted definitions of the key concepts such as hazard, disaster, vulnerability, risk, that have already been employed in the introduction, but this is not always possible where there is still no agreed standard usage.

A *natural hazard* is a geophysical, atmospheric or hydrological event that has a potential to cause harm or loss. Usually these are both uncommon and extreme events in terms of the range of natural phenomena such as rainfall, tropical storms, flooding or seismic tremor/earthquake. Hence the need to determine *risk*, which is understood to be ‘A

² Despite the considerable literature on disasters in Bangladesh, it is no exception. The public finances dimension had received little attention outside official post-disaster assessments for individual events such as the major floods in 1998.

combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence' (Royal Society, 1992: 4).

A *natural disaster* is the occurrence of an abnormal or infrequent hazard that impacts on vulnerable communities or geographical areas, causing substantial damage, disruption and possible casualties and leaving the affected communities unable to function normally. From an economic perspective a disaster implies some combination of *losses* in terms of human, physical and financial capital, and a *reduction* in economic activity, such as income and investment, consumption, production and employment in the 'real' economy. There may also be severe impacts in terms of financial flows, such as revenue and expenditure of public and private bodies (Benson and Clay, 1998). The losses in *stocks* of capital and inventory and reductions in short-term *economic flows* are sometimes confounded in reporting the costs of disaster impacts.³ Stock losses and short-term flow effects may be so extreme as to result in a modification in the medium to longer-term trajectory or development path of an enterprise, region or national economy.

Vulnerability is the potential to suffer harm or loss in terms of sensitivity and resilience or the magnitude of the consequences of the potential event.⁴ Economic behavior is *sensitive to* a disaster shock. This sensitivity is reflected at a macro or sectoral level in the deviation of economic aggregates from trends that were expected without taking into account the effects of this event. Because economic activity is sensitive to many influences, including other sources of shock, in practice it can be difficult to isolate precisely the impacts of a specific disaster or disasters. The primary objective of our studies has been to seek to isolate and understand these short and long term consequences of natural disasters. *Resilience* is the speed of recovery in economic activity, which may involve repair and replacement of lost and damaged capital. People seek to *cope with* shocks within a range of responses that will not jeopardize their survival or lifetime aspirations. Similarly, communities and formal public and private institutions seek to *manage* the effects of a shock without jeopardizing their envisaged longer-term plans.

The disaster management literature commonly distinguishes *rapid on-set* disasters, such as storm surges or earthquakes, which cause immediate loss and disruption, and slow on-set events, notably drought. In our empirical investigations of economic consequences we have found it useful to distinguish atmospheric or *climatic hazards* and related riverine and coastal hydrological hazards (known collectively as hydro-meteorological hazards) from *geophysical* hazards, because of the different character of the risks involved.⁵

Hydro-meteorological hazards present threats of varying intensity that are usually recognized at a local or national level, and there is consequently some form of *adaptation* in terms of economic behavior and the technology in which capital – productive, housing and habitat or

³ For example, an official assessment of the costs of the 1998 Bangladesh floods aggregated capital losses such as damage to infrastructure with rice crop losses. An assessment of Hurricane Lenny in 1999 in Dominica included costs of physical damage and reductions in income from small-scale fisheries. This practice is quite general: the widely cited Centre for Research on the Epidemiology of Disasters (CRED) Emergency events database (EM-DAT) estimates of disaster related 'direct damage' includes crop losses (reductions in the flow of agricultural output) along with damage to infrastructure, housing, etc (stocks of assets) (IFRC, 2002).

⁴ There is no generally accepted definition of vulnerability beyond recognition of sensitivity and resilience as component aspects (Alexander, 1997).

⁵ There is no accepted term to cover atmospheric or climatic and hydrological hazards. However, the *World Disasters Report 2002* uses the term 'hydro-meteorological' disasters to distinguish events resulting from atmospheric and oceanic processes that are recurrent, widespread and dynamic, under the influence of global climatic change (IFRC, 2002).

infrastructure – is embodied. The economic, and of course wider social, consequences of individual events appear to be susceptible to investigation for most lower and middle-income developing countries. In contrast, potentially catastrophic geophysical hazards may be very rare in occurrence. Even in potentially high risk geographical regions there may have been no extreme event in living memory or even within the historical record. Consequently, such hazards pose quite different problems of risk perception and economic behavior. However, a global phenomenon, satellite television and linked media information may be changing perceptions of risk associated with these types of hazard too.

1.5 Method of investigation

To isolate the economic impacts of natural hazards from other internal and external factors poses considerable methodological difficulties. The study adopts an eclectic approach employed in previous studies by the authors. This involves the construction of a historical narrative of disasters for the case study country or region. Disasters are not treated as ‘black box’ economic shocks. Instead care is taken to establish through close consultation with relevant scientists the precise nature of each hazard type, including the frequency and characteristics of extreme events. A mixture of formal quantitative and qualitative analyses to examine the economic impacts of natural hazards at an economy-wide level (Benson and Clay, 1998; Benson, 1997a, 1997c, 1998). The quantitative investigations are partial, involving a combination of regression analysis, the use of charts to examine movement around trends, and comparisons of ‘before-and-after’ impacts of disasters and of forecast and actual performance. The implied null hypothesis is that there is no direct link between disaster shocks and the relevant aspect of economic performance. Such analysis cannot always be definitive, but the results at least provide the basis for further reflection and investigation. If impacts are not apparent at an aggregate level, then the analysis moves on to consider possible impacts within the composition of the relevant economic indicator. A qualitative political economic analysis is also employed in a complementary way to place quantitative results within the specific economic and social policy context of each case study country. Where similar qualitative results repeatedly emerge from previous and current studies, this is taken to be preliminary evidence of a more general finding about the economic consequences of natural disasters.

The country studies have been constrained by the very limited resources and time available and, in some regards, substantial data limitations. Moreover, the deliberately simple methodological approach, which is, after all, only an extension of the approach typically employed to look at a single shock, relied heavily on judgment. Most obviously, it was necessary to select the ‘major’ natural hazard events to be included in the analysis.

Each country involved a country visit to collate data and undertake interviews with selected present and former officials and administrators, civil society and private sector managers who had been involved in specific hazard events as well as environmental scientists with direct experience of the country. Interviewees were also consulted about the selection of ‘major’ hazard events. Relevant country program officers at the World Bank in Washington, DC, were additionally contacted and met where possible. The case studies also entailed a review of available official documentation and recent literature. Local researchers or researchers in the region contributed to each of the country case studies.

Chapter 2

Disasters and the macro-economy

This chapter explores the overall vulnerability of an economy to natural hazards. Case study evidence about the dynamics of vulnerability leads to a more general discussion of sources of vulnerability. Then the macro-economic impacts of disasters are reviewed in terms of short and long-term effects. The impacts of disaster on development strategy are considered and, finally, the lessons learned drawn.

2.1 Dynamic nature of vulnerability

The vulnerability of an economy to natural hazards is determined by a complex set of influences. This section presents briefly evidence from the three country cases, which typify broader country situations. The cases highlight the dynamic, rapidly changing sensitivity of economies to natural hazards in the present era, focusing on developmental, economic and societal factors that interact with natural hazards. There are some common influences at work, as well as country and regional specific factors. The details of each case study are set out in more detail in Annexes A, B and C and documented in full in the separate case study reports. In the longer term climatic change is also altering the frequency and intensity of hazard events, with implications for the scale and nature of vulnerability. This is an issue that the case studies findings suggest should be explored separately.

2.1.1 Dominica

This small island economy is susceptible to a wide range of natural hazards. The most common, most probable and historically most significant, are extreme climatic events, tropical storms and hurricanes. There has been a sequence of disasters since 1978: Hurricanes David, an extreme Category 4 storm with sustained winds in excess of 210 km, and Frederick both in 1979; Allen in 1980; Hugo, another a Category 4, in 1989; the cumulative impact of three tropical storms in 1995; and Hurricane Lenny, also a Category 4, in 1999. Hurricane David directly hit the island and was extremely devastating, with severe environmental and demographic consequences. Landslides are common and can cause substantial economic damage, as well as the potential for loss of life. There are geophysical hazards too. Although there has been only one volcanic eruption in Dominica's recorded history, the island is now in a period of increased seismic activity, and the risk of volcanic activity remains relatively high, particularly in the south of the island, where the capital and most of the key infrastructure are located.

Dominica has a small, very open economy, still heavily reliant on a single export crop - bananas - which represented a third of total merchandise export earnings in 1997. Although its GDP share reduced from 37% in 1977-78 to 20% in 1997-98, the agricultural sector remains the major productive sector and is the major source of livelihoods. Despite limited growth since the mid-1970s other private sector activity remains small. Manufacturing output rose from 3.9% to 8.2% of GDP between 1977 and 1998, and there has also been promising growth in the burgeoning offshore financial services industry. Along with tourism, which by the late 1990s accounted for an estimated 35% of external earnings, these have helped to meet the substantial deficit on the external visible trade account.

Macro-economic performance

The close association between fluctuations in Dominica's banana exports, agricultural, non-agricultural and total GDP and the incidence of severe storms demonstrates the substantial impact of natural hazards on the island's economic performance since 1978 (Figure 1). The analysis also suggests that the economy is becoming relatively less sensitive to extreme climatic events. These shifts in the nature of vulnerability to natural hazards are related both to changing levels of development and capital investment in the island, and also to changes in the structure and composition of economic activity. The economy was most vulnerable to extreme climatic events in the years 1975-85, shortly before and after Independence in 1978.⁶

From the 1950s, bananas, largely grown by smallholders, had progressively displaced plantation tree crops as the principal commodity exported to the UK and then the Economic Union (EU), under a preferential access agreement. These changes in the type and structure of production increased the overall vulnerability of both the agricultural sector and wider economy to natural hazards.

Hurricane David, followed rapidly by Hurricanes Frederick and Allen demonstrated that vulnerability, causing severe damage to banana plantings. However, these hurricanes directly led to an increase in the share of bananas in total agricultural output, as banana cultivation offered a fast, low-investment means of restoring agricultural livelihoods in an assured export market.⁷ The rapid recovery in export production after Hurricane Hugo in 1989 again demonstrated the resilience of the banana economy. In this case, the compulsory WINCROP banana crop insurance scheme, introduced in 1987-88 by the banana marketing boards of four Windward Island states, also played a role in encouraging re-planting of bananas, by offering partial financial protection in the event of a disaster (see Box 6). The dominance of bananas in Dominica and similar mono-crop agricultural sectors in other small island economies exemplifies a progressive adaptation to a specific external economic environment, and is often accompanied by institutional innovation.

The wider economy's vulnerability to natural hazards has changed over the past two decades as a consequence of changes in the sectoral composition of GDP, a development accelerated by the World Trade Organisation (WTO) process. From the mid-1990s, external factors resulted in a decline in export-oriented banana production, with falling real prices and the loss of guaranteed preferential access to the European market. Counterintuitively, a more diversified agricultural sector will be more sensitive to both natural hazards and other risks. However, agriculture's share of GDP halved to only 19% between 1977 and 1997, while manufacturing, tourism and financial services grew and increased their share of GDP. These latter service sectors are less sensitive to all except a catastrophic event, such as Hurricane David, and so their growth implies a reduction in vulnerability of the economy as a whole.

⁶ Other broadly comparable countries made a more rapid but similar transition, leaving Dominica as the least developed of the former British Caribbean island colonies.

⁷ Bananas are highly sensitive to damage from winds of 40 mph or more, so that even the fringe impacts of less severe tropical storms can cause serious damage. Smallholders are also less able to bear heavy losses, because of their lack of assets and access to credit. However, recovery only takes 9-12 months, even where crops are totally devastated. So where finance for replanting is available and marketing channels not disrupted, bananas are also highly resilient. In contrast, production of copra, the other major commercial crop in 1979, took 3 – 4 years to recover.

Infrastructure

Development of the island's infrastructure shows how long-term changes in vulnerability are linked to the broad level of development as well as changes in the structure and composition of economic activity. From 1950 to 1978, Dominica was transformed from an underdeveloped plantation cum subsistence colony into an independent middle-income economy. Key to achieving this was rapid infrastructure development. Given the severe financial constraints, development was achieved at the lowest possible construction costs. The investment took place following more than 20 years without any major hurricane impacts. The result was construction without adequate disaster mitigation built into the design, with devastating consequences when Hurricane David struck.⁸ . All the key infrastructures were devastated and, excepting airports, were again partially disrupted by Hurricane Lenny in 1999. Their vulnerability to natural hazards now varies, reflecting the degree of hazard mitigation investment that has taken place and associated practical and funding issues.

Dominica is part of the Eastern Caribbean dollar (EC\$) area, carefully and conservatively managed by the Eastern Caribbean Central Bank (ECCB). That framework of monetary stability reduces financial uncertainties for the private sector and lessens the potential destabilizing financial impacts of a disaster shock (see Chapter 3).

⁸ The deep-water port at Woodbridge Bay, built between 1974 and 1978 highlights the value-for-money case for designing new infrastructure and buildings to withstand hurricane damage. Most of Dominica's road system runs along the narrow coastal strip very near to the shore, rendering it highly vulnerable to storm damage. Other key infrastructure networks – telecommunications, electricity, and water transmission and distribution – run alongside the road and are similarly vulnerable.

Figure 1: Dominica - real annual fluctuations in agricultural, non-agricultural and total GDP 1978-1999



Source: Benson and Clay, 2001

2.1.2 Bangladesh

Most of Bangladesh's large, densely settled population of 130 million people lives in the delta of the great Ganges and Brahmaputra River systems and is at significant risk to more than one form of natural hazard. Riverine floods, tropical cyclones sometimes accompanied by devastating storm surges, flash flooding and erosion and drought have all caused severe economic and social disruption and considerable loss of life in recent decades. Bangladesh is also in a zone of very high seismic activity.

A decade of severe disasters began in the mid 1960s, including a catastrophic cyclone in November 1970 that killed over 300,000 people and the conflict and humanitarian crisis of the war of independence and its aftermath in 1971, in which 12 million were displaced. Massive damage to infrastructure and institutional disruption resulted. The decade culminated during 1974-5 in a famine, linked to extreme floods in 1974, hyperinflation and bloody political crisis. These events created a worldwide perception in the mid 1970s of Bangladesh not just as a disaster-prone country but, in the insensitive words of the then US Secretary of State, a non-viable 'basket case'.

With no further major disasters, the Bangladesh economy achieved rapid recovery in the late 1970s. Annual per capita GDP growth averaged 1.7% in the 1980s and 3.3% in the 1990s, this rise reflecting both higher GDP growth and declining population growth. At the same time there has been a change in the structural composition of the economy: agriculture's share of GDP has declined, while the industrial and service sectors have expanded, resulting in a sharp shift in the composition of the country's exports. A gradual process of structural adjustment and trade liberalization, alongside more disciplined monetary management resulted in the 1990s in an inflation rate kept in single digits and an annual current account deficit below 2.5% of GDP. The reforms have also helped increase private sector development and foreign direct investment. Fiscal policy has not been so successful: there have been large fiscal deficits, a low tax to GDP ratio and relatively poor quality spending.

A simple assessment of the sensitivity of Bangladesh's economic performance to major disasters in terms of fluctuations in GDP, and rates of growth in agricultural and non-agricultural sector product highlights some key issues:

- ? In the period 1965-75, there was extreme volatility in the still largely agricultural economy and a very clear link with catastrophic natural disasters.
- ? With the notable exception of the most recent 1998 floods, major disasters have resulted in a downturn in the agricultural sector annual rate of growth.
- ? The short-term impact on the non-agricultural sector is much less significant, but longer-term impacts of disasters are not reflected in inter-yearly fluctuations: if resources are diverted from productive investment to disaster response, the pace and nature of development will be adversely affected.
- ? The sensitivity of both agricultural and non-agricultural components of GDP to natural hazards appears to be declining over time, suggesting greater resilience (Figure 2).

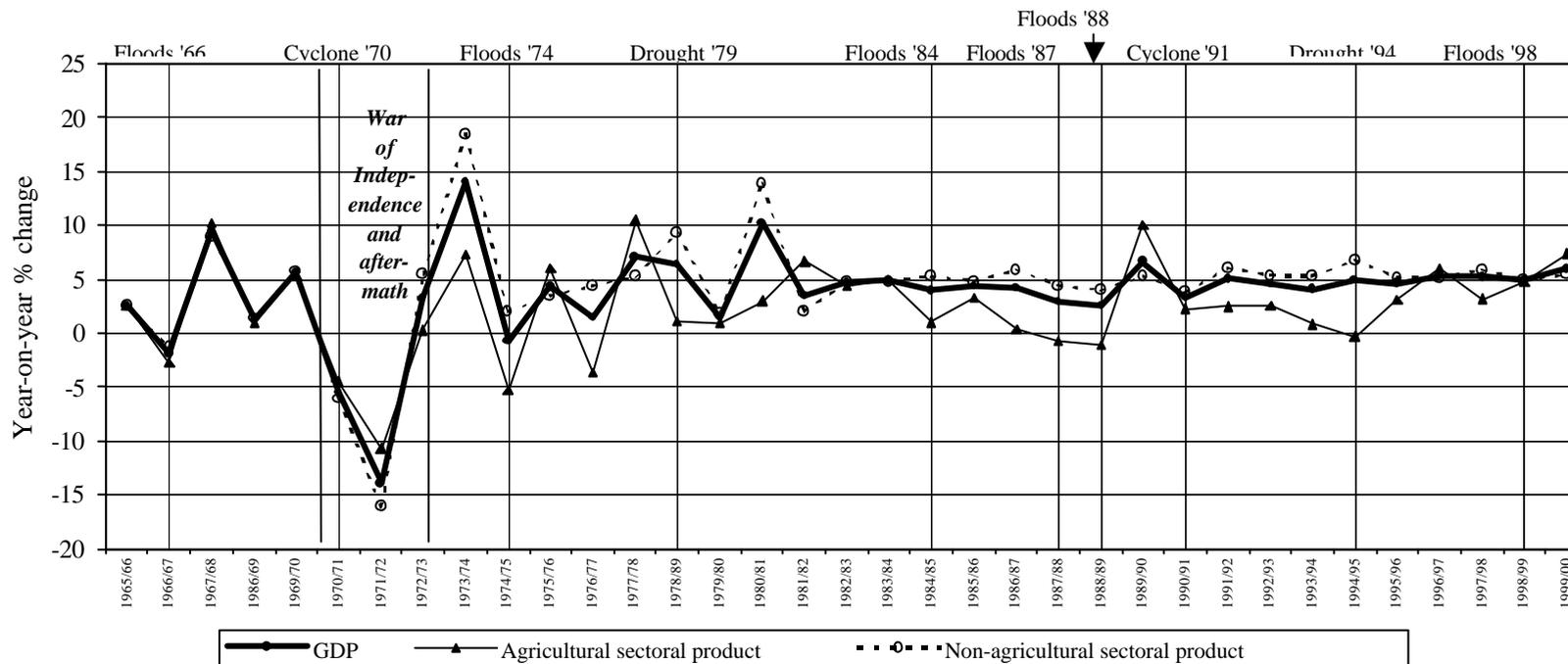
Part of Bangladesh's greater resilience is attributable to structural change in the agricultural sector. Following the 1987 and 1988 floods, a relaxation of restrictions on private agricultural investment and imports of equipment, initially to encourage recovery, was associated with a rapid expansion of much lower risk dry winter season irrigated rice, displacing highly flood-prone deep water rice and jute. Increased rice production and external and domestic grain trade liberalization has also played a role. As Bangladesh approached self-sufficiency in rice, the national staple, internal prices displayed reduced seasonal volatility and moved closer to import parity price levels with liberalization of the grain import trade. After the floods of 1998 large-scale private sector imports covered the greater part of the temporary food gap, limiting pressures on prices and public finance (del Ninno and others, 2001).

Greater investment in structural flood control has been another factor contributing to increased resilience. Urbanization is rapidly creating large urban and peri-urban zones, including in the capital Dhaka, which is quickly becoming a sprawling minimally planned megacity, with weak overstretched infrastructure. However, since the severe floods of the late 1980s there has been a *de facto* shift with some success in flood control investment and O & M (the major area of public expenditure on disaster mitigation) from rural and agricultural to urban and industrial protection. The 1998 floods, of longer duration and with higher river levels than 1987 or 1988, did not severely affect the greater Dhaka metropolitan area or some secondary towns that had received enhanced protection.

Changes in the composition of productive activity have also changed the nature of vulnerability of the economy. Rapidly expanding export-oriented garment manufacture has been the primary motor of export growth as inward foreign direct investment (FDI) and some local industrialists exploited the trading niche offered by the Multi-Fibre Agreement (MFA). During the 1998 floods, there was some disruption to supply and export chains, but the industry, which was largely based in less flood affected urban zones, proved resilient. Again, however, it appears that risks have altered rather than simply been reduced. The industries' markets are far from assured and could be lost if there were a major disaster-related disruption. Manufacturing in coastal Chittagong is potentially exposed to an extreme cyclone and storm surge, such as that in 1991. Building standards in new industrial and commercial developments, with a short life expectancy, and in rapidly expanding housing also largely ignore seismic hazard.

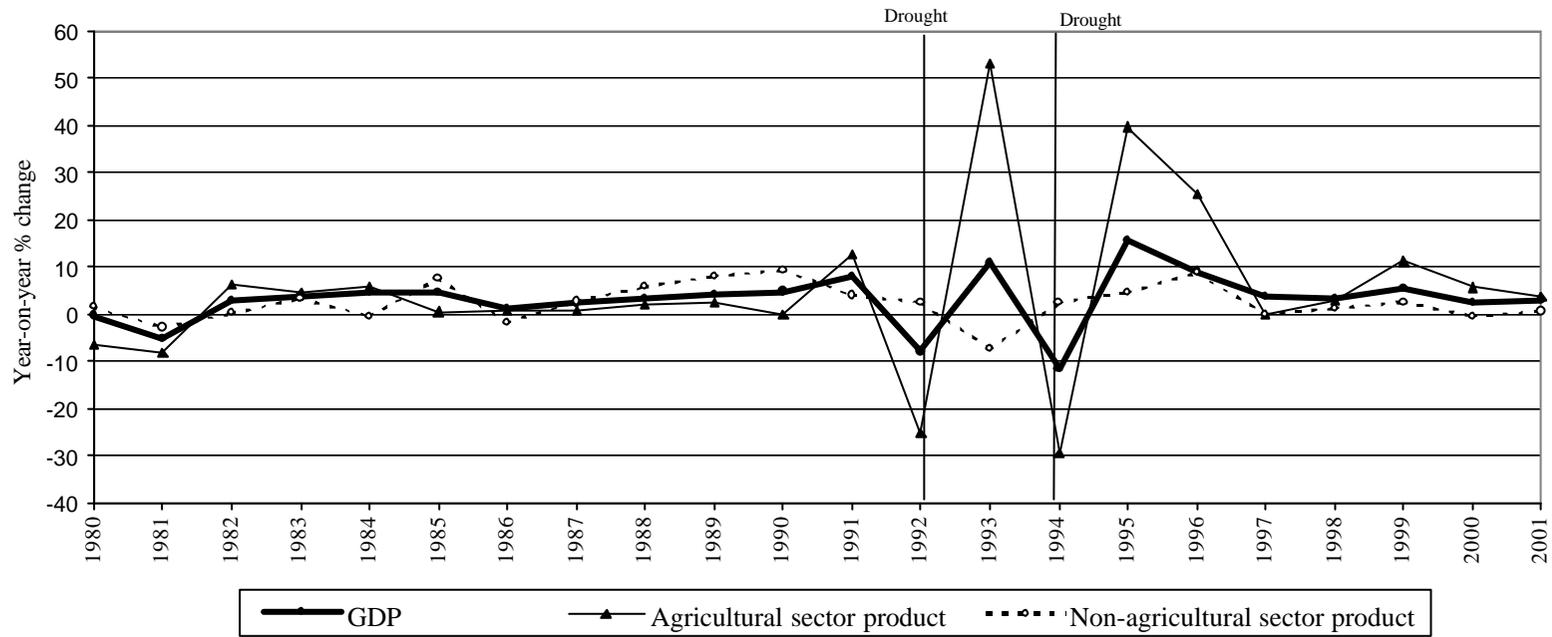
Other major developments have been in the financial system, with some important innovations in financial services. After the chaotic hyperinflation that contributed to the famine of 1974, the government has maintained relative financial stability in the aftermath of subsequent disasters. Labor migration has played an important role in financing economic growth through the remittances of incomes and also in providing financial support post disaster. For example, remittances increased by 18% in the financial year that include the 1998 floods. Bangladesh has been a leader in developing micro-finance for the rural and, more recently, urban poor. Micro finance played a significant but still limited role in enabling the poor to cope with the costs of the 1998 floods (del Ninno and others, 2001). Importantly, the (central) Bangladesh Bank was also able to protect this critically important financial sector through massive refinancing.

Figure 2: Bangladesh - real annual fluctuations in GDP, agricultural and non-agricultural sector product 1966-2000



Source: Benson and Clay, 2002

Figure 3: Malawi - real annual fluctuations in GDP, agricultural and non-agricultural sector product 1980-2001



Source: Clay and others, 2003

2.1.3 Malawi

On current evidence, some of the countries in Southern Africa have, since around 1990, experienced increased economic volatility that is linked with climatic variability (Figure 3). This apparent increase in vulnerability has occurred during a period of many complex interacting developments in the region. Some have been positive, such as the political reintegration of South Africa and the end of the conflict in Mozambique. Others are negative, such as the increasing problems of governance in Malawi, Zambia and Zimbabwe and the HIV/AIDS epidemic, undermining capacity to cope with shocks. These developments are highlighted by what has happened in Malawi.

Malawi, a small, landlocked country, had a population of 10.8 million in 2000. It is one of the poorest countries in Africa, with per capita GDP of US\$170 in 2000. Health and social indicators are also amongst the lowest, in one of the countries most severely affected by HIV/AIDS. The loss of human capital and ill health amongst the economically active population is probably making the country more disaster-prone.

Malawi still has a largely rural economy, with 89% of the economically active population classified as rural. Agriculture accounted for some 40% of GDP in 2000, compared with 44% in 1980. Its share in GDP was declining but rose again in the 1990s, with industrial stagnation and contraction in the public service sectors. Export earnings are dominated by agricultural commodities, largely rainfed tobacco, making the economy sensitive to climatic variability and commodity price shocks.

Although there has been internal liberalization and reduction in tariffs, the economy has become relatively less open over time. Exports have declined as a proportion of GDP from 28% in 1980 to 24% in 2000, and imports from 43% to 40%.

The main source of natural hazards is climatic variability. The major food staple, rainfed maize, accounting for over 70% of energy intake, is extremely sensitive, not just to drought or low rainfall, but to erratic rainfall within the growing season and to abnormally high rainfall. There were only two clearly defined droughts in the 20th century, one associated with the famine of 1949 and the other in 1991/92, when maize production was reduced by around 60%. However, relatively unfavorable conditions such as widely reduced and erratic rainfall in 1993/94, or extremely high rainfall as in 2001, or locally erratic rainfall as in 2002, pose increased food security and wider economic threats to a more vulnerable, less resilient economy.

Riverine flooding is an annual, relatively predictable hazard in lower population density southern districts. Even in 2001 flooding did not have a widespread, catastrophic impact. There are apparently no other significant forms of natural hazard.

Sources of Malawi's increasing sensitivity to climatic shock

At least six factors are contributing to increasing economic fragility:

- ? *Non-sustainable agricultural practice:* The stagnation in cereal production over more than two decades is a problem of Southern Africa more generally (Figure 4). It has been linked to a failure to follow cropping patterns that maintain nutrient levels and a failure to compensate for lost nutrients through increasing fertilizer applications. Demographic pressures are a factor in smallholders seeking to feed themselves and find a livelihood from ever smaller areas of land. But other factors are required to explain why they are unable to address technical constraints.

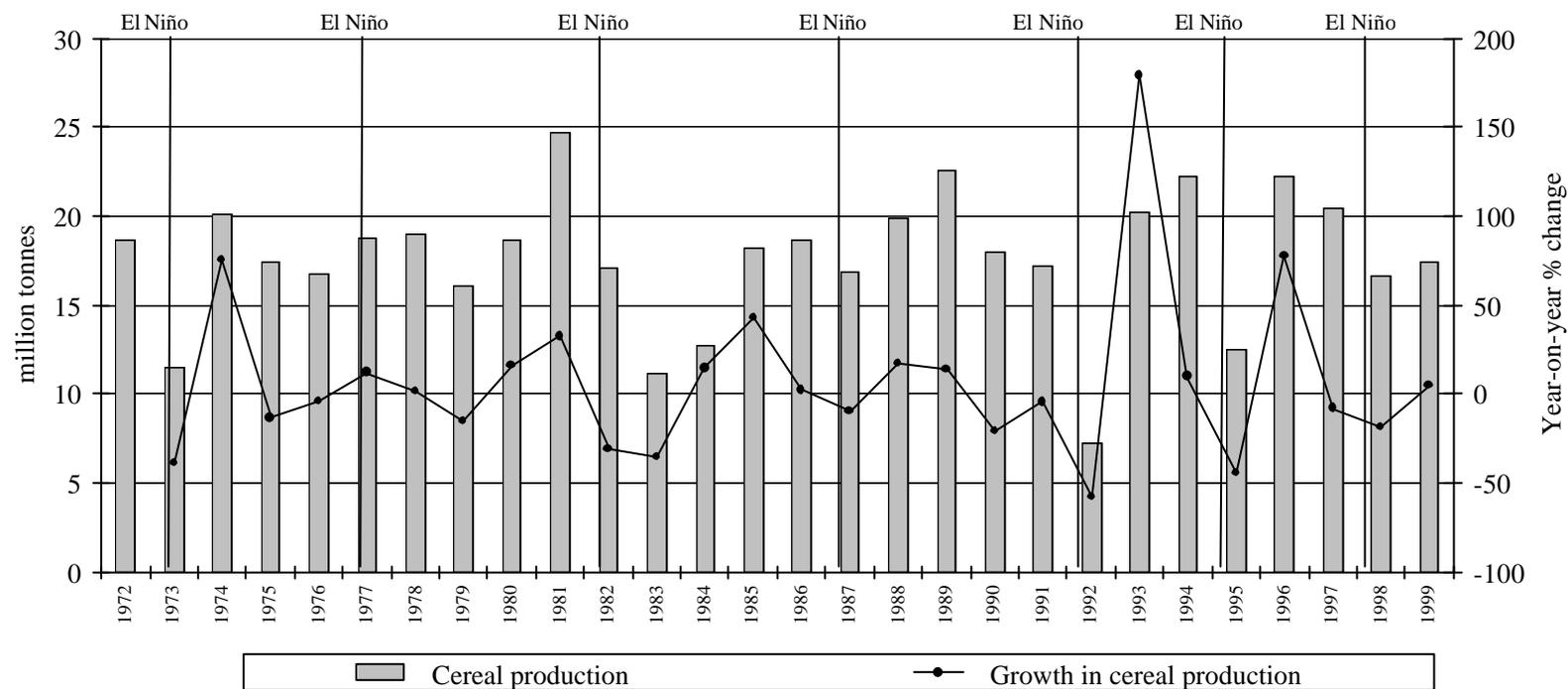
- ? *Structural change in agriculture:* This has resulted from deliberate land redistribution and also economic processes, both influenced by policy. Decades of marginalizing the small farmer and then switching in the 1990s to encouraging the small farmer into tobacco production have increased volatility. This has not been accompanied by sufficiently successful attempts to establish a viable credit system, input supply and a supportive marketing structure for smaller producers.
- ? *Institutional weaknesses in agriculture:* These reflect lack of success in many sectoral and structural adjustment programs. Previously dominant or monopoly parastatal marketing, credit and input supply organizations have been weakened, but effective and efficient commercial enterprises have not emerged to fill the gap. The 2002 regional crisis confirms that too little has been achieved.
- ? *Political instability:* Since the early 1990s, political instability and problems of governance have weakened the government's capacity to manage the fiscal and monetary aspects of shocks (see Chapter 3).
- ? *The short-term behavior of external aid:* The country-specific policies of donors – in turn is influenced by political, governance issues, as well as directly economic and humanitarian considerations – have been an important factor in the volatility of public finances.
- ? *The effects of HIV/AIDS on human resources:* Such effects are insidious, much discussed, but only gradually being understood, quantified and seriously addressed. The loss of human capital and ill health amongst the economically active population, undermining coping strategies, is making the country more disaster-prone (Haacker, 2002).

Climatic change and disasters in Sub Saharan Africa

Climate change is frequently mentioned in the context of an extreme event, such as the 1991/92 regional drought (Figure 4) or the 2000/1 floods in Mozambique. There is as yet no conclusive evidence that Malawi, Southern Africa more widely or other regions of sub-Saharan Africa are experiencing either more frequent extreme events or longer-term aridification (Hulme and others, 2001). However, both are anticipated for parts of Southern Africa as a consequence of climatic change (IPCC, 2001; Fischer and others, 2002).

The three case study countries demonstrate striking contrasts, not just of increasing and decreasing but also changing forms of vulnerability. These developments belie somewhat simplistic notions of general and rapidly increasing vulnerability to natural hazards associated with global economic growth and climatic change. In Bangladesh and Dominica sensitivity to climatic related hazards seems to have peaked in the 1970s, but Malawi and some other Southern African economies are currently indicating increasing sensitivity. In contrast, risks emanating from geophysical hazards appear to have increased with urbanization and growth of the secondary and tertiary, industrial and service sectors in both Bangladesh and Dominica.

Figure 4: Southern Africa – cereal production and El Niño events 1972-1999



Source: Clay and others, 2003

2.2 Factors determining vulnerability

Economic vulnerability is not a static condition reflecting location specific environmental hazards. Rather, the scale and nature of the economic impacts of a natural hazard event depend on a range of influences, which are also time specific. The country studies along with evidence from previous case studies suggest five basic factors determining broad macro-economic vulnerability to natural hazards:

- ? the type of natural hazard
- ? the overall structure of an economy, including natural resource endowments;
- ? the geographical size of a country;
- ? income level and stage of development; and
- ? prevailing socio-economic conditions, including the policy environment and state of an economy.

Each of these influences is considered in more detail below.

There are also other factors affecting vulnerability. For instance, vulnerability is time-dependent, not only in the context of the stage of socio-economic development of a country but also in that of technical and scientific advancement. For example, since the early 1990s there have been considerable advances in seasonal climatic forecasting for Southern Africa and other regions of sub-Saharan Africa. Such information can be used to inform private and public decisions - such as those pertaining to the management of water resources, choice of crops and the level of grain exports and imports - in turn altering the relationship between climatic variability and economic performance.

The application of technical and scientific developments in economic activity can also alter vulnerability. For example, flood-tolerant cultivars used in deep-water rice cultivation in south and south-east Asia have gradually been displaced by shorter-stemmed cultivars that require more controlled, often irrigated water management, but also permit more intensive production. In Bangladesh, this intensification, which is associated with a switch to dry season irrigated, high input rice, has reduced overall crop production variability and vulnerability to climatic hazards.

Disaster management more narrowly defined, in terms of specific mitigation, preparedness and post-disaster response, plays an additional role in determining the level and nature of vulnerability, as discussed in the country studies.

A further critical factor, environmental change, also influences vulnerability to natural hazards. In Bangladesh the destruction of Sundarban mangrove forest may affect the impact of cyclones. In addition, upper riparian water management and use may alter the risks of extreme flood and the consequences of drought. Deforestation also probably increases the risks of landslides, which could be triggered by climatic or seismic events in Dominica. Farming practices and social pressures on waste and forest in Malawi accelerate soil erosion and increasing sensitivity to climatic extremes. Global climatic change could also alter the frequency and scale of climatic hazards.

2.2.1 Natural hazards

The inductive nature of case study investigation suggests preliminary findings and hypotheses that need to be more widely explored. The authors' previous study of drought in sub-Saharan

Africa suggested the hypothesis that vulnerability is linked in a non-linear way with the process of economic development from a simpler to a more complex economic structure, characterized by increasing inter-sector linkages and integration of financial flows (see below). Further investigations, reported in this study, lead us to propose a second hypothesis – that the changing patterns of economic vulnerability are distinct for two broad types of hazard – firstly, hydro-meteorological hazards (drought, flood, cyclones and hurricanes) and secondly, geophysical hazards. If that hypothesis is provisionally accepted, then it has important implications in terms of the need for further investigations and for disaster reduction policy.

Hydro-meteorological hazards

Climatic variability and drought Abnormally low or erratic rainfall (usually characterized as drought) and also abnormally high rainfall are likely to impact negatively on agricultural performance. The negative impacts of abnormally high rainfall may be less severe but serious for a highly vulnerable rural economy. This relationship is demonstrated for Malawi and Southern Africa more generally. *Drought* in particular can cause heavy crop and livestock losses over wide areas, often affecting several countries simultaneously (*covariance* aspect of disaster risk) as in Southern Africa in the early 1990s. Extreme climatic events may be extended – there is a significant risk of one or more very dry years in the Sahel (*auto or serial correlation*). In southeast Africa, extreme events occurring within a well-established long quasi-cycle of drier and wetter periods of approximately a decade may be amplified – drought in the early 1990s and more recently floods at the turn of the century. They may also be dampened, as with droughts in the 1970s. Such quasi-cyclical phenomena, which modify the potential impact of an event considered in isolation, have implications not only for agriculture, but other water-related (hydrological) sensitive sectors of an economy, such as hydro-electricity and domestic water supply (Hulme, 2001).

Riverine floods Abnormally severe flooding is likely to damage infrastructure and productive capacity, as well as directly reduce output, particularly by destroying standing crops, and disrupt economic and social activity. These effects can be widespread (Bangladesh) or very restricted (Malawi).

Tropical cyclones and hurricanes These pose a considerable threat to human life, especially when associated with storm surges, and can have devastating impacts on the productive economy. These economic impacts may be less widespread than the impacts of drought or riverine flood (Bangladesh) or, like Caribbean hurricanes, leave a path of destruction and disruption across a whole region. Storm impacts are likely to have a more localized impact in larger economies (coastal Bangladesh or Philippines) but to be overwhelmingly devastating for smaller economies (Dominica, Fiji, Montserrat).

Severe storms are likely to be associated with other intensified, localized hazards – flash flooding and landslides. Examples include Hurricane David in 1978 in Dominica or Hurricane Mitch in 1998 in Central America (IFRC, 1999).

Geophysical hazards

Earthquakes can cause widespread destruction of infrastructure and other productive capacity over relatively large areas. But these events have little impact on standing crops, excluding localized losses occurring as a consequence of landslides. The greatest risk of catastrophic macro-economic consequences is where the event occurs in a major urban center or the metropolis (e.g. Tokyo in 1923). The possibility of such an extreme outcome is, as with all hazards, in part a function of the economy's size, so that a single volcanic eruption could wholly disrupt the Montserrat economy. Volcanic eruptions and tsunamis also usually have localized direct impacts.

Geophysical and climate-related hazards compared

The area of danger in a geophysical event is usually more restricted than that of the most extreme climatic events. The other important difference between climate-related and geophysical hazards is the form of risk associated with events likely to cause severe economic impacts. In Dominica damaging storms have been 5 – 50 year events, depending on their intensity. The droughts in Malawi and extreme floods in Bangladesh during the 1980s and 1990s, with clearly macro-economic impacts, have also been 5 – 50 year events, according to levels of severity. The recurrent nature of hazard leads to adaptation in economic and social activity, such as agriculture, housing and water supply at micro and sectoral levels. The historical climatological and hydrological records have also allowed formal assignment of risks within probability bands that can be taken into account in larger scale public and commercial investment and in production decisions. However, these risks are also non-random, potentially subject to quasi-cyclical and secular change.⁹ Consequently, experiences based on climatically relatively short periods may be profoundly misleading in the formation of expectations.¹⁰

In contrast, from the viewpoint of most public and private investment decisions geophysical hazards are to be regarded as random, stochastic events of uncertain and mostly low probability. Extreme geophysical events, with the potential to cause severe damage and disruption are very rare – a 1% risk or less in any year. It is very unlikely that in relatively high risk zones there have been disastrous events within living memory (earthquake in Bangladesh) or even the historical record (extreme volcanic eruption in Dominica). Risks have therefore, until very recent media dissemination of information about events elsewhere, had very little effect on private or even public decisions on the location of activities or construction standards for the built environment. Only formal regulation or risk assessments that are required in internationally funded investment are likely to introduce risk reduction into economic decisions. However, the global disaster-related costs of geophysical hazards are rising rapidly, and in countries with a significant risk the potential cost is rising exponentially with economic development.

2.2.2 Economic structure

The interplay of the types of natural hazard risk to which a country is exposed and the basic structure of its economy at a particular moment in time plays a significant role in determining broader macro-economic vulnerability. That structure is reflected in the relative importance of the various sectors and sub-sectors, and within that, factors such as patterns of ownership and systems of production, as well as inter-sectoral linkages and the role and nature of capital in production.

Both the Dominica and Bangladesh cases show how reductions in broad macro-economic vulnerability are related to structural change – specifically, to a relative decline in agriculture,

⁹ Formally, hydro-meteorological hazards are determined by highly complex, chaotic climatic processes, reflected, for example, in the well-known El Niño-Southern Oscillation.

¹⁰ The base period for climatic analysis is 30 years, currently 1961-90. A much longer run of data is required to assess climate related risks. Two examples from case study countries illustrate the potentially costly consequences of expectations formed from short-term experiences. In Dominica which had not experienced a direct hit from hurricane of storm force three or more for over 40 years prior to 1979, there was widespread underestimation of the levels of storm proofing required in buildings and infrastructure. The decision rules established in the relatively wetter 1970s for managing water levels in Lake Kariba failed to provide sufficient reserves to prevent the 1991/2 drought disrupting electricity supplies to Zimbabwe (Benson and Clay, 1998)

commonly the most vulnerable sector. Even within the agricultural sector, however, there are various factors working to determine the precise nature and level of vulnerability, including capacity to recover and the degree of resilience to a hazard event. As seen in the case of Dominica, banana producers can suffer enormous damage as a consequence of disasters but their resilience in terms of their capacity to recover has been strong. The relative importance of different socio-economic groups in production can also significantly influence vulnerability, as in Malawi and Zimbabwe (Benson, 1998).

Dominica and Zimbabwe provide contrasting examples of the importance of the degree of intersectoral linkages in determining hazard sensitivity.¹¹ In some countries, there is a high degree of dualism, with a large capital-intensive extractive sector that features significantly in the trade account but is weakly linked with other sectors of the economy. In the macro-economic aggregate and trade account, effects of drought were modest in Zambia in the 1980s, before the collapse of copper mining, and in Botswana and Namibia during the 1990s.¹²

2.2.3 Stages of development

Economic development is widely understood as a process of increasing complexity reflected in the increasing proportion of GDP accounted for by secondary and tertiary sectors of the economy. The stage of development of an economy, as defined and measured in terms of the degree of sectoral, geographical and financial integration, levels of economic specialization and government revenue-raising capabilities is then likely to influence vulnerability to natural hazards (Benson and Clay, 1998).

Least developed or simple, less complex economies are typically perceived as most vulnerable. Absolute losses as a consequence of a particular disaster may be small relative to levels reported in developed countries. Reflecting weak intersectoral linkages, a high degree of self provisioning, and, often, poor transport infrastructure, the multiplier effects from the immediately affected regions and/or sectors through the rest of the economy may also be fairly limited. Moreover, much of the relief and rehabilitation costs may be met through external grant and concessional assistance. Nevertheless, the physical impact of a disaster may be severe, causing widespread destruction and sometimes high loss of life, whilst disasters can also exacerbate existing problems of indebtedness and poverty.

However, economic growth and development *per se* may not reduce vulnerability. In Bangladesh and Dominica, for instance, development is altering rather than simply reducing sensitivity to natural hazards. Poor and socially disadvantaged groups can become differentially vulnerable.¹³ Although this much researched subject is outside the scope of this

¹¹ Manufacturing and exports of coconut-based soap products, encouraged by a CARICOM agreement, increased during the 1990s in Dominica. However, the destruction of coconut trees and reductions in yield as a consequence of a hurricane in 1995 had little impact on manufacturing production. A substantial share of copra was being sourced by then from overseas due to high domestic prices and Dominica's very limited production. In contrast, in Zimbabwe during the early 1990s strong inter-sectoral linkages transferred the impacts of increased vulnerability of the agricultural sector to drought to the rest of the economy.

¹² The governments in Botswana and Namibia have had sufficient resources of their own to finance substantial relief programs, reflecting the importance of extractive mining sectors in both countries (Drèze and Sen, 1989; Thomson, 1994).

¹³ Socio-economic change related to development can lead to the breakdown of traditional familial support, declines in traditional ways of life and associated coping measures and the increased occupation of more hazardous land. These processes are in part associated with urbanization.

study, its importance should be fully acknowledged. Similar patterns may be mirrored at a macro-level. An economy at an intermediate stage of development is typically more integrated than a simple one, both between sectors and different geographical regions, thus increasing the multiplier effects of adverse performance in a particular sector or regional economy. For example, climatic hazards may impact on the (larger) manufacturing as well as agricultural and livestock sectors, particularly where initial growth of the manufacturing sector is based primarily around agro-processing (as is commonly the case). Meanwhile, the government is likely to meet a larger share of the costs of the relief and rehabilitation efforts itself, rather than relying almost entirely on international assistance (see Chapter 3). In such an economy, the financial sector is also likely to play a more important role in shaping the impact of a natural disaster. Intermediate economies typically have more developed economy-wide financial systems for the flow of funds, including small-scale private savings and transfers, diffusing the impact of disasters more widely.¹⁴

In the later stages of development, evidence, such as the reported costs of disaster damage (e.g. Alexander, 1997) and the effects of drought shocks on GDP (Benson and Clay, 1998), suggests that the relative scale of the economic impacts of disasters is likely to decline again. In part, this relationship reflects the smaller role of the particularly hazard-vulnerable agricultural sector in GDP, as a source of employment, a source of inputs to other sectors and an end-user. More developed economies are also typically more open and have fewer foreign exchange constraints, implying that any disaster-related increases in imports will not displace normal imports. Other factors also contribute to lower vulnerability in more developed economies, including higher investment in risk reduction, improved environmental management and lower levels of poverty. Moreover, a greater level of economic assets is likely to be held by the private sector and adequately insured against disaster. Similarly, a higher proportion of damage sustained by individual households will be covered by insurance. Thus, the scale and cost of relief and rehabilitation programs will be limited and is less likely to necessitate a substantial increase in government domestic or external borrowing. However, a small segment of the affected population may be severely affected in terms of loss of income, assets and savings.

Increased provision of infrastructure and services may also alter, even increase, vulnerability. For instance, construction of arterial roads from rural to urban areas can shift cropping patterns away from lower yielding and less marketable but more hazard-tolerant traditional, towards more marketable, but higher risk, crops. Kelly and Khan Chowdhury (2002) explore these issues for Bangladesh.

¹⁴ For example, in Zimbabwe following the 1991/92 drought the transfer of remittances from urban to rural regions was facilitated by the well-articulated system for small savings. These transfers mitigated the impact of the drought in rural areas but also spread the effects more widely (Hicks, 1993).

Box 1: Measuring vulnerability

There have been several recent attempts to distinguish between countries more or less vulnerable to natural hazards for essentially international development policy purposes. The results typically generate a numerical ranking of countries according to relative vulnerability. Attaching a single quantitative number to a country's level of vulnerability is an appealing notion. Levels of poverty provide an immediate indicator of the likely importance of poverty reduction efforts in a country, and the extent to which poverty factors should be considered and addressed in broader policy. Similarly a summary indicator could serve to highlight the possible need to address vulnerability to natural hazards and perhaps bring risk concerns into the heart of government thinking.

The recent flurry of interest in indices of vulnerability to natural hazards is part of a wider attempt to measure the extent of vulnerability of individual nations, particularly small states, to external economic shocks. This interest is partly fuelled by the fact that many small states have relatively high levels of per capita GNP, suggesting economic strength rather than - as is often, the case - fragility. Focus on their relative wealth, rather than economic stability, has limited their access to concessional aid resources, generating concern that they may require differential treatment by the international development community. Vulnerability indices could become an important determinant of a country's graduation status within the UN and Bretton Woods systems (World Bank, 2002).

The usefulness of vulnerability indices ultimately hinges on their success in capturing meaningful differences in sensitivity to shocks. The vulnerability indices that have been developed have been based on a (sometimes weighted) range of components capturing different aspects of vulnerability, including that relating to natural hazards. Vulnerability to natural hazards, in turn, has been based on some form of historical record of impact, variously defined as total damage from significant disaster events (defined as exceeding 1% of GNP) over a specified period (Briguglio, 1995); the percentage of population affected by natural disasters (Atkins and others, 2000); and the total number of natural disasters over the period 1970-96, expressed relative to total land area (Atkins and others, 2000). UNDP is currently working on the development of a more sophisticated form of vulnerability indicator, incorporating political, social and economic factors that could influence current and future vulnerability. However, even then, the scores and relative ranking of different countries will be approximate at best.

Differences of definition, compounded by incomplete and inaccurate data, have resulted in significant differences in the resulting ranking of countries, although all rankings have highlighted the apparently particular vulnerability of small-island economies to natural hazards. Bangladesh ranked 15th according to total damage as a percent of GDP, 2nd according to population affected, and 23rd according to total number of disasters relative to land mass. Dominica ranked 2nd according to total damage, 13th according to population affected, and 7th according to total number of disasters relative to land mass. Malawi ranked 51st according to total damage, 23rd according to population affected, and joint 44th according to total number of disasters relative to land mass.

More fundamentally, any ranking is sensitive both to the period of analysis and type of hazard faced by a particular country. Different types of hazard have different types of risk. A country might score highly, say, because of a single extreme geophysical event with very low probability of recurrence - or very low because it has not experienced that event.

Moreover, each index has been based entirely on historical impact, however defined, ignoring the dynamic nature of vulnerability, which demands a forward-looking concept. The impact of past disasters is significant and comparisons of hazard events across countries and, within countries, helps build understanding of factors contributing to vulnerability. However, past impacts cannot be directly equated with future vulnerability. The nature and scale of vulnerability, whether viewed in economic or other terms, is itself highly dynamic and in constant flux, as human actions continually influence vulnerability, both at the household and macro-economic level. The insidious, progressive effect of the HIV/AIDS pandemic in Southern Africa on vulnerability to natural hazards, only fully exposed by the 2002 humanitarian crisis triggered by unfavorable weather, highlights these issues.

Source: Benson (2003)

Within this broad framework, very small island economies represent a special case – a point illustrated in case studies and underlined by recent attempts to develop national indices of vulnerability (see Box 1). In such a country, a cyclone (Hurricane David in Dominica) or a volcanic eruption (Montserrat) whose impact would be relatively localized in a larger country, can be catastrophic, potentially disrupting the whole economy, destroying much of the transport, power and communications networks, productive capacity and social infrastructure and precipitating an exodus of human capital. A loss which ‘would be merely a local transfer in a larger economy’ – for example, the temporary or permanent displacement of markets for a country’s outputs – could be a loss to the nation in the case of a small island economy (Handmer and Thompson, 1997: 15).

2.2.4 Prevailing socio-economic conditions¹⁵

There are a myriad of other factors, either coincidental or the consequence of deliberate public policy, which can also act to dampen or amplify the economic impact of a hazard event. Such factors are contingent, reflecting a range of dynamic influences. A probably incomplete list of these factors include:

- ? Domestic macroeconomic policies such as a stabilization or structural economic reform program.
- ? Medium term economic and social strategies such as poverty reduction (Box 2).
- ? Domestic sectoral policies such as those concerned with food marketing, foreign exchange management or cereal stocks, although there is no clear pattern relating to the implications of particular policies.¹⁶
- ? Deliberate changes in policy in response to a disaster, for instance to control inflation, encourage reinvestment or generate revenue to meet the costs of rehabilitation.
- ? The external policy environment to the extent that it influences the pattern of productive activities and thus underlying vulnerability. In the case of Dominica, banana production has been encouraged by preferential trade arrangements. Malawi is experiencing deindustrialization with the reintegration of South Africa into the regional economy.
- ? Coincidental fluctuations in primary export and import prices (e.g. cereals or oil), either lessening or exacerbating balance of payments and inflationary impacts.
- ? A country’s significance in various export markets. The shift from agricultural to manufacturing exports and thus to an apparently less hazard vulnerable form of economic activity, may not in fact have reduced the potential disaster sensitivity of Bangladesh’s export earnings.¹⁷

¹⁵ See Benson and Clay (2000) for a fuller discussion.

¹⁶ Gradual integration and deregulation of food markets in Bangladesh has played a role in reducing the macro-economic effects of major disasters. In contrast, the deliberate run down of maize stocks in Malawi in 2001 proved highly costly, partly because the private sector had failed to respond to previous deregulation. The export of maize stocks by Zimbabwe prior to the 1991/92 drought offers an uncomfortable parallel. Meanwhile, in Fiji sugar reserves have been used to maintain export earnings and prevent loss of export markets in the aftermath of natural disasters (Benson, 1997a).

¹⁷ Bangladesh faces severe global competition in the export of ready-made garments. In contrast, it was the world’s primary jute producer and, as such, was a price setter on the international market. Disruption to the production of ready-made garments could result not only in the direct loss of export revenue but also in the subsequent loss of markets overseas.

- ? The timing and nature of other shocks, especially conflict, as with the independence struggle in Bangladesh and the war in Mozambique that destabilized Malawi's transport links and brought an influx of refugees.
- ? The incidence of health hazards: the HIV/AIDS pandemic and the resurgence of malaria and tuberculosis are undermining coping strategies, eroding human capital and placing potentially considerable strains on public finances in Southern and Eastern Africa.

Box 2: Saying it does not make it so: poverty reduction strategies

During the 1990s there were international commitments to what became millennium development goals for poverty reduction, a process initiated in response to disappointing achievements of efforts to reduce poverty over earlier decades. As a consequence, since the late 1990s the process of preparing a Poverty Reduction Strategy Paper (PRSP) or similar policy document has become a major focus of government-donor dialogue on development strategies. To some extent poverty reduction has superseded structural adjustment, the focus issue of development policy dialogue in the early 1990s at the time of the authors' initial studies (Benson and Clay, 1998). There was clear evidence of this change of in priorities in undertaking the three country case studies.

In Dominica at the time of country investigations (mid 2000) the government of this small middle-income country had not yet prepared a formal poverty strategy. Some aid officials saw this omission as an obstacle to providing support for disaster mitigation. In the aftermath of Hurricane Lenny in 1998 some donors wanted to support only components of reconstruction that accorded with their poverty reduction priorities, for example, funding repair and hazard proofing of parts of the vulnerable west coast road in the relatively poorer northern extremities of the island.

In Bangladesh the government published its draft strategy on poverty reduction and development during the course of the study. However, disaster reduction is not incorporated in any systematic way into this new strategy. As in previous medium-term planning exercises, it is treated as a separate sector of public action (GoB, 2002).

The draft Malawi PSPP is organized around a framework for sustainable improvements in the livelihoods of the rural poor and the negative impacts of drought shocks on livelihoods were recognized (Government of Malawi, 2001). However, prior to the food crisis in 2002, actions for mitigating drought and climatic shocks were not accorded any priority in the proposed strategy.

These cases suggest a potentially unsatisfactory feature of the PSRP process that merits further investigation. Disaster linkages to poverty receive increasing recognition. Indeed, exposure to risk and income shocks, including those emanating from natural hazards, is identified as one of the four basic dimensions of poverty in the PRSP handbook (Klugman, 2002). However, evidence from the three country studies suggests that, despite this, disaster reduction is not being included as a significant, integrated, crosscutting priority within the new development strategy. Ways need to be found to ensure that disaster mitigation and preparedness are mainstreamed within the PRSP framework.

2.3 The macro-economic impact of disasters

The wide range of views on economic consequences of natural hazards justifies a careful re-examination of the theoretical arguments to set the context for a presentation of case study findings. This section reviews available evidence on the economic impact of disasters, both in the short and longer term, primarily as captured in aggregate measures of GDP performance. It should be borne in mind that disasters may also have implications for sustainable development more broadly defined, in terms of livelihoods, human development and poverty reduction. However, it was beyond the scope of the study to investigate such effects.

2.3.1 Theoretical perspectives

This study has been based on the premise that natural hazards potentially have significant adverse macro-economic consequences and so require serious consideration by policy and decision makers. A number of other studies have also recognized their economy-wide significance and the problems they pose for long-term development (e.g., Anderson, 1991; Gilbert and Kreimer, 1999; ECLAC/IADB, 2000; Jovel, 1989; UNDP, 1999; UNISDR, 2002). However, such acknowledgements have typically been made by those working within the field of disaster management and there is little wider appreciation of their potentially serious implications.

There is an alternative view: some economists question their adverse effects, even arguing the opposite – namely, that disasters can represent a positive shock. This view has been recently expressed, for instance, by Stewart and others (2001: 15-16): ‘The development costs of war are greater than the destruction associated with natural disasters, for two reasons. First, natural disasters such as floods, hurricanes, and earthquakes tend to destroy housing and transport infrastructure, but have less effect on productive capacity and leave human capital (other than those killed, of course) intact. Second, as organizational and social capital remains intact and natural disasters tend to be of relatively short duration, investment quickly recovers and may even have a positive multiplier effect on the economy as a whole’.

This argument relies heavily on a multi-country empirical analysis of the impact of single disaster events on overall levels of economic growth and other broad macro indicators undertaken by Albala-Bertrand (1993). He considered the impact of some 28 disasters in 26 countries occurring over the period 1960-79. Based on his analysis, Albala-Bertrand concluded that there are no such things as economic “national calamities” and that the overall rate of growth of GDP improves after a disaster.

A theoretical explanation for this apparently contradictory finding is provided by Aghion and Howitt’s (1998) endogenous Schumpeterian model of growth through a process of creative destruction. In this model, growth is generated by a random sequence of quality-improving innovations resulting from (uncertain) research activities (Benson, forthcoming). Replacement capital is likely to embody technical changes that raise factor productivity and thus competitiveness. A disaster would be the random event that results in the adoption of such improved innovations. Thus each disaster would force an economy up onto a new scaled-up version of itself. However, in reality the process is not that simple. Post-disaster investment resources, for instance, are not necessarily additional (see Chapter 3), implying that some technological advances may simply occur at the expense of others that were already scheduled. Moreover, post-disaster reconstruction efforts are not necessarily well planned or carefully orchestrated events, and so potential technological and other improvements may not occur. Financial capital may also move its place of business or fresh FDI may select other

sites, with loss of capital assets in favor of less risky locations. And where there is factor mobility, there may be loss of human capital through labor migration.¹⁸

A careful re-examination of Albala-Bertrand's data set suggests that his findings may not entirely contradict this study's on the negative impact of hydro-meteorological disasters. Most of those countries that he found to have achieved higher GDP growth in the two years after a disaster as compared to the two years before the event had experienced earthquakes. However, 10 of the 12 countries with lower post-disaster growth had been affected by other types of hazard (Benson, 1994). These contrasting results imply that the net positive effects reported were largely associated with geophysical hazards, the potential impacts of which are somewhat different to those of climatic-related events. Large reconstruction programs may be required, potentially creating a construction boom that can last several years, while agriculture – in many developing countries still a major source of livelihoods – is seldom severely affected. Albala-Bertrand also treated disasters as isolated, one-off events, rather than as re-occurring shocks with potentially cumulative economy-wide impacts. That is a reasonable assumption for a low probability event such as an earthquake or tsunami. But in order to conclude that natural disasters are beneficial for long-term development it would at least be necessary to undertake analysis over a much longer period and to include a careful examination of relatively frequently occurring climatic hazards, such as floods in Bangladesh or drought in southern Africa.

2.3.2 Short-term impacts

Disasters commonly cause a short-term decline in GDP. For example, Charvériat's study (2000) of 35 disaster events in Latin America and the Caribbean between 1980 and 1996 found that real growth rates fell in the year of disaster impact in 28 of the cases examined, typically increasing again sharply in the two successive years. However, both this and other studies have found wide variations in the level of inter-annual fluctuations in GDP, reflecting not simply the scale of direct losses but also other variables at play, as discussed above. The factors underlying these variations can often only be identified – and the nature of their interplay with natural disasters understood – through more in-depth analysis of individual country experiences.

In considering individual countries, it is useful to make a distinction between:

- ? very small countries where hazard impacts may be economy wide;
- ? larger countries where substantial areas are directly impacted by individual events;
and
- ? larger countries typically experiencing individual disasters in a geographically limited area.

Small island economies are particularly vulnerable to natural hazards. Their impacts are typically clearly reflected in inter-annual fluctuations in economic performance, as in the cases of Dominica, Fiji and Montserrat. The sensitivity of Dominica's sectoral economic performance to hurricanes over the period 1978–98 was tested more formally using regression analysis. This analysis confirmed the negative impact that major hurricanes have had on overall short-term economic performance, although also indicating that the impacts of hurricanes have become relatively less severe as agricultural sector product has declined as a share of GDP. Fiji, another small island economy, displays similar evidence of extreme

¹⁸ Case study evidence for Dominica and Montserrat indicated that both capital and labor mobility are a reality in the Caribbean region.

sensitivity to natural disasters, as confirmed by regression analysis on sectoral economic performance from 1971 to 1994 (Benson, 1997a).

Montserrat is the extreme case of a hazard prone micro-economy. After the devastation of Hurricane Hugo in 1989 GDP only returned to its pre-disaster level in 1994. Then, after the start of the volcanic eruption in 1995, GDP fell by half over three years. In fact, even these dramatic figures underestimate the true extent of economic downturn because the economy has only been sustained by substantial inflows of assistance since the onset of the volcanic crisis, to some extent offsetting the massive decline in autonomous private sector economic activity (Clay and others, 1999).

In geographically larger countries the short-term impact of disasters are discernible where severe natural disasters affect extensive areas or the whole country. This was broadly the case in Southern Africa in 1991/92. GDP contracted sharply in every country except mineral export-dominated Botswana and Namibia. The recovery in 1993/4 failed to compensate for the departure from pre-drought trends before the next shock occurred in 1994/95. These regional findings are confirmed by country-level statistical analysis for Malawi and Zimbabwe.

In Bangladesh, there is also a clear relationship between extreme volatility in the economy between 1965 and 1975 and catastrophic natural disasters. These disaster shocks were compounded by conflict and internal disorder during and in the aftermath of the war of Independence in 1971, as already noted. However, the amplitude of disaster shocks considerably diminished after initial post-conflict reconstruction and reintegration of the economy was completed in the early 1980s. Subsequent structural transformation of the economy has further reduced vulnerability.

In contrast, an earlier examination of the Philippines highlights potential difficulties in estimating the short-term impacts of disasters in a geographically extensive economy. The Philippines is one of the most hazard-prone countries in the world, experiencing all major types of natural hazard. However, because of the country's large geographic size, individual hazard events typically affect only a small part of the country, except in the case of drought, implying that their impact may not be reflected in fluctuations in national economic performance.¹⁹ Measurement problems are further compounded by the fact that tropical cyclones and extreme floods often occur in some parts of the country, making it difficult to establish a non-disaster counterfactual scenario. Indeed, government accounts of national economic performance only include reference to major disasters. Yet annual losses as a consequence of tropical storms alone could be equivalent to as much as a 0.3% reduction in GDP growth (Benson, 1997c).

2.3.3 Long-term impacts

Theories of development place considerable emphasis on the roles of capital and labor growth and productivity (e.g., Solow, 1956; Denison, 1967). Yet capital assets and other resources can be severely damaged by natural disasters, whilst productivity of undamaged capital and labor can be reduced by associated disruptions to infrastructure and markets. There can be potentially significant direct capital losses (except in the case of drought). All major types of disaster, including drought, can also potentially disrupt longer-term investment plans, both in physical and human capital. Governments may divert resources away from planned

¹⁹ Preliminary investigations for Indonesia, when it was being considered as a possible country case for this study, similarly indicated that it might be difficult, due to the country's large physical size, to isolate at a national scale the effect of disasters that had a large provincial impact.

investments to fund the relief and rehabilitation process. Other public reconstruction efforts may be funded through domestic or external borrowing, increasing future debt servicing payments. Disaster-related external assistance may be extended, but this may not be entirely additional, instead in part replacing development investment aid flows due to some combination of limited donor resources and local counterpart funding constraints (see Chapter 3). Other damage may be covered by insurance policies but, even then, there are opportunity costs relating to the payment of premiums (see Chapter 5). Some destroyed assets may not be replaced at all. In the longer term, disasters and related risk can also contribute to economic instability and an atmosphere of uncertainty, deterring potential investors

Modeling the long-term impact of disasters

Research into the effects of natural disasters on longer-term economic growth and development has focused primarily on modeling the implications of impacts on capital accumulation. For instance, a study by the International Institute for Applied Systems Analysis (IIASA) modeled the potential impact of disasters in three countries finding that post-disaster financial resource gaps reduce future growth (Box 3). Currently, projections of future economic performance and the identification of existing and prospective resources to meet growth objectives typically do not take into account the impact of potential disasters.

Box 3: Funding rehabilitation: long-term growth implications

IIASA, in conjunction with the World Bank, has developed a planning tool for incorporating future probabilistic losses from natural disasters into macroeconomic forecasting models and quantifying the implications, in particular for growth objectives, of various options in financing rehabilitation. In essence, this tool is based on a simple model focusing on the impact of disaster-related capital losses on rates of national economic growth.

To illustrate its use and the nature of findings that it can generate, IIASA applied the planning tool to three case studies of Argentina, Honduras and Nicaragua under varying assumptions about sourcing of post-disaster funding. The results clearly demonstrate that the ability to finance losses following a catastrophe is crucial to recovery, affecting how quickly a country can resume its growth path. In the Argentina case it was assumed that all relief and reconstruction financing would be met out of private consumption and foreign savings and that the country would still achieve its growth projections by making sufficient financial resources available to replace damaged capital stock and fund needed future investment. The model was used to estimate increased government expenditure and import requirements consequent on a disaster and the implied rise in external debt and fall in private consumption. The Honduras case considered a situation in which private consumption and foreign savings (i.e., external borrowing) are not reliable sources of post-disaster reconstruction and relief funds (in the case of private consumption due to the high incidence of poverty). The model forecast the impact of a disaster on the Honduran economy assuming no access to foreign assistance to meet reconstruction needs and thus that investment resources were diverted into private and government disaster-related consumption, leading to chronic under-investment. The model indicated that this would result in stagnation in future expected economic performance. Nicaragua, like Honduras, currently depends on external funds to sustain infrastructure investment, including post-disaster reconstruction. In the Nicaragua case, the impact of decreased economic growth occurring as a consequence of natural disasters was translated into implications for poverty, using a household level model to supplement the RMSM. The results indicated that the inability to finance probable losses would stall or defeat poverty reduction measures.

The study concluded that risks emanating from natural hazards should be incorporated into economic projections for three reasons. First, there are high opportunity costs associated with the diversion of scarce financial resources into post-disaster relief and reconstruction efforts. Second, disasters can impose havoc on the already-complicated budgetary planning process. Third, disasters place high demands on international aid resources, diverting resources away from development uses (McKellar and others, 1999; Freeman and others 2002).

In a similar vein, Cochrane (no date) explored the important, but rarely considered impact of disasters on a country's indebtedness. A recursive Keynesian growth model was used, introducing disaster shocks as a reduction in private and public capital and increase in government expenditure on emergency relief. It was assumed that the increased government deficit is financed entirely through external borrowing. Cochrane concluded that disasters can lower a country's credit rating; increase interest rates on external borrowing, in turn dampening investment and reducing long-term growth; and increase debt stocks.

The empirical reality of exploring precisely how countries have, in fact, financed relief and rehabilitation is far from straightforward, however. As clearly outlined in Chapter 3, a considerable part of post-disaster public reconstruction efforts involve reallocated resources, but this is typically only partly reported in official accounts making it difficult to determine both total reallocations and related opportunity costs. There are further complications in disentangling the roles played by disasters and other factors in determining levels of domestic and external borrowing or any monetary expansion.

It is also typically difficult to determine exactly how much is ultimately spent, even by the public sector, on post-disaster response as reconstruction projects are not necessarily labeled as such and may not correspond with needs identified in post-disaster assessments, a point clearly illustrated by an examination of Bangladesh (see Chapter 3).

As for the private sector, it is very difficult to get much handle on total private expenditure on reconstruction, let alone how it is financed. Aggregate consumption, saving and lending data reveal very little, as demonstrated by case studies of Dominica, Fiji and the Philippines. Data for some countries with large communities of overseas nationals, such as Bangladesh, do indicate considerable increases in remittances post-disaster but how much of this is for consumption and how much for investment purposes cannot be determined without detailed investigation. Moreover, private household investment post-disaster would, anyway, entail considerable social capital.

These various constraints make it extremely difficult to apply models such as those developed by IIASA and Cochrane in drawing out the growth implications of past rehabilitation funding decisions for long-term growth. Nevertheless, the models offer ways of planning financial responses more strategically in the future, including in incorporating probable losses into the development planning process. As such, they are potentially of significant value in planning future responses, including in determining appropriate external assistance, as part of this more rational, coordinated response.

The IIASA model is, of course, currently restricted to RMSM modeled countries. Many very small countries do not have RMSM models, implying that partial analysis building on the types of statistical methods used in this study would be required. This approach should give reasonable approximate answers because small economies tend to be highly open and have weak intersectoral linkages.

Empirical evidence

There has been little empirical analysis of historical evidence on the impact of disasters on long-term growth. This is despite the recent revival in interest in the significance of environmental and other geographical factors on development.²⁰ Benson (forthcoming) attempts to address this issue, examining comparative cross-sectional data on real GDP performance for 115 countries over a 34-year period 1960-93. The results suggest that

²⁰ For example, climate, location (coastal/landlocked), availability of natural resources, agricultural productivity and incidence of disease (e.g. Diamond, 1998; Gallup and Sachs, 1999).

countries experiencing a higher incidence of disasters over the period of analysis tended to achieve lower rate of growth than countries experiencing fewer disasters.

There are fundamental problems in undertaking such an analysis. First, countries experiencing a lower incidence of disasters were typically amongst the more developed countries by the latter half of the 20th century. In other words, the subset of less developed countries includes a disproportionate number of more disaster-prone countries. So the finding that slower growth and higher incidence of disasters are associated may simply reflect Quah's (1993) broader finding of a polarization towards a bimodal distribution, with countries already at the higher end of the income distribution likely to experience further increases in income. Second, the pace of growth and level of development of an economy is obviously not determined by incidence of disasters alone, as clearly demonstrated by the vast body of evidence on other causes of development, under-development and economic growth.

However, the basic finding, if tentative, of a negative association between disasters and development at a cross-country level is paralleled by qualitative evidence differential development within individual countries. The poorer regions of a country are often more hazard prone. Charvériat (2000), for instance, notes that the northeast part of Brazil and coastal areas of Ecuador and Peru are typically poorer than less hazard-prone parts of the same countries. Kelly and Khan Choudhury (2002) note a concentration of poverty in more hazard-prone districts in Bangladesh. In part, such patterns reflect differences in opportunities for growth and development as determined by the relative risks faced by different communities.²¹ There is scope for further research on the potentially differential influence that different forms of hazard exposure and related risk have on regional development.

Qualitative evidence

The authors in both this and previous studies have adopted a less formal, eclectic approach combining various forms of partial statistical analysis with other qualitative evidence. An extended country specific narrative is constructed, including an assessment of the effects of a sequence of disasters. Although no attempt was made to formally model or quantify the longer-term impacts of disasters in any of the three case study countries, there is strong qualitative evidence that disasters have affected the pace and nature of growth in both these and previously researched countries.

In Dominica disasters appear to have had a ratchet effect in determining shifts in the structure of the economy. Agricultural sector product and agriculture's share in GDP fell successively with each major natural disaster shock – in 1979-80, 1989 and 1995.²²

²¹ For example, farmers in more hazard-prone ecosystems of Bangladesh, Vietnam and other South East Asian countries have been less well placed to take advantage of higher-yielding but less hazard-tolerant strains of rice (Catling, 1994; Hossain and others, 2001). Some combination of greater incidence of natural hazards and (related) higher incidence of poverty can also influence the choice of location of investments. In Vietnam, for instance, this is contributing to widening regional disparities as some of the more hazard-prone regions of the country have received disproportionately small shares in both private and public investment and external assistance (Benson, 1997b).

²² The post-disaster shift out of agriculture is explained by a combination of a gradual reduction in larger-scale production (failure to invest fully in replacement), a shift of smallholders into employment in other sectors and, following Hurricane David in 1979, off-island migration. Hurricane David resulted in the temporary exodus of almost 20,000 people, equivalent to about a quarter of the pre-disaster (1978) population. This exodus included many school-aged children and 20 years later the population had still not recovered to its 1978 level. The fisheries sector in Dominica, which provides the livelihood of many poorer families, also contracted with each major disaster. Capital losses are high in every major storm and some fishermen, lacking insurance, fail to replace damaged boats and equipment following storms.

Natural disasters can hamper the pace of investment in basic infrastructure, with implications for long-term growth. As the Bangladesh Government recognized in a memorandum to the Bangladesh Development Forum ‘inadequate infrastructure has been a constraint on investment in productive activities as well as on utilization of installed capacity’ GoB (2000a: 17). It goes on to state that interruption of electricity, transportation bottlenecks, limitations of port facilities and so forth are well known difficulties.²³ The fact that natural disaster related expenditure has largely displaced planned capital investment and normal recurrent expenditure must be part of the problem (see Chapter 3).

Similarly, in the Philippines there have been only modestly successful efforts to improve the country’s transportation systems and increasing difficulties in meeting the social infrastructural needs of the country’s rising population. An important factor is that a large proportion of available public resources earmarked for such purposes have had to be re-directed in response to calamities (Benson, 1997c).

Other case studies provide further glimpses of the longer-term impacts of disasters on various aspects of economic life. For example, the loss of human capital by emigration may be long term as in Dominica after 1979 and Montserrat since 1995-98.²⁴ The poor also draw on their financial and material savings in coping with disasters, with opportunity costs, as is well documented for droughts in sub-Saharan Africa.²⁵ This behavior, combined with disaster-related losses of productive assets, can contribute to the progressive impoverishment of poor households and communities, an issue that can only be systematically explored at a micro-level.²⁶

²³ Writing a decade earlier, Khan and Hossain (1989: 144) also concluded that ‘inadequate infrastructural facilities constitute a serious obstacle to the economic and social development of Bangladesh’ and that ‘the physical infrastructure is in urgent need of rehabilitation and expansion’ (op cit.: 181).

²⁴ The continuing volcanic crisis in Montserrat provides an extreme example of the long-term impacts of a disaster. The present eruption, which began in 1995, has had a devastating impact on the economy, with serious implications for the island’s medium and long-term development. Most of the island’s administrative, commercial and industrial facilities have been destroyed and the crisis has forced fundamental changes in Montserrat’s economic structure. It has also had serious ramifications for the island’s financial institutions, precipitating high rates of default on outstanding loans. The economy will not be viable in either the short or medium term without large-scale subsidies from the UK. At an individual level, Montserratians have faced loss of livelihoods and other assets, including savings. Demographic effects have also been massive – over 50% of residents leaving. The country has been fragmented by mass migration and relocation and community and household structures have broken down (Clay and others, 1999).

²⁵ In Zimbabwe, for instance, goats are often kept as a form of savings to pay for secondary education. However, a number of households were forced to sell their goats to sustain short-term levels of consumption in the aftermath of the 1991/92 drought shock, with implications for longer-term investment in human capital (Hicks, 1993).

²⁶ This process of pauperization is well documented, for example in drought prone areas in the Ethiopian Highlands (Devereux, Sharp and Amare, 2002).

2.4 Lessons learned

2.4.1 Complementary approaches to impact assessment

A mixture of quantitative and qualitative analysis has been used to examine the macro-economic impacts of natural hazards. The evidence assembled indicates that major disasters have both short and longer-term impacts for economic growth and development. This finding has broad policy implications. However, such evidence cannot, of itself, be used directly as a basis for formulating disaster reduction strategies. This requires quantitative data, facilitating risk analysis of the potential financial and economic returns of specific policy options and measurement of relative opportunity costs in the use of financial resources. At an individual project level (whether for preparedness or hazard-proofing), cost-benefit or investment analysis is needed.

Nevertheless, the case study approach sheds light on the factors determining the nature of vulnerability and the outcomes of specific events. The impact of a particular event is determined by a complex and changing combination of factors. Thus, outcomes of similar events are, as the case studies demonstrate, likely to be significantly different even where separated by only a few years in time; and single event analysis likely to be an unsatisfactory basis for policy. Detailed, disaggregated and careful assessments such as those undertaken in this study can generate considerable understanding of both the forms of vulnerability faced by an economy and the possibilities for mitigation and preparedness. They can also generate information allowing governments and civil society to see how they could incorporate risk reduction concerns into national economic strategies and policies and, ultimately, how to contribute to sustainable development.

Thus, the current study sheds light on the forms that pre-emptive action might take, seeking to understand the complexity of factors determining underlying vulnerability so that it can be appropriately reduced. Cost-benefit and investment analysis determines the economic efficiency of individual risk reduction actions. A formal broader economic planning tool, such as that developed by the International Institute for Applied Systems Analysis (IIASA), provides a means of quantifying remaining risk more broadly in terms of its potential economic growth implications – a possible wake up call to governments and the international community to take further pre-emptive action – and of reconstruction funding requirements. It can facilitate exploration of the implications of different public choices in financing reconstruction and financial planning for disasters. Thus, the various approaches are complementary.

But a methodological caution is also required. The case studies were selected purposively as disaster-prone countries. The economy-wide and sectoral analyses undertaken show that in the short term these economies are highly sensitive to natural disaster shocks. The impacts of these shocks are visible in national income and trade flows and physical measures of production such as crop yields. The more formal statistical analysis has quantified the effects of the most extreme events where the footprint of a disaster is economy-wide or impacts are diffused through linkage and multiplier effects. For geographically larger countries, however, regional or provincial level as well as national analysis may be required, particularly where relatively localized natural disasters are experienced on a regular basis. An earlier case study of the Philippines (Benson, 1997c) highlighted the problems of isolating the impact of disasters from annual fluctuations in key economic indicators in situations where the benefits of an entirely disaster-free year cannot be directly measured but nation-wide disasters are rare. Thus, for large countries, such as Brazil, Indonesia and Nigeria, a more disaggregated regional analysis may be more appropriate. However, regional analysis will not take into account redistributive impacts across provincial boundaries and thus may provide an inflated measure of the national economic cost of a disaster.

2.4.2 Opportunities for reducing macroeconomic consequences of disasters

The evidence presented in this chapter suggests that natural disasters can, and often do, have negative impacts for both short- and long-term growth. However, it also demonstrates striking contrasts, not just of increasing and decreasing but also of changing forms of vulnerability. These developments belie somewhat simplistic notions of a general decline in vulnerability to natural hazards as an economy grows. Instead, a more sophisticated perspective needs to be both adopted and applied in undertaking detailed risk assessments from a macroeconomic standpoint.

Based on the outcome of such assessments, risks emanating from natural hazards then need to be incorporated into broad development policies and plans. In doing so, a distinction needs to be made between potential short and longer-term hazard impacts – and possible trade-offs between the two – as well as recognizing interlinkages of impacts. Direct short-term impacts can sometimes be severe but rates of recovery rapid – as illustrated in the case of banana production in Dominica. Alternatively, immediate impacts may be entirely indirect, for instance involving a reduction in availability of inputs to industry, but recovery slow.

Risk management strategies also need to reflect the fact that disasters are not a single homogeneous form of economic shock. The two broad categories of hazard, climatic and related hydrological hazards and geophysical hazards, appear to be associated with different patterns of economic vulnerability and so entail different options for reducing risk. These partly relate to differences in the probability of occurrence. Climatic hazards occur more frequently and it is economically worthwhile, and recognized to be so, to adapt productive activities – for instance, agricultural practices or sources of livelihoods - to reduce risk. It is also worthwhile to take appropriate structural and related measures, relating to the design and location of buildings and other infrastructure. In contrast, options for reducing vulnerability to geophysical events are largely restricted to physical structural and locational factors. However, with rapid urbanization in many countries in the world and increasing investment in physical infrastructure, the potential importance of such measures cannot be over-emphasized.

In addition, risk management strategies should take into account the challenges and opportunities presented by increasing trends towards globalization. Globalization has expanded opportunities for risk diversification and, for nations as a whole, is probably a positive trend from a natural hazards perspective. There may be opportunities for smaller enterprises and consumers, as well as larger corporations and government. However, whether globalization ultimately exacerbates or reduces sensitivity, both of particular economies and individual households, is complicated and depends on specific country circumstances, including public action to reduce vulnerability. (Benson and Clay, 2002b).

Risk management necessarily involves the private sector, as well as the public sector. The private sector should be encouraged and supported in enhancing its awareness and understanding of risks posed by natural hazards and adopting appropriate risk management tools, both structural and non-structural. As part of this process it is important to ensure that there is sufficient investment in risk mapping, monitoring, assessment and dissemination and that this information is provided in an easily understood and usable form. Service industries, including financial institutions, as well as productive sectors should be included in such initiatives.

Post-disaster reconstruction efforts need to be well planned and carefully orchestrated, seeking to maximize potential economic structural, technological and other improvements that can be made in the process of re-building an economy. Currently, the emphasis often

seems to be on restoring the status quo – politically and administratively the easiest approach and satisfying pressures for rapid recovery. Even where external resources are involved, direct replacement of a particular road or power facility or support for the recovery of existing agricultural and industrial activities, may not require detailed cost-benefit or environmental impact assessments before a project is approved. However, pre-planning of potential changes that could be implemented post disaster to reduce vulnerability to future events could ensure that objectives of rapid recovery are still met whilst the political will for change is already secured and pre-investment analysis completed, a point discussed in more detail in Chapter 3.

Finally, lessons learned from particular disasters need to be assessed and, where appropriate action taken. Disasters can induce policy changes and institutional innovations that are ultimately beneficial, in some cases not only in reducing vulnerability but also in supporting economic growth and development. Food policy reforms in Bangladesh were directed at preventing a recurrence of the 1974 flood related famine (Clay, 1985) and then containing the financial costs of subsequent floods (Ahmed and others, 2000). The deregulation of agricultural investment after the floods in 1987 and 1988 encouraged the rapid expansion of disaster-reducing irrigation. The micro-finance revolution was in part a response to the 1974 famine (Yunus, 1998). These examples take the discussion into the realm of political economy and serve as a reminder that an economy is not a purely technical system, in which there are mechanistic responses, but that there is also conscious learning, with potentially profound longer-term consequences. One such attempt at learning has been the application of climatic forecasting to reduce the impacts of climatic variability in Southern Africa (Chapter 4). Another area of learning is in financial mechanisms to manage risk (Chapter 5).

Chapter 3

Public finance and disasters

There has been little, if any, systematic examination of the public finance consequences of natural disasters and related risk management, except in the narrow context of a single disaster event.²⁷ This chapter seeks to address that gap. It is based in the first instance on findings and issues raised by the Bangladesh case study.

3.1 Background

Natural disasters can have important implications for public expenditure. Disasters are likely to result in additional expenditure and/or the partial reallocation of already committed financial resources, both to meet the costs of repair and rehabilitation of public property and to provide support to the victims. These actions may lead to the postponement or abandoning of planned investment, a reduction in the provision of public services, deferment of wage and salary increases and staff appointments. Implementation of on-going projects may also be delayed, increasing their ultimate cost. Such problems can be exacerbated by additional administrative pressures in the aftermath of a disaster.

Public revenue may also be affected. Disasters can cause a fall in government revenue as lower levels of economic activity, including possible net falls in imports and exports, imply reduced direct and indirect tax revenue. Although such losses may be partly offset by increased flows of official external assistance, they are unlikely to be entirely compensated for. Publicly owned enterprises may also experience disaster-related losses, placing an additional burden on government resources.

In consequence, a government may face increasing budgetary pressures, which it will be obliged to meet by running down foreign-exchange reserves, increasing levels of domestic and/or external borrowing or increasing the money supply. These financing options, in turn, have potentially significant knock-on effects. The creation of base money is inflationary. Domestic borrowing exerts upward pressure on interest rates and can result in a credit squeeze. Foreign borrowing can result in an appreciation of the exchange rate, reducing the price of imports and increasing that of exports. In addition, it can place future strains on the economy via higher debt-servicing costs. Natural disasters can also trigger an increase in interest rates charged on external debt by increasing the risk premiums associated with a country's assets. Another option, the run-down of foreign-exchange reserves is limited by the very size of those reserves and also entails an appreciation in the exchange rate, with possible associated risks of capital flight and a balance-of-payments crisis (Fischer and Easterly, 1990).

Disasters can also impose continuing pressures on public finance to the extent that governments undertake mitigation and preparedness measures. These are costs which governments in less hazard-prone countries do not have to bear.

On the positive side, post-disaster investment may result in high levels of economic activity. Rehabilitation and reconstruction also provide an opportunity for necessary but neglected repairs, and for the upgrading of facilities. Needless to say, the specific circumstances in

²⁷ The authors of this current study have so far been unable to identify any other in-depth retrospective analysis on disasters and public finance, apart from single event studies.

which a major disaster occurs, such as the Bangladesh floods of 1998, will influence the outcome.

The challenge is to respond to disasters and related risk in such a way that economic losses and disruption, including fiscal impacts, are minimized; that economic recovery is rapid; that poorer and more vulnerable sectors of society receive priority support, in keeping with Poverty Reduction Strategy Programs (PRSPs); and that the attainment of longer-term development objectives is not significantly delayed. In sum, this is a tall order.

This chapter examines actual evidence on the public finance consequences of natural disasters. It is based in the first instance on findings and issues raised by the Bangladesh case study. It also draws on evidence from Dominica and Malawi, as well as previous work by the authors and others. The details of the Bangladesh, Dominica and Malawi experiences are documented in the case studies and summarized in Annexes A, B and C.

3.2 Broad fiscal impact of disasters

So major disasters could have significant budgetary impacts. However, when broad fiscal aggregates, such as central government's recurrent and capital expenditure, revenue and the budgetary deficit are examined, disasters are found to have little discernible impact in many cases. Bangladesh is a case in point: a superficial review of overall budgetary aggregates during the 1980s and 1990s suggests that major disasters, including the most extreme floods in 1987, 1988 and 1998 and the devastating cyclone of 1991, had little impact on central government finances. Total revenue and expenditure rose gradually over the two decades, while the overall budget deficit remained fairly stable, until the 1998 flood, when it rose markedly.²⁸ Indeed, an examination of Bangladesh's overall expenditure and revenue forecasts and performance suggests that the public financial impacts of even the 1998 flood were very limited.

In three other countries examined – Dominica, Fiji and the Philippines – it is similarly difficult to discern much impact of natural disasters on government finances, apart from annual allocations of small tranches of budgetary resources for use in the event of a disaster. In the Philippines, for example, budgetary resources are annually allocated to a Calamity Fund, totaling 0.4% to 0.7% of total annual government expenditure, and 0.9% to 1.6% of discretionary spending over the period 1991 to 1994 (Benson, 1997c). In Fiji, budgetary resources to the tune of F\$2m (US\$1.4m at 1994 rate of exchange) have been annually earmarked for emergency relief activities, with a further allocation of F\$0.1m set against the 'emergency' transportation of water (Benson, 1997a). In Bangladesh, the process is less formal, with some disaster-related expenditure apparently in part met by drawing on existing unallocated resources (Block Allocations) under the revenue budget.²⁹ In countries experiencing localized disasters – such as storms, landslides, flooding – on an annual basis, there is a strong case for such pre-assignment of funds to meet a substantial share of costs (see Section 3.7.1).

²⁸ For example, despite the 1988 floods, Bangladesh's overall budget deficit for 1988/89 was actually lower than had been originally projected. Total revenue was higher, both relative to budgeted figures and as compared to actual revenue in all earlier years during the 1980s. Meanwhile, recurrent expenditure on both public food operations, via the Food Account, and the revenue budget (effectively all recurrent expenditure) was only marginally higher than budgeted, despite increased flood-related expenditure.

²⁹ These funds, which are a comparatively recent phenomenon, are substantial and increasing. For example, total Block Allocations under the 1998/99 Budget totaled Tk 11.2bn or 7% of the total gross revenue budget, of which Tk 5.3bn were allocated for unexpected expenditures.

The fiscal impact of more sudden impact disasters may also be obscured by lagged effects. For example, a close examination of the 1988 flood in Bangladesh reveals that some effects of the disaster were delayed.³⁰ The impacts of such a disaster are not readily captured in a statistical analysis or modeled at a highly aggregate level.

The consistently contrary cases in which fiscal impacts of disasters are readily discernible are drought-affected Sub-Saharan African economies. Five of the six economies compared in Benson and Clay (1998) showed a sharp drought-related increase in government borrowing in response to drought. The sixth, Zimbabwe, was studied more closely. Over the period 1980/81-1993/94 fluctuations in both total central government and direct tax revenue generally mirrored overall trends in economic performance, including during drought-related economic downturns. As a consequence, the 1982/3, 1986/7, 1991/2 and 1992/3 droughts all resulted in an increase in the public deficit (both excluding and including foreign grants). The 1980s droughts also resulted in higher borrowing and lower debt repayment than had been planned although the extent of borrowing was apparently constrained by deliberate government policy to contain the budget deficit.

Malawi experienced near fiscal chaos in the period of the two droughts in the early 1990s. In the context of violently fluctuating GDP, twice falling and then recovering by around 10%, public expenditure grew rapidly, rising by 30% in real terms between 1992/93 and 1994/95. Revenue, in contrast, declined by 9% in 1992/93 and again by 11% in 1993/94, reflecting the effects of drought on exports and imports (other than emergency food), accentuated by fiscal laxity in an election year. The deficit increased by 23% over three years. There were also confounding influences, of the election and the incoming government's efforts to honor its commitments, especially to universal free primary education.

It is unwise to generalize from a small sample. Nevertheless, evidence for low-income African economies suggests that drought has distinct fiscal impacts. Part of the explanation could lie in the fact that the adverse macroeconomic consequences of droughts can be particularly severe (see Chapter 2). Other factors noted in Box 4 may also play a role.

Public resources in a very small economy can be overwhelmed by the sheer scale and duration of a disaster, as in the extreme case the British Overseas Territory of Montserrat. First, Hurricane Hugo in 1989 wrecked the economy's infrastructure, requiring massive external assistance for reconstruction up to 1994. Then a volcanic eruption that began in 1995 forced 90% relocation of the population and over 60% voluntary and officially assisted emigration. The volcanic crisis resulted in a massive budgetary deficit, reflecting a sharp contraction in revenue and increased expenditure, and the government lost its financial autonomy.³¹

³⁰ The most serious pressures on the separately administered food account were not felt until 1989/90 when stocks were re-built. Meanwhile, revenue was boosted by the introduction of additional measures to counteract the budgetary impacts of the floods, including the imposition of a 6% surcharge on income tax; the collection of additional surcharge of 5.1% on excise duties in respect of certain items; deduction of a 4% relief and rehabilitation levy from dividend/interest incomes on balances in savings and fixed deposit accounts and a levy of 4% on telex and telephone bills. Expenditure on the Annual Development Programme (ADP) was almost 20% lower than budgeted, despite flood-related expenditure, implying that spending on some projects was much lower than planned.

³¹ Montserrat had a pre-eruption resident population of 12,000 in an area of 100 km² and, prior to the crisis, was a middle-income country, with GDP per capita of US\$3,600 in 1994. In 1997, revenue receipts (excluding budgetary assistance in the form of a special grant) totaled only 59% of their 1993-4 average (and only 35% in 1998). Meanwhile, government expenditure increased by 56% in real terms, despite a decline in population. As a consequence, Montserrat became the recipient of budgetary support for the first time since 1981. According to British government procedures, if an Overseas Territory receives budgetary aid on a regular basis, or is likely to do so, the finances of that

Box 4: Fiscal impacts of drought in Sub-Saharan Africa

The fiscal impacts of disasters are readily discernible in drought-affected Sub-Saharan African (SSA) economies. The case studies identify some of the specific factors underlying these impacts helping to inform policies on the financing of disasters, both ex ante and ex post. These factors relate both to the nature of impact of drought – SSA’s principal type of hazard – and also to specific macroeconomic circumstances.

- ? The macroeconomic impacts of droughts can be particularly severe, directly causing a sharp fall in productive activity. These impacts will be exacerbated in economies that are already weak, as is the situation in many SSA countries. Recovery may also be relatively slow, particularly where there are strong intersectoral linkages between agriculture and other sectors. Unlike other types of disaster that cause extensive physical damage, droughts do not trigger a potential post-disaster boost to the economy in the form of increased, largely non-tradeable post-disaster construction activity.
- ? Severely limited public resources imply that there are simply fewer funds to be re-allocated whilst limited existing capacity of government agencies may restrict ability to absorb costs, effectively making relief and rehabilitation expenditure more visible by involving additional resources, for instance in the form of external borrowing or aid.
- ? Relief and rehabilitation needs associated with droughts are typically very pressing and immediate if further potential losses, including to human life, are to be avoided and rapid recovery possible upon the return of favorable rains. This puts severe short-term pressures on budgetary resources with the related need for additional financing.
- ? Droughts have a direct impact on the principal source of livelihood for a significant share of the population in SSA, combined with lower per capita incomes forcing a large proportion into dependency on public relief programs.

3.3 Disaggregated re-examination of public finances

A fuller understanding of fiscal effects of disasters requires a careful, more disaggregated examination of individual country experiences. Rather than focusing on budgetary aggregates, an analysis of budgetary impacts and related government response should be examined in the context of overall budgetary performance, recent government policies and budgetary targets, and the structure of government revenue and expenditure itself. Indeed, a more detailed examination of the budgetary impact of disasters begins to reveal a somewhat different picture, as already indicated in the case of Bangladesh following the 1988 flood.

A key issue is the reallocation of expenditure. Another is the role of funding sources. In some countries, external assistance also finances a significant part of public expenditure, as explored separately in Section 3.4 in the context of the impact of disasters on commitments and rates of disbursement of both old and new pledges of aid.

territory must come under the supervision and, in effect, control of the Secretary of State for International Development. As such, the island’s government lost any semblance of financial independence as a direct consequence of the volcanic crisis (Clay and others, 1999).

3.3.1 Expenditure

The impacts of disasters may be much greater than at first apparent, due to the reallocation of budgetary resources. Country case studies and anecdotal evidence suggests that post-disaster reallocation of resources is common. The brunt of these reallocations, at least as they involve financial reallocations, appears to fall primarily on capital expenditure, which typically is largely discretionary.

In Bangladesh, reallocations occur in most years because revenue projections are consistently over-optimistic (Rahman and others, 2000), whilst recurrent expenditure is under-estimated. Additional post-disaster related pressures on resources then force further reallocation, as in 1998/99.

In Dominica, the apparent insensitivity of budgetary aggregates to disaster shocks also partly reflects post-disaster reallocations in support of relief and rehabilitation efforts. Indeed, the practice of reallocating expenditure in this way is apparently an annual occurrence, as unanticipated expenditure on landslides and storm damage crowds out routine maintenance.

In Fiji there has been significant redeployment of resources in the aftermath of major disasters. In early 1993, for instance, Fiji experienced a severe cyclone – Kina – necessitating a government rehabilitation program, equivalent to almost a third of the annual capital budget and 5.3% of total allocated expenditure. Nevertheless, the government remained intent on containing expenditure and so redeployed resources to meet the cyclone-related costs, holding a special meeting to determine reallocations. As a consequence, total annual expenditure was only 0.5% higher than budgeted. However, recurrent operating expenditure increased by 7.1% year-on-year while capital expenditure fell by 3.4%, to around only 75% of the original allocation. Some investment projects were suspended, including a number of small rural projects and a rural road program.

Malawi's experience again confirms that fiscal effects are more extreme when disaggregated. The composition of expenditure in broad sectoral terms and between recurrent and development expenditure categories became extremely volatile in the early 1990s. There were substantial reallocations within expenditure in drought-affected years to agriculture.

The Zimbabwe Government, incurred almost Z\$600m in additional drought-related expenditure in 1991/92, equivalent to some 2% of GDP and over 6% of total expenditure. Yet real expenditure fell by 4.9% year on year, as part of broader government efforts to reduce the budget deficit under a structural adjustment agreement. The drought apparently forced a change of emphasis in the public sector investment program, with some planned projects brought forward and new, previously unplanned, projects introduced.

With a few exceptions, however, such reallocations are typically poorly documented and cannot be easily quantified. In the Philippines, for example, circumstantial evidence suggests that post-disaster reallocations are significant, but they often occur within broad budget headings and so are not apparent published expenditure reports.

There may also be substantial unrecorded reallocations within the recurrent budget. Freeman and others (2003) suggest that such reallocations are likely to be relatively limited because a large part of the recurrent budget may be non-discretionary (in the form of wages, debt servicing and operational overheads). However, in reality there may be considerable re-deployment in kind – of government staff, vehicles and equipment, supplies of drugs and other items and so forth. According to the Bangladesh government, during the 1998 floods, 'the entire civil administration was deployed in relief operations' (GoB, 1999a: 5). Such reallocations can be even more difficult to track because funds are often spent under the same line item – salaries, maintenance of road-building equipment and so on. In some cases, re-allocation of

recurrent resources is also facilitated by the negotiation of temporary moratoriums on debt servicing.

In many countries, a substantial part of development expenditure is funded by external assistance, but carries a local counterpart funding commitment. If local funds are not available, then aid disbursements are delayed, as observed in both Bangladesh and Dominica, with further consequences for non-disaster related expenditure.

Disasters also have longer-term impacts, beyond the crisis year, again squeezing non-disaster related expenditure. Some reconstruction projects may not begin for months or even years after an event. However, exercises to measure the longer-term impacts of disasters on patterns of expenditure are again hindered by reporting practices. Disaster-related projects are often not reported as such, as in Bangladesh after the 1998 floods.³² Attributing expenditure to a particular disaster can also be complicated by the fact that prior to the event some infrastructure may have already been in a poor state of repair, as was the case in Dominica immediately before Hurricane David in 1979.³³ In some instances, measurement difficulties are further exacerbated by the fact that reconstruction can involve some upgrading of services. Nevertheless, it remains important to know how much disasters cost in order to inform strategies and policies on optimal risk management, including appropriate forms and levels of financial risk transfer.

3.3.2 Revenue

The impact of a disaster on government revenue is in part dependent on the structure (including relative importance) of taxation and other forms of government revenue relative to the impact of a disaster. In Bangladesh, a substantial part of government revenue is generated from import earnings. In consequence, the revenue base has become more resilient to natural hazard since the early 1980s due to changes in the country's principal sources of foreign exchange (see Chapter 2). In Dominica the insensitivity of local revenue to natural disasters in part reflects the fact that there is no direct taxation on agricultural production, which is particularly sensitive to natural hazards, while export taxes are also being relatively unimportant, accounting for less than 1% of local revenue since 1979/80. Meanwhile, the yield on general consumption taxes will only fall markedly if there are widespread personal income losses – an exceptional occurrence only observed in extreme cases such as during the 1990s volcanic crisis in Montserrat.

Post-disaster changes in taxation can also affect levels of revenue. In addressing the economic consequences of natural disasters a government may choose to offer certain tax reductions as an incentive to economic recovery or to increase taxation to meet additional disaster-related expenditure. Some governments choose both courses of action, as in the case of Bangladesh following both the 1988 and 1998 floods.

³² For instance, according to a UN damage assessment undertaken in the wake of the 1998 flood in Bangladesh, US\$186m was required for the repair of damage to roads and highways alone. Yet the 1999/2000 ADP contained no projects under this sector that specifically indicated in their titles that part or all of the expenditure was intended to address damage resulting from the flood.

³³ In Dominica capital investment projects relating to post-disaster rehabilitation and reconstruction are typically not identified as such in annual budget statements. In reality a large part of the increase in capital expenditure that occurred between 1983/4-1985/6 – that is, up to seven years after Hurricane David - could be attributed to major road investment projects in part necessitated by the hurricane. However, part of this increase in capital expenditure would have been required in any case due to years of inadequate maintenance and low investment.

The available evidence suggests that in making any fiscal changes there is often some attempt at achieving greater equity, supporting those hardest hit. In Fiji an existing tax exemption on farming income was extended for a further five years following two cyclones in 1985, partly in recognition of the particular difficulties faced by cane farmers (Benson, 1997a). In the aftermath of the 1982/3 drought in Zimbabwe, a temporary 5% drought levy was imposed on all individuals, except those in the lower tax bracket (Benson, 1998). Also in Zimbabwe, following the 1986/7 drought, a 2.5% surcharge was introduced on company taxes, applicable over the tax year April 1987 to March 1988, to help finance drought-related expenditure. Other efforts target particular industries, as in Fiji, where tax payable on reinsurance premiums remitted overseas was waived following two hurricanes in 1985 to assist recovery in the insurance industry.

However, decisions on post-disaster fiscal changes are often made very rapidly, with little time for analysis. Such issues require greater retrospective analysis in order to inform future decisions. It is also important to explore the impacts of disasters on different types of tax in more detail in order to understand how the overall sensitivity of the tax structure to disasters and other economic shocks can be reduced, whilst also considering income distributional impacts of any tax changes. More in-depth analysis of disasters on other sources of government income would also be useful.

Finally, it should be borne in mind that disasters may affect the timing of payment of taxes. Disasters can disrupt the smooth inflow of revenues through the year, perhaps creating increased bunching of inflows and necessitating greater short-term borrowing, as in Bangladesh in 1998.

3.3.3 Policy context

The budgetary impact of disasters also needs to be understood in the context of prevailing government policies and priorities. Pursuit of various budgetary goals can play a role in obscuring their impact. For example, increased disaster-related expenditure may be offset by additional cutbacks elsewhere, as already discussed. The declining fiscal deficit in Bangladesh in flood years 1987/88 and 1988/89, for instance, reflected deliberate efforts to reduce the fiscal deficit following the 1979 oil price shock and then the collapse of international jute prices in the early 1980s. In fact, in the prevailing policy environment, which typically emphasizes careful budgetary management – indeed, may be an aid conditionality – natural disasters are often more likely to force reallocations than substantial increases in expenditure.

Monetary objectives also influence budgetary outcomes. The Bangladesh government deliberately made only modest use of deficit financing in the aftermath of the 1988 flood, with the objective of keeping the expansion of domestic credit and broad money within the desired limit. In consequence, spending on the Annual Development Programme (ADP) (effectively capital and some recurrent expenditure) for the year was almost 20% lower than budgeted, despite flood-related expenditure.³⁴ Such policies can delay rehabilitation and curtail other investments, thereby contributing to lower long-term rates of growth (see Chapter 2).³⁵

³⁴ This figure of 20% should be put in context. Actual ADP expenditure is typically lower than planned anyway. Over the period 1980/81 to 1998/99, actual expenditure averaged 89% of the budgeted amount.

³⁵ In the particular case of Bangladesh, following the 1988 flood, the World Bank commented that ‘while this is a prudent approach, it is not necessarily desirable in all situations, particularly when (as at present) domestic demand is stagnant, the inflation rate is declining, the banking system has adequate liquidity, and there are substantial donor resources available to assist in flood rehabilitation

Disasters themselves can trigger changes in policy that affect the budgetary outcome. There may be temporary adjustments in fiscal or monetary policy. Disasters may also prompt more fundamental change, with longer-term budgetary implications. Following the 1987 and 1988 floods in Bangladesh, for example, the government embarked on deregulation of private agricultural investment. This shift in policy had a direct impact on production and, because of government's active involvement in the food economy, on public finances in 1989/90 and beyond.³⁶

3.3.4 Reporting and accounting practices

Budgetary reporting practices can also obscure the impact of a disaster. The Bangladesh Government's method of reporting, which is unusual in several respects, makes it less likely that the public accounts will reveal the full extent of the impact of disasters on public finance. The quasi-fiscal deficit of the central bank is not yet recognized as part of public deficit. This is despite the fact that the Bangladesh Bank supports effective losses on subsidized credit programs that the financial sector is obliged to offer on the directive of the government, and counter-guarantees government external borrowing.³⁷ Analyzing performance of the Bangladesh government's separate Food Account is difficult, as budgetary reporting does not cover stock changes.

More generally, it is not easy to obtain information on the impact of disasters on autonomous and semi-autonomous government agencies. Information on public enterprise finances and transfers to and from such bodies may not be included in government financial statistics or budget estimates, as in the case of Dominica. In exploring the impact of disasters on public sector enterprises it is important to consider all such enterprises, rather than make assumptions about likely impacts. For instance, the impact of the 1991/2 drought in Malawi and Zimbabwe was not confined to agricultural parastatals, but affected utilities and transport parastatals as well.³⁸

that are likely to be under-utilized because of shortages of local funds. In this situation, increased deficit financing can be helpful to the economy, provided that the Government is prepared to take subsequent measures to increase revenues and restrict expenditures so that the economy does not overheat' (World Bank, 1989: para 2.19).

³⁶ In 1988 the GoB lifted restrictions on the import and manufacture of agricultural pumping equipment, encouraging an accelerated expansion of private investment in lift irrigation and an associated rapid growth in production, especially in *boro* rice output. The benefits of this expansion were particularly noticeable in terms of agricultural resilience in the aftermath of the subsequent 1998 floods.

³⁷ The accounting treatment of bonds for investment, recapitalization and replacement of non-performing loans is also ambiguous. Meanwhile, foreign aid is shown as a receipt for financing the ADP but the loan component in aid is not included in public debt (World Bank, 1996). A further issue concerns the practice of cash accounting, with any internal transactions going unreported.

³⁸ The Electricity Commission of Malawi (ESCOM) incurred losses from a failure of tariffs to keep pace with inflation. Non-payment also peaked in the crisis year of 1992. The National Railways of Zimbabwe ran a deficit in 1992/93 owing to increased operating costs as a direct consequence of the drought-related import program that, amongst other impacts, obliged it to hire wagons from South Africa and elsewhere (EC, 1993).

3.4 External aid

It is widely believed that the international community responds to disasters by increasing aid, particularly in the form of emergency relief and food aid. This has given rise to concerns about moral hazard, in the sense that 'provision of post-disaster assistance creates disincentives for recipient countries to ensure the physical protection of their assets through disaster prevention and mitigation measures (Freeman and others, 2002: 35). But is disaster-related assistance really additional?

The response by donors to a particular disaster needs to be set in the context of their normal non-crisis activity. Aid typically provides support to development, encompassing investment and, as case studies confirm, elements of projectized recurrent spending. In some policy contexts bilateral donors and international financial institutions provide broader based programmatic and budgetary support. A subsequent disaster shock then puts pressure on public finances and creates foreign exchange difficulties. In such circumstances, an appropriate crisis response is low cost, rapidly disbursing, additional financial aid, focused on meeting the direct costs of disaster response and counteracting the recessionary effects of the shock. The appropriate balance of aid instruments, including food aid and other relief supplies, also depends on the precise nature of the shock and the circumstances of the affected country. Both governance and the sheer scale of assistance required can be issues influencing donor decisions. In some cases it is infeasible to provide all assistance as financial aid to governments. Direct emergency relief through international and NGO channels may be required (Benson and Clay, 1998).

The three case studies considered external assistance only in terms of aggregate commitments and disbursements and the related fiscal and macroeconomic implications. The findings are consistent, despite very different country circumstances. In all three countries external aid has been the main source of funding for development. In low income Bangladesh and Malawi, aid also directly supports social safety nets through the provision of food aid and, indirectly, via NGOs' poverty reduction activities. In Malawi, aid additionally finances small farmer inputs. Excepting emergency assistance following Hurricane David in 1979/80, lower middle income Dominica has received development project aid and programmatic support in response to export earnings shortfalls and in the context of stabilization and adjustment policies.

Available data suggest that disasters have little impact on trends in aid flows. Many donors appear to respond to disaster crises by reallocating resources and bringing forward commitments under existing multi-year country programs and budget envelopes. Reflecting these practices, total aid commitments do typically increase in the years of, or immediately following a major disaster. Reallocations can be an appropriate way of responding, in the sense that these involve a lesser administrative burden than the negotiation of fresh aid commitments. However, by the same token, development spending, largely aid supported, tends to fall as aid and counterpart local funds are shifted to emergency assistance. The re-allocated resources are typically not subsequently made good, with aid commitments instead falling back after the crisis to reflect longer-term trends.

Post disaster, there is often a substantial gap between projected and actual aid disbursement, reflecting management constraints – such as procedural difficulties, procurement delays and lack of local counterpart finance (problems that can also delay disbursement of development aid). Rapid disbursement of food aid commitments may be particularly important as even relatively short delays can prejudice post-disaster agricultural recovery and cause food system related financial pressures, as in Bangladesh in 1989 and Malawi in 1993.

Aid flows are also strongly influenced by other considerations, such as changing donor views on governance and wider policy priorities. The requirement to demonstrate acceptable

internal rates of return resulted in under-investment in storm proofing of port facilities in Dominica. The potential cost of storm damage had not been adequately factored into the calculations (see footnote 8). More recently in Dominica, the priority of some donors for investing in poorer areas made it more difficult to obtain coordinated funding for protecting economically key sectors of the island's coastal road network.

Some of these policy decisions were unfortunately timed. Bilateral development aid to Malawi had been frozen in the drought of 1992 because of human rights abuses, exacerbating the financial effects of the drought. After a considerable surge in pre-Independence colonial aid in 1978, newly independent Dominica was beset with governance problems and poor financial management. Most donors and international agencies had not established effective working relations with Dominica when its most extreme 20th century disaster, Hurricane David, struck in 1979. The US halted food aid to flood-affected, famine-stricken Bangladesh in 1974, because of a breach of the US trade embargo on Cuba. These are not just old issues. There were donor-related difficulties in Malawi over governance and poor financial management that delayed the commitment of emergency assistance in the lead up to the 2002 food crisis. The first famine deaths in Malawi since 1941 were reported in 2002 (Devereux, 2002; IDC, 2003). Low-income countries are at their most vulnerable, financially and economically, to a disaster shock when there are problems of governance and poor fiscal and monetary management. The international community needs to be especially alert to potential disaster in such circumstances.

3.5 Is reallocation an appropriate solution?

Disasters can trigger considerable reallocation of budgetary resources, as already discussed. Such reallocations help limit overall levels of expenditure and, thus, any possible widening of fiscal deficits. On one level such actions would appear beneficial, minimizing some of the potential adverse longer-term impacts of disasters such as possible increases in public sector borrowing and monetary expansion, as well as perhaps satisfying aid conditionalities regarding the size of budget deficits. To some extent reallocations may also represent a natural choice. Some planned expenditure cannot go ahead because of the damage and disruption created by a disaster, effectively releasing resources for reallocation.

Ideally the reallocation of funds after a disaster should occur through a formal process, in the context of a careful strategic review, rather than either on an *ad hoc* basis or via across-the-board restrictions on flows of funds to spending agencies. This, in turn, requires that procedures be in place preventing the virement of funds. A number of further pre-conditions then need to be satisfied in order to ensure that reallocations are rational and cost-effective. These are discussed below with illustrative evidence from Bangladesh.

Donors also respond to disasters by reallocating funds as a rapid practical expedient, working within an overall country aid program. This is rationalized as drawing on commitments to poorly performing projects. But the same considerations hold about the need for a formal and, in this case, joint review process.

i) A clearly defined and applied policy framework

Ideally reallocations should be carefully planned to minimize disruption and delays to the attainment of key policies and goals. This requires a clear understanding of the implications of particular decisions for the achievement of longer-term goals and objectives. That in turn, requires well-functioning planning and control instruments, linked to carefully defined, achievable sets of objectives and outcomes as well as, more specifically, a system of prioritization of individual projects (see below). In reality, however, planning processes are

often weak, particularly where government capacity is itself limited, hindering rapid, appropriate decision-making in an immediate post-disaster context.³⁹

ii) A system of prioritization of individual investment projects

The development budget, including most public capital investment, often bears the brunt of post-disaster reallocations of resources, as discussed above. Ideally, any reallocations should entail the movement of resources away from lower priority projects. In order for such a process to be implemented rapidly and effectively, projects already need to be ranked according to some level of priority.

In Bangladesh, certain projects, known as ‘core’ projects are, indeed, prioritized under the ADP, a practice that informally stretches back at least to the mid-1970s. A formal ‘core’ investment program was introduced in 1983. However, in practice this system does not appear to function particularly well. Following the 1987 and 1988 floods, available funds were basically spread more thinly across existing projects rather than allocations to individual projects adjusted according to levels of priority. Following the 1998 floods funding allocations to particular projects were adjusted on the basis of their priority, but determined according to the stage of implementation (that is, whether they had yet been approved) and whether or not they were externally aided, rather than on a longer-term strategic basis.

Such problems may well be generic, a recurrent feature of budgeting practice. Writing about responses to shortfalls in budgetary resources more generally, Foster and Fozzard (2000: 18) comment on a tendency for across the board cuts ‘on the grounds that this is “fairer” to the various spending agencies and easier to apply’.⁴⁰

However, there is some evidence suggesting that in the case of natural disasters social sectors may typically fare particularly badly during any reallocations. Available data on budgeted, revised and actual allocations for the year of the 1998 Bangladesh, for instance, suggests that social sectors, particularly health, population and family welfare, appear to have fared poorly. This is a pattern that would seem to contradict stated objectives of many governments, contravening pro-poor policies.

³⁹ In Bangladesh the basic medium term planning exercise is the Five Year Plan (FYP). A Three Year Rolling Plan was also introduced in FY1991, with the terminal year of each plan coinciding with the first year of the next. The two types of plan are used as the basis for drawing up the ADP. Projects on the ADP are examined in terms of their compatibility with these Plans, as well as their cost, technical quality and economic viability. However, political pressures and the availability of external assistance for particular activities also play a role. Thus, development priorities may already be compromised even prior to the occurrence of a disaster. Problems are exacerbated by the slow process of formalizing budgetary allocations and reallocations, so that post-disaster expenditure is sometimes undertaken before it has been formally approved. Some flexibility is also permitted in the use of funds (although it varies between ministries), again potentially contributing to a deviation away from stated objectives post disaster.

⁴⁰ Foster and Fozzard continue ‘Unfortunately, such indiscriminate cuts ignore spending priorities and the differing composition of expenditure, particularly as regards non-discretionary items. Where a substantial proportion of sector expenditure is dedicated to payroll, as in the case of the social sectors, cuts on discretionary items are likely to be more severe than in the sector with a smaller payroll component. In all sectors, cuts will be directed at consumables. In some cases this will mean that staff continue to be paid although they lack the basic materials necessary to deliver services. Investment projects are another common target of cuts in expenditure, leading to the postponement of projects or the failure to meet commitments with donors for the financing of internal contributions.’

iii) Up-to-date and reliable information on the current availability of resources

Good accounting and monitoring systems are needed to provide timely information on the financial status of line agencies and the availability of resources, including external assistance, in the aftermath of a disaster. In addition, immediate analysis is required of the likely impact of disasters on future flows of public revenue, again including pledges and flows of external assistance, both on a monthly basis and for the remainder of the budgetary year. In reality, many countries may have problems satisfying this condition. In the three case study countries information on actual revenue and expenditure becomes available only after considerable delay.

In fact, Foster and Fozzard (2000: 17) find that virtually all developing countries operate a cash accounting system, with transactions registered once payment has been made. This makes it difficult to obtain a clear picture of outstanding liabilities and payment arrears at any given point in time – and thus of resources available for reallocation post disaster. Problems can be exacerbated in countries where donors deal directly with line agencies and the Ministry of Finance is not informed about post-disaster assistance.

iv) Up-to-date and reliable information on the demand for resources

Linked to the above, information is needed on the impact of disasters on planned expenditure and the new expenditure requirements they generate. This requires the timely production of comprehensive and accurate damage assessments, together with proper appraisals and reliable cost estimates of post-disaster rehabilitation and reconstruction projects.

Preliminary damage assessments are, indeed, often produced relatively rapidly after a disaster. But these assessments are commonly problematic. In 1991 the Economic Commission for Latin America and the Caribbean (ECLAC) developed a formal methodology for assessing damage and ECLAC is working in conjunction with ProVention to promote its wider use (ECLAC/IDNDR, 1999). However, many governments, particularly outside the ECLAC region, still do not apply comprehensive guidelines for use in estimating losses. This lack of guidance potentially results in non-scientific sampling procedures and incorrect valuation of damage. There are also often gaps and discrepancies in coverage. Damage assessments are typically undertaken by a range of government and other agencies. Each has its own specific concerns, and so some impacts may go unreported. Then, as in Bangladesh following the 1998 floods and in Dominica in 1999 after Hurricane Lenny, there is no considered reassessment of losses once the situation has stabilized, and no final loss figure is produced.

A comparison of the 1988 and 1998 floods in Bangladesh highlights the benefits of fuller assessment as well as the critical need for standardized guidelines for disaster damage reporting. The coverage of impacts was still somewhat arbitrary in the 1998 assessment. However, the consequences of the floods were more closely examined, providing a better understanding of the effects of this disaster and so creating the opportunity for improved risk management in the future. More information was also made available by the Bangladesh authorities for external assessment, making the management of this crisis a more transparent process. .

v) Good information on the broader macroeconomic impact of disasters

Government and other economic decision-makers face considerable uncertainty in responding to a disaster and planning appropriate, cost-effective interventions. They have to consider not only the nature of direct assistance required but also levels of resources available to government and, underlying this, issues such as the most appropriate form of fiscal and monetary policy. There are inevitably trade-offs, and the relative benefits and costs of various options have to be considered. For example, should a government expand credit availability to support productive recovery or tighten monetary growth to stem possible

disaster-related inflationary pressures? The appropriate answer to such questions depends on prevailing circumstances, in turn requiring accurate, reliable, up-to-date information on many aspects of economic performance, which themselves may be affected by the disaster, as well as the direct costs of the disaster. In reality, it is difficult to obtain such information and expectations of economic performance may be revised substantially in the months succeeding a disaster, as in Bangladesh in 1998–99 and in Malawi in 2001-02.

To conclude, the conditions under which decisions on post-disaster reallocations of budgetary resources are made are likely to be far from ideal. Indeed, disasters can result in budgetary chaos and confusion. Where disaster-related expenditure occurs regularly, resources should be specifically earmarked for use in post-disaster response as part of the annual budgetary process, as well as efforts taken to ensure that appropriate mitigation and preparedness measures are properly funded and undertaken. Failure to do this constitutes poor budgetary planning and management. This discussion of reallocation processes and the extent to which various pre-conditions are likely to be satisfied is also further evidence of the need for financial risk transfer instruments to help meet the cost of larger rehabilitation programs, alleviating some of the pressure on budgetary resources post disaster.

In fact, the time frame for budget preparation, execution and the finalizing of accounts is typically three years. Budget preparation starts perhaps a year or more before the budget year, but even this may not be enough. So, there may be insufficient time to analyze and adequately address the impacts of a disaster even in the budget for the succeeding year.⁴¹

3.6 Longer-term budgetary impact of disasters and related risk management activities

3.6.1 Risk reduction activities

In seeking to manage risk, a government needs to explore the precise nature of the problem and forms of vulnerability. Based on this analysis it should develop an appropriate, integrated risk strategy, covering various aspects of vulnerability and using a range of responses (regulatory, fiscal, investment, strategic policy). A system of monitoring is also required to explore the vulnerability implications of particular policies and expenditure decisions and to modify them as appropriate.

Some elements of a strategy do not require substantial financial resources but others may. Even if the funds required are modest, budgeting is invariably very tight, with many demands competing for limited funds. As such, the implementation of a such a strategy ideally requires a long-term budgetary framework, ensuring that longer-term goals are not repeatedly subordinated to shorter-term, perhaps populist, spending decisions.⁴² In reality, Fozzard and others (2001) argue that even countries with a tradition of five-year plans have not been successful in integrating plans with the annual budget. However, there is at least increasing

⁴¹ In Bangladesh the budgetary difficulties resulting from the 1988 floods made it exceptionally difficult to prepare the budget for FY1989/90, because of the implied additional financial demands and also uncertainties created by the crisis. At one point during the preparation of the 1998/99 budget, it was even suggested that there would be a deficit on the revenue (recurrent) budget, implying no surplus – or resources - for the ADP. The ADP had to be re-worked again and again as priorities and estimates of the available budgetary envelope changed.

⁴² As Foster and Fozzard (2000: 12) state: ‘The budget cycle needs to be nested within a longer term policy and planning process, which provides a clear link from planning to the allocation of resources ... an annual budget is too short a time frame for addressing development priorities, which require sustained implementation of policies and reforms over a medium to long term period.’

recognition of the need to capture the long-term implications of current spending decisions more generally, providing a more strategic approach that would benefit agendas generating longer-term benefits such as the promotion of measures of risk reduction.⁴³

In the mean time, current evidence suggests that in many countries expenditure on structural mitigation may at least be lower than economically justified. In Dominica public expenditure on disaster mitigation and preparedness was relatively low, at least until the 1990s.⁴⁴ More generally, an Organization of American States (OAS) study provides examples from a retrospective analysis of infrastructure that has been damaged by disaster, illustrating how small incremental increases in initial investment costs would have avoided far higher subsequent repair costs following a disaster.⁴⁵

It is difficult to obtain more precise data on levels of expenditure for disaster mitigation and preparedness, such as on hazard proofing of infrastructure, construction of physical defenses, scientific monitoring and forecasting, early warning systems, preparation of emergency plans and stock-piling of food, drugs and relief supplies. Funding for such activities is often contained within overall budgetary allocations to individual departments. These departments are issued with only loose directives about their preparedness and mitigation responsibilities, and relevant measures and actions are not necessarily clearly labeled. Thus, it is near impossible to ascertain with any accuracy the total amounts spent on mitigation and preparedness. This lack of data has further policy implications, because it is more difficult to present a possible case for maintaining or increasing expenditure, if the current level of spending is not known.⁴⁶

The fact that governments and donors typically do not report expenditure on mitigation and preparedness suggests that such spending has low political priority. Of course there are

⁴³ Fozzard and others (2001) report that many OECD governments have already introduced a medium term expenditure framework (MTEF), with a number of developing countries also beginning to embark on this process. The MTEF represents a 'top-down' resource envelope consistent with macroeconomic stability and explicit strategic priorities; a 'bottom-up' estimate of current and medium-term costs (both recurrent and investment) of existing and new policies, which are also reviewed to verify their consistency with overall government priorities and spending limits; and an iterative decision-making process that matches these costs with available resources.

⁴⁴ Hurricane Lenny in 1999 again exposed the inadequacies of sea defenses and the considerable vulnerability of the road network and other infrastructure along the coast, 20 years after Hurricane David had inflicted severe damage and almost a decade after the first comprehensive sea defense protection plan was completed.

⁴⁵ The study demonstrates the potential benefits of structural mitigation through a retrospective analysis of public and private projects in the Caribbean that have suffered damage from tropical storms. The study examined amongst these the deepwater port in Dominica. This facility was constructed by the Dominica government to handle banana exports more efficiently and to lower the handling costs of imports. A year after completion, Hurricane David struck, causing reconstruction costs equivalent to 41% of the cost of the original port. Had the original facility been built to a higher standard, able to resist hurricane-force 4 winds, an option rejected on cost grounds, the study estimated that it would have increased investment costs only about 12% (Vermeiren and others, 1999).

⁴⁶ Bangladesh arguably is a notable exception, at least to the extent that considerable public resources have been invested in flood control under the highly interventionist Flood Control, Drought and Irrigation (FCDI) strategy launched in the 1960s. However it is difficult to estimate total spending on disaster related activities, other than in terms of the substantial proportion of development expenditure absorbed by the water resources sector. Also the proportion of FCDI accounted for by disaster reduction is difficult to isolate. Meanwhile, expenditure on mitigation of other hazards, most obviously earthquakes, may be far too low from an economic perspective.

measurement problems, particularly where a risk reduction measure is included as just a small component of a project rather than entailing dedicated projects that are clearly identifiable as mitigation or preparedness. Examples are cyclone or earthquake proofing of buildings as part of a school building project, or a drought proofing of water supply. Other initiatives in areas such as poverty reduction, agricultural extension or micro-finance, can also play a role in reducing vulnerability, further complicating any attempt at calculating spending. However, aggregate expenditure on mitigation and preparedness, even purely on dedicated projects, is rarely, if ever, reported in annual public accounts.

The nature and level of recurrent expenditure also has implications for of vulnerability. Many countries, including the three case study countries, have a dual budgeting system, with different ministries, or separate departments within the Ministry of Finance, responsible for the preparation of recurrent and investment expenditure plans. Mitigation is sometimes perceived in terms of major structural investment projects, and so is of little concern to those preparing recurrent budgets. However, levels of recurrent expenditure in particular areas, most obviously operations and maintenance (O&M), have substantial implications for levels of vulnerability. Badly maintained infrastructure can increase vulnerability to natural hazards, as well as impose larger post-disaster costs. In Bangladesh the high costs of rehabilitation following the 1987 and 1988 floods and 1991 cyclone partly reflected inadequate O&M and poor past investment planning. Inadequate O&M has been a major constraint on the effective functioning of Flood Control, Drought and Irrigation infrastructure as well, despite huge capital investments.

Indeed, it is widely held that expenditure on O&M is too low in most developing countries.⁴⁷ Greater integration of recurrent and capital budgets, as embodied in the MTEF (see footnote 13), would be beneficial in this regard, helping to tie mitigation objectives into the recurrent budget. If risk management concerns were more fully integrated into the project cycle, this could also influence both levels of expenditure on O&M and design standards to which infrastructure is constructed. The road network in Dominica, which is vulnerable to coastal storm damage as well as annual flooding and landslides, exemplifies these issues (see Chapter 2).

3.6.2 Longer-term policy consequences of disasters

To what extent do successive disasters thwart the attainment of longer-term policy goals? Country case evidence suggests that disasters have had some effect, but that it may be difficult to demonstrate clearly. In Bangladesh poverty reduction is widely acknowledged as the country's central developmental challenge (e.g. GoB, 2002; World Bank, 2002). Successive governments have attached high priority and considerable resources to poverty reduction, focusing on economic growth and human resource development as the main ways of achieving this goal. However, disasters have played a role in thwarting the attainment of targets and also hindered efforts to develop the country's infrastructure. As demonstrated above, disaster related expenditure displaces planned investment and normal recurrent expenditure. In Dominica disaster spending has similarly displaced planned investment by creating more urgent needs, although it is difficult to measure their precise impact on the overall level of capital expenditure.⁴⁸ Efforts to improve the efficiency of the Philippines'

⁴⁷ There is 'a significant bias toward capital expenditures, driven by governments which perceive the current coverage of services and infrastructure to be inadequate and the expansion of service networks as a priority... One of the results of this capital bias is to reduce the funds available for O&M, leading to inadequate funding of service provision and the gradual degradation of capital investments and the quality of public services' (Fozzard and others, (2001: 46). The project bias of aid towards additionality favors investments in new physical and human resource development rather than in making good inadequate recurrent spending.

⁴⁸ The Dominica government states that 'the fiscal burden (of natural disasters) has been

transportation systems are also reported to have been only moderately successful because much of the available resources have been redirected in response to calamities, with knock-on implications for the pace of improvement of rural transport linkages.⁴⁹

Other disaster legacies include increased indebtedness, again with potential long-term development implications, in this case primarily relating to the opportunity cost of future debt servicing and repayment costs.⁵⁰ Disasters can create additional external debt pressures to the extent that they also destroy infrastructure and other assets funded with still-outstanding external loans.⁵¹

The financial effects of disasters can also have long-term implications for broader economic policy. In Dominica these severe budgetary effects have been a factor in the adoption of major reforms. In the aftermath of Hurricane David, Dominica undertook certain reforms under an IMF-supported program. A subsequent structural adjustment program (SAP) in 1986/87 sought to address the problem of slow recovery from the 1979-80 disasters and the effects on exports of subsequent storm damage. There was further pressure for adjustment following the 1995 storms.

In contrast, on some occasions disasters have been made an excuse for fiscal problems that in part had other causes, so deflecting pressure for policy change. In Zimbabwe the 1991/2 drought was in part blamed for difficulties in fact arising as a result of the government's SAP, adopted in the previous year. Such tactics are potentially dangerous, perhaps buying a government and other interested parties time, but implying that they might postpone efforts to address other underlying causes of budgetary difficulties. More positively, in the case of Zimbabwe the existence of the SAP ensured that an effective macroeconomic monitoring

significant necessitating the diversion of scarce resources from programmed activities' (GoCD, 2000: 4). In aiming to achieve one of its principal goals of economic diversification, the GoCD has placed particular emphasis on the provision of infrastructure to support growth in agriculture, manufacturing and tourism. However, the weak infrastructure base has been consistently identified as a critical constraint to the pace of development, limiting the country's ability to attract and sustain new productive investment. Part of this weakness relates to the continuing vulnerability of the internal transport and communication network to adverse weather systems, necessitating expenditure to rehabilitate the roads in the aftermath of storms. The indirect fiscal impact of disasters has been an additional factor contributing to limited government saving and restricting the availability of counterpart financing. The lack of counterpart financing is also reported to have 'led to the non-implementation or the deferral of important projects in the social sector, notably in housing, water and sewerage' (GoCD, 1998: 24).

⁴⁹ Strains placed on the country's ability to provide sufficient classrooms and other social infrastructure by its rising population have also been exacerbated by the damage inflicted by natural hazards. Indeed, the *National Physical Framework Plan 1993-2022* lists this damage and the consequent redirection of resources, in turn hampering the implementation of other infrastructural projects, as one of six key issues and concerns in terms of infrastructural development (Philippine NLUC, 1992).

⁵⁰ In the Philippines, the 1990 earthquake and 1989-90 drought were reported to have contributed to a 6.7% increase in total external debt, and a 22.4% increase in debt from official creditors alone, in 1990 (Ernst and Young, 1991). An examination of the impact of the mid-1980s drought on external borrowing in six SSA countries revealed that the growth rate in total debt stocks accelerated during the year of most severe drought in five of the countries (Benson and Clay, 1998). The exception, Zimbabwe, had been pursuing a deliberate long-term policy of debt reduction.

⁵¹ The Japanese Overseas Economic Cooperation Fund (OECF) extended a loan to the Philippine Government for the construction of rural roads in Northern Luzon that were subsequently damaged by typhoons (Benson, 1997a). However, such loans cannot be cancelled.

system was already in place, providing early indications of the additional economic difficulties emerging as a consequence of the drought (Benson, 1998).⁵²

3.7 Lessons learned

3.7.1 Analyzing and reporting budgetary impacts of disasters

This chapter has shown that a disaggregated approach in exploring the public finance impacts of disasters and better documentation of expenditure on all aspects of risk management and post-disaster response would aid public decision making.

A superficial review of broad fiscal aggregates is likely to be hugely deceptive, suggesting that even severe disasters have very limited budgetary consequences. However, this initial attempt to explore the budgetary effects of disasters and related decision making more closely, suggests a somewhat different picture. Disasters were found to have significant short and longer-term narrowly fiscal impacts, with broader development implications. They caused widespread – if largely non-transparent – immediate and inter-year reallocations of funds by governments and aid donors. Disaster responses can and does crowd out other expenditure.

In all the countries studied so far by the authors, it has been impossible, however, to ascertain actual levels of expenditure on either post-disaster responses or mitigation and preparedness. Expenditure is made from a number of budget lines held by various departments and levels of government and is often not explicitly identifiable as disaster-related. These limitations of fiscal reporting lead to specific recommendations.

First, expenditure on disasters and other related risk reduction activities should be measured more explicitly. Spending on mitigation and preparedness needs to be properly reported. Risk management measures take many forms and cut across virtually all sectors of government however. It is not proposed that dedicated funds should be established for such purposes but, rather, that relevant activities and related expenditure are tagged, enabling total expenditure in this area to be estimated. Spending levels could then be assessed relative to government risk reduction policies and goals.

Second, improved information on the fiscal impact of disasters is also required. This will help to ensure the adoption of appropriate mitigation measures in the design of new projects and implementation of dedicated structural projects where necessary. More broadly, it will

⁵² In 1991 the economy had failed to meet certain extended SAP targets, most notably falling 0.6 percentage points below the target GDP growth rate. Some commentators believed that the economy was unlikely to meet target performance indicators in 1992 as well; and by the end of 1991 the government was also beginning to warn of short-term adverse conditions as an unavoidable part of the structural adjustment process. The subsequent drought certainly impeded the progress of adjustment and a number of the original economic targets for 1992 and 1993 were not achieved. In particular, the drought hampered efforts to reduce the budget deficit or thus to reduce domestic borrowing and also to restructure the civil service and parastatal bodies. In consequence, the expected domestic supply side response to the reform program, which was critical to its success, was partly curtailed. But retrospectively the drought was seen by the Zimbabwe Government as well as the World Bank and IMF to be the principal cause of the economic difficulties experienced in 1992, rather than as a factor exacerbating existing problems. Cynics might even argue that the drought provided a convenient scapegoat for the country's economic difficulties, allowing the IMF and the World Bank, who were keen to achieve a 'successful' story of adjustment, to continue to hold up the Zimbabwe example as a potential triumph. Meanwhile it enabled the Zimbabwe government to sustain the reform process by avoiding a large fall off in public support (Benson, 1998).

help facilitate the integration of risk management concerns into medium- and long-term economic and financial planning.

Careful and detailed review of the fiscal implications of individual disasters would also help identify appropriate post-disaster policy responses. The reasons underlying any failure to reach planned targets would be more transparent – an ever more pertinent exercise in the face of stagnant aid resources and increasingly stringent donor conditionality. Such reviews could provide a useful input into policy on taxation and other forms of revenue generation in a post disaster situation.

Third, as part of efforts to improve information, attempts to finalize disaster loss figures would be helpful. It would be also be useful to tag post-disaster relief and reconstruction funding. Currently, post-disaster assessments produced in the turmoil and disruption immediately after an event are rarely revised while actual relief and rehabilitation activities may not directly correspond with those identified as required immediately post disaster.

Finally, for longer-term consideration, the sensitivity of revenue generation to disasters and the effects that different forms of revenue raising, such as indirect taxes or school fees, have in a post disaster situation on affected groups are also issues for fiscal policy.

3.7.2 Financing hazard-related costs

Policies on the future funding of post-disaster relief and reconstruction need better information on the impact and cost of disasters. Many countries lack any explicit policy on financing post-disaster response, beyond making some relatively minor annual budgetary allocations for use in the event of a disaster. Instead they implicitly rely on post-disaster reallocations to meet a large share of relief and rehabilitation costs, without exploring the long-term developmental implications of the various funding options (reallocation, borrowing, insurance, etc.). In many developing countries it is also assumed that additional external assistance will be forthcoming in the aftermath of a disaster, although the reality is somewhat less straightforward (see Section 3.4). Such approaches to the financing of disaster relief and rehabilitation constitute poor planning. Moreover, in many countries they may not be sustainable in the long term, without causing significant economic damage, because of the escalating cost of disasters (see Chapter 1). However, better information on the costs and impacts of disasters is required in order to persuade policy makers to change practices. Emerging realization of these facts has at least triggered increased interest in alternative ways of financing disaster costs (see Chapter 5).

In countries experiencing localized disasters, such as storms, landslides, flooding, on a near annual basis, there is a strong case for the annual pre-assignment of funds to meet a substantial share of relief and rehabilitation costs (see Section 3.7.1) as well as for seeking to mitigate against them. Annual budgetary allocations help strengthen financial planning and fiscal discipline more broadly. However, such allocations alone may not be the most cost-effective strategy. When disasters do not occur, the contingency provisions may well be dissipated in wasteful, last minute, unplanned, supplementary allocations to various expenditure heads. By making budgetary allocations for use in the event of disasters, governments are also raising the general level of budget expenditure and/or squeezing planned allocations to programs.⁵³ Moreover, contingency funds of this nature are unlikely to

⁵³ John Roberts (ODI), Personal communication, February 2003.

be adequate in the event of a major disaster, particularly where the same budget line is also required for other purposes.⁵⁴

Longer-term disaster contingency reserves that are rolled over between years raise different problems. Such reserves can be held either domestically or abroad, ideally in highly liquid accounts allowing immediate access to funds. However, highly liquid accounts offer only a 5-6% rate of return compared with a 16% rate of return frequently attributed to investment in development projects, an alternative use of resources (Freeman and others, 2003). In theory, annual contributions to contingency reserves should also be equal to annual expected losses based on the risk the fund is designed to cover. However, as Freeman and others argue, the time frame involved in accumulating a sufficient fund would be so long that the fund would not effectively protect against large events occurring in the first years of accumulation. In addition, there may be political difficulties in keeping up adequate commitments and protecting accumulated funds if there is a long run of disaster-free years. Instead, hazard-prone countries need to undertake analysis to determine optimal bundles of financing options. They should consider all possible instruments and funding needs raised by more extreme as well as more frequently occurring, lesser events (see Box 3 and Chapter 5). They should also try to determine appropriate levels of funding for, and forms of, mitigation and preparedness.

Post-disaster reconstruction should be better planned, incorporating mitigation needs as well as being in line with development objectives. An option for governments experiencing frequent, large scale disasters would be to pre-plan possible reconstruction and rehabilitation programs on the basis of a series of disaster scenarios and, within that, to identify critical projects that should receive priority in the allocation of funds post disaster. Such exercises should also seek to identify key areas of capital and recurrent expenditure that must be protected in a crisis. Possible policy options, for example, exploring the likely effect of particular fiscal changes and monetary measures, could also be explored through scenarios to develop guidelines for responding to disasters. Such guidelines could be presented in the form of computer simulations.

For improved financial management of disasters it is also necessary to explore how risks that combine frequency of occurrence with magnitude of consequences may change over time (see Chapter 1). The main factors likely to affect occurrence are global climate change and more localized environmental changes. In Bangladesh, the costs of urban flood protection, including drainage and continuous protection against erosion, are inevitably rising. In contrast, the rethinking of the rural disaster reduction strategy points to possibly less costly, more localized solutions in the future. The effects of climatic change and how this will interact with the dynamics of land and water use also need to be taken into account. In Dominica the decline of agricultural exports makes protection of communications infrastructure, essential to the service sector, of increased importance. In Malawi evidence of increased sensitivity to climatic variability resulting from a number of factors, including the wider HIV/AIDS pandemic, will require a rethink of finance for information systems.

3.7.3 Governance

Donors and civil society organizations draw attention to the critical role of good governance, including a transparent and accountable fiscal regime. Countries studies were certainly at their most vulnerable to natural disaster in periods of conflict and weak governance, characterized by extreme uncertainty and insecurity, as in Bangladesh during 1969-75 and Dominica during 1978-80. Government was ineffective in managing relief, public finances were chaotic and

⁵⁴ General contingency reserves are often used to meet the cost of any public sector wage increases negotiated during the year.

plagued by corruption. Dominica returned to more disciplined fiscal management during the 1980s; a relatively straightforward case. In contrast, in Malawi the government's failure since the early 1990s, and despite democratization, to manage the fiscal and monetary aspects of shocks, has contributed to increased sensitivity to disasters. However, such a simple generalized explanation of failure is at once too facile and a means for those focusing on governance to escape from responsibility.

There are other influences on vulnerability and also things that can be done within a country and internationally to reduce vulnerability, even where there are continuing serious problems of governance. In Bangladesh the Ministry of Finance slowly and not with reverses established a more stable budgetary envelope and with the (central) Bangladesh Bank achieved more disciplined monetary management in the 1980s and 1990s. Government allowed, and sometimes actively encouraged the growth of micro-finance institutions with much support from international donors. Such developments eventually contributed to reduced sensitivity to disasters. However, there has been continuing political instability and micro-decision-making within government remains severely compromised by short term rent seeking behavior (Sobhan, 1998).

Chapter 4

Information on Natural Hazards and Disaster Reduction

Information on natural hazards has a key role in disaster risk management. The conceptual framework of international public goods is employed in this chapter to explain sources of weakness in hazard information systems. It considers provisionally, on case study evidence, whether there is adequate funding of hazard information for developing countries as an international and national public good.

4.1 Information and Public Action

Good quality, trustworthy data is a necessary condition for effective natural disaster risk management and all areas of public action. This is confirmed by evidence from the case study countries. There are clear examples where strengthening of information systems and the application of information in risk management has reduced the economic as well as human suffering inflicted by extreme events.

The cyclone warning system in Bangladesh is widely recognized as a successful case of disaster reduction. The meteorological forecasts provide earlier and more precise advice on imminent storms. This information has been translated into warnings with increasing effectiveness (notably in 1997), thus allowing precautionary evacuations of at risk people to shelters and livestock to protective mounds.

The reassessment of coastal protection levels required in Dominica to minimize damage and economic disruption from wave action during severe hurricanes is reflected in the more limited impacts of recent storms. In 1999 the Category 4 Hurricane Lenny caused limited damage to infrastructure that had been reinforced or constructed to higher specification in the 1990s, for example the sea defenses in the capital, Roseau. In contrast, there was costly damage to other port facilities, coastal roads and other infrastructure that still had little protection against wave action in a severe storm, causing extended disruption. The risks were understood but funding constraints had curtailed protective measures.

The case studies have also provided evidence that weaknesses in the systems that generate and disseminate information on natural hazards and their likely effects has been a factor in extreme natural events becoming social and economic disasters. The floods in southwest Bangladesh in 2000, and most notably the 2002 food crisis in Malawi and more widely in Southern Africa, are recent examples.

The purpose of this chapter is to go beyond presentation of such case experiences of good and bad practice. An organizing framework is required to make sense of these experiences. So this chapter considers the usefulness of the framework for understanding international public goods in explaining sources of weakness in hazard information systems. The chapter is based primarily on the case study about climatic forecasting in Malawi and Southern Africa (Annex C). Research into global climatic processes and forecasting the likely weather at regional levels and below is a classic example of a public good. There is additional case evidence on Bangladesh and Dominica, concerning geophysical hazards and the difficulties that arise when there are some externalities in resource use and some element of rivalry between users of information, as in hydrological information on river systems and related flood hazard. The details of these experiences are documented in the case studies and summarized in Annexes A, B and C.

4.2 Hazard information as a public good

Scientific information on natural hazards – including both its generation and dissemination to potential users or consumers, would appear to be a classic example of a public good.⁵⁵ If the good's benefits are both *non-rival* and *non-excludable*, then the good is a pure, public good.

A good's benefits are non-rival amongst users when one agent's consumption or use of the good does not detract in the slightest from the consumption opportunities of other agents from the same unit of good. Non-excludability requires that no one can be excluded from use or consumption of a good once it has been provided. So the provision of such a good is inherently problematic. Institutions can restrict access. There is the problem of the incentive to free ride, which cannot be prevented. Confronted with this situation, some suggest that 'where benefits are non-rival, it is inefficient to exclude anyone who derives a positive benefit, because consumption to more users creates benefits that cost society nothing.' (Kanbur and others, 1999: 61). In practice goods may not exhibit either characteristic purely, but information on environmental hazards and environmental change, i.e. changes in hazard risk, is generally regarded as being a public good.

Meteorological information on tropical storms is close to the theoretical paradigm case of a public good. Such information typically includes climatic risk assessments, which may be the annualized probability of a storm, above a specified wind speed, or the probable levels and intensities of wave action, associated with specific wind speeds. Forecasts are the other typical products, real time information on the likely spatial range, duration and intensity of a storm when it is threatening or actually happening. Both types of information have made important contributions to disaster risk reduction in Bangladesh and Dominica.

A public good may be *international*, *regional* or *national*, depending on the potential spread of benefits. Some hazard information is country-specific (e.g. landslide hazard assessment risk in Dominica). An example of a regional public good (RPG) is tropical storm warning in the Caribbean. The El Niño-Southern Oscillation is a disaster phenomenon with global consequences, and information is being explicitly generated and disseminated as an international public good (IPG). Furthermore, where programs are country-centered, benefits may spill over to others (e.g. seismic monitoring in India is registering events in Bangladesh).

Practically, the World Bank (2001) has found it useful in considering IPG to distinguish between:

- ? *Core* activities that aim to *produce* public goods, and
- ? *Complementary* activities that in turn prepare countries to *consume* the IPG that core activities make available – while at the same time creating valuable national public goods (NPG).

Public choice analysts suggest that different IPG are likely to require different funding arrangements. The arrangements will depend on the extent to which IPG are purely public goods and the practicalities of exclusion and country financial capacity (Sandler, 2002). Grant funding may be required for the generation of core IPG. Complementary activities that are largely country-specific would be funded by governments, to the extent that NPGs are involved. NPGs may justify and more easily allow use of traditional country-based aid instruments including loan finance (Ferroni and Mody, 2002). The levels of aid funding for IPG is difficult to estimate precisely, but is currently put at about US\$10 billion, and is

⁵⁵ Recent important theoretical and policy contributions to the subject include Kaul and others (1999) and Ferroni and Mody (2002). Cornes and Sandler (1996) is widely regarded as the fullest statement of the theoretical framework on which these discussions are based.

generally agreed to be increasing as a share of ODA, which is currently by at least 10%.⁵⁶

Non-excludability is the common source of co-ordination and financing problems, because of the incentive to free ride (Ferroni and Mody, 2002). As all countries benefit from an IPG or RPG, all should contribute to the costs of provision. But there are problems of valuation and also differences in ability to pay, as reflected in the experiences of the case study countries.

4.3 Climatic forecasting in Southern Africa

Global climatic processes, especially the forcing mechanisms that underlie variability and climatic change, are the subject of intense investigations. The El Niño Southern Oscillation (ENSO) phenomenon is widely regarded as a key indicator of global processes, providing the basis for long-lead forecasting. This research is widely regarded as generating an IPG. There is international co-ordination under the World Meteorological Organization (WMO) and the findings and predictions of a substantial number of forecasting models are regularly and openly reported, for example by the International Research Institute for Climate Prediction (IRI) at Columbia University.

In Southern Africa the close association between regional droughts in 1982/3, 1991/2 and 1994/5 (Figure 4) and El Niño events provided the impetus to the development of regional long-lead or seasonal forecasting. By 1997/98 a formal process for consensus-based long-lead forecasting had emerged, managed through the Southern African Climatic Outlook Forum (SARCOF), and involving national meteorological agencies from all the SADC countries (Thomson, Jenden and Clay, 1998). This was funded to begin with as part of a wider global initiative to strengthen regional climatic forecasting. The SARCOF forecasts rely heavily on forecasts from global models that also strongly reflect the behavior of ENSO. Additional detail takes account of regional topography. During the 1997/98 El Niño, closer Southern India ocean conditions were locally more influential, resulting in higher than anticipated rainfall in some countries, especially Malawi and much of Mozambique. Much less well-understood oceanic-atmospheric interactions in the Indian Ocean and Southern Atlantic are now recognized as important influences on rainfall patterns and have become the focus of internationally supported research.

The precision of SARCOF forecasts is still very limited, assigning only broad probability bands to zones, encompassing parts or the whole of several countries. The forecasts are difficult to downscale and imprecise about the risks of erratic rainfall patterns that are critical to crop performance.⁵⁷ On the other hand, the greater attention now paid to forecasting and monitoring weather through the season ensures that scientific data on a ten-daily basis is more rapidly available to inform assessment and decisions. Global climatic developments are also closely watched and assessments quickly disseminated through the internet. A real problem is that decision-makers would like very clear predictions – this climatic event will lead to this pattern of weather in the coming months - particularly when food security depends on good crop growing conditions. The reality is that the complexity of weather patterns and impacts mean that forecasts often have to reflect a lack of certainty. For example in 2002, as the food

⁵⁶ The World Bank (2001) estimated total annual average aid commitments on 'core' IPG as US\$5 billion, and on complementary activities as US\$11 billion, totaling US\$16 billion during 1995-98. On a narrower basis Te Velde and others (2002) estimated total annual average IPG commitments during 1996-98 as US\$9 billion, equivalent to 9% of ODA.

⁵⁷ The spatial scale of forecasts is often not detailed enough. There is insufficient detail about the distribution of rainfall within the wet season. Information about the start and end of the rains is needed. There also needs to be sufficient time to respond to forecasts. Finally users would like more information about the accuracy of past forecasts.

crisis affected six Southern African countries, forecasters indicated the high probability of and then confirmed a moderate El Niño event, but there was great uncertainty about what this might mean for the 2002/03 wet season and whether it would continue. In effect, the models are saying that decisions about an already difficult food security situation have to be taken in circumstances of more than usual uncertainty about rainfall.

The international effort to understand and predict global climatic processes is a pure public good. The generation of this public good has been extended with international support to regional forecasting as an RPG in Southern Africa and elsewhere in SSA. Because of the wider consequences of food security crises in SSA, the international community finds itself with a contingent responsibility to respond. So regional forecasting in SSA continues to be a core IPG activity. However, the effectiveness of these efforts depends on a capacity for decision makers to use this information at a country level and below.

Country-specific forecasts can alert international and national agencies and civil society to the need for precautionary measures to safeguard food security and water supplies, and reduce the cost of potentially financially destabilizing crisis measures. The study of Malawi has confirmed the value of forecasts at a country level and the need for complementary activities. But it has also highlighted problems mentioned above which at present limit the value of forecasts. Presently, only some commercial farmers are able to respond to more specific seasonal forecasts. Smallholders lack the technical options and resources to modify significantly their choice of crop, seed variety or traditional planting practices. These differences in capacity to exploit information have income distributional and poverty implications. Pressures for cost recovery at a national level could result in the focus of product development and dissemination as ‘club goods’ for those with incentive and ability to pay. The use being made of climatic forecasting is promising, but it still needs considerable institutional strengthening, technical capacity building, more systematic application of current scientific knowledge and investment in data and equipment.

The World Bank, using IDA credits, invested in the development of climatic forecasting in Malawi, following closely the distinction of core and complementary activities (Clay and others, 2003). This is within the wider context of supporting the strengthening of the national meteorological agency. However the limitation of this approach is that forecasting has a high proportion of recurrent fixed costs, posing the problem of sustainability. In the case of Malawi these costs are well beyond the level of expenditure funded by central government. Meanwhile the possibilities for cost recovery in providing services are severely limited for what is relatively generalized information. In such a situation a cost benefit calculation is required to indicate whether this IPG and complementary activities at country level are a continuing priority for international support.

It is difficult to place a robust value on climatic forecasting for Southern Africa. However, qualitatively, its potential usefulness is clear. Efforts to strengthen climatic forecasting and associated dissemination activities have:

- ? provided a scientific consensus process;
- ? integrated and strengthened meteorological systems in the region;

- ? established systems for closer monitoring and reporting of weather through the year; and
- ? identified priorities for further research to improve forecasting ability.
- ? provided systems for assessing climatic risk that can feed into decision making processes

The strengthening of forecasting systems is providing improved real time information on rainfall and weather more generally that can inform decision making after a crisis has begun.

However, so far benefits in terms of demonstrable improvements in decision-making are yet to be reaped.

The financial costs attributable to the whole forecasting effort for Southern Africa are around US\$ 5 million, spread across services and research institutions inside and outside the region. There is a large element of fixed costs in sustaining climatological monitoring capacity, and forecasting at a national level is a joint product, whose costs are difficult to isolate. These costs are modest compared with the economic costs imposed by climatic variability in the region, which are estimated to be equivalent to at least US\$ 1 billion a year. Even a small reduction in losses through improvements to public decisions on food system management and private risk management would justify both past and continued investment put into strengthening forecasting.⁵⁸ Regional climatic forecasting needs to be sustained as a learning process. The scientists need to understand and then attempt to respond to more specific information requirements. Similarly, public and private users need time and probably assistance to understand how climatic information will be able to improve risk management. Long-lead forecasting is still in its infancy, and climatic research is making rapid progress.

4.4 Tropical Storms

Bangladesh

Cyclone protection has become an intermittent official donor and international NGO priority in response to specific extreme events. After the 1970 cyclone, in which at least 350,000 lives were lost, the Bangladesh Red Crescent managed programs for cyclone shelter construction, with increasing success. Although 140,000 lost their lives in the May 1991 cyclone, 340,000 people survived by evacuation and sheltering in purpose built shelters and public buildings. In May 1997 a similar cyclone claimed less than 200 lives, whilst 1 million people were evacuated into shelters (IFRC, 2002). Since 1991 cyclone shelters have been designed for multipurpose use, mainly for schools, with budgetary implications for O&M. Even so there is still under-provision of shelters. For that reason, and because buildings are in multiple use, the principle of non-rivalry is compromised. Institutional arrangements are required to ensure that the poorest are not excluded (Pantelic and others, 2000).⁵⁹ Mitigation investments and humanitarian aid, unless provided to levels that saturate demand - that is they become a free good, are private goods (rivalry and excludability), raising intense problems of competitive access.

Forecasting: A critical factor in the success of cyclone protection is the considerable progress that has been made in coastal cyclone warning since the devastating storm of May 1991. Meteorological observation of storms by remote sensing has become, in effect, an internationally funded public good. The complementary cost of using this information is

⁵⁸ For example, there is a large gap between import and export parity prices for cereals in the landlocked countries of Southern Africa. The failure to recognize increasing risks of an impending poor production season has resulted in costly decisions to run down national food security stocks of maize that quickly made necessary costly replacement imports. This happened in Zimbabwe in 1991 and in Malawi in 2001. Liberalization of internal and external markets for cereals shifts part of the decision-making to the private sector. However, if the private sector misjudges the situation, governments and the international community face the contingent liability of ensuring food security and preventing famine at almost any cost.

⁵⁹ Even more problematic has been the construction and maintenance of the network of coastal embankments to mitigate the effects of storm surges. There is, for example, potential rivalry between rice production, mostly by small farmers, and large scale shrimp producers, who sometimes breach the embankments to allow in saline sea-water, thus jeopardizing their protective function.

relatively modest and an institutional vehicle has been found to undertake this task.⁶⁰ Cyclone protection has also been facilitated by the gradual emergence of large NGOs that provide further institutional support to affected communities, including the poorest, in crisis situations.

Dominica

Forecasting: Tropical storm warnings in the Caribbean region have also been progressively strengthened. The region benefits from the close proximity to the United States as the lead nation in official support for forecasting as a public good. In addition, commercial media and internet based communication have come to provide real time information on storm risks. However, as the unpredicted course of the destructive Hurricane Lenny demonstrated in 1999, even the most advanced prediction models may be found wanting.

Risk assessment: The recurring damage to Dominica's key infrastructure highlights deficiencies in risk assessment that are only slowly being made good. Following independence for many Caribbean states, wider regional arrangements for scientific research on strengthening disaster management are emerging under the auspices of OAS, in practice supported with international and bilateral US financial and human resources. These projects have played a role in enhancing scientific hazard assessment and monitoring. For example, concerns about sea level rise within the Caribbean Sea and the absence of reliable benchmarks have highlighted the past lack of sea level and wave monitoring within the region. Dominica itself had no capacity to undertake such monitoring independently. Consequently only qualitative assessments of the coastal sea conditions associated with the impact of individual storms, including Hurricane Lenny in 1999 are available. To provide benchmarks for determining the effects of climate change, the OAS has launched a regional program for sea level monitoring, supported by the Global Environment Facility (GEF).⁶¹

4.5 Failures in the provision of information as a public good

4.5.1 River system hydrology

In Bangladesh riverine flood warning is still primitive and gives very limited advanced warning. Bangladesh effectively received only a 24-hour warning in the form of 'rivers at danger level' advice from its upper riparian neighbor, India, at the time of the 2000 floods in SW Bangladesh. Similarly river modeling, crucial for risk assessment, only began to be seriously undertaken under the Flood Action Plan from 1989 onwards. Even this work has been restricted by the attempt to model only for Bangladesh, which includes the larger part but not all of the Brahmaputra-Gangetic delta system.⁶²

This weakness partly reflects very restricted regional co-operation in meteorology and hydrological systems monitoring. The long running dispute over the use of the Farakka

⁶⁰ In 2001 the GoB contributed 56% of the recurrent operational costs of US\$ 460,000 of the Cyclone Preparedness Program, managed by the Bangladesh Red Crescent, with the International Federation of Red Cross and Red Crescent Societies covering the remainder (IFRC, 2002).

⁶¹ Monitoring units have been installed, one in each participating country. Such a project raises problems of sustainability, so trust funds of US\$50,000 have been agreed for the maintenance of each unit. In the light of the damage suffered by some units during Hurricane Lenny, further expenditure will also be required to improve storm resistance (information derived from www.cpacc.org).

⁶² There are as yet no models that integrate real time meteorological information for upstream areas in India to predict flood hazards in Bangladesh. Warnings depend on direct assessments by dam and river engineers that pass through official channels within India and then onto the authorities in lower riparian Bangladesh (Chapman and Rudra, 2002).

Barrage upstream in India to control the flow of the Ganges highlights the problems that arise when the assumption of non-rivalry in consumption of information does not hold.

The floods in Mozambique in 1999-2000 have highlighted similar problems of ensuring hazard warnings between upper and lower riparian countries. There are externalities in water use and control. However, the generation of knowledge on hydro-meteorological systems and its regional dissemination can help to address the problem of significant externalities and provide the basis for co-operation.

4.5.2 Geophysical hazards

The Bangladesh and Dominica case studies have highlighted the difficulties in ensuring that an adequate system of monitoring is established and sustained for geophysical hazards. This problem appears to stem from the typically low probabilities of severe or catastrophic events. There are both issues of awareness and of understanding how to respond in risk management to hazard assessment.

Bangladesh

The entire country is part of a high earthquake risk region. Minor tremors are common and one of the most extreme events ever recorded, the 1897 earthquake (Richter Scale 8.8), had its epicenter in the nearby Shillong Plateau of the Indian State of Meghalaya. The 1950 Assam earthquake brought huge sediment loads into the Brahmaputra river, raising its river bed for a number of years (thereby probably contributing to the serious floods in the mid-1950s) and creating large areas of new alluvial land in the Meghna estuary.

The assessment of earthquake hazard in Bangladesh has been relatively neglected. This again reflects an institutional failure at a regional level to provide scientific information on a serious natural hazard as a public good.⁶³ The historical record implies an average of more than one extreme (RS 7.0+) event every 50 years. But the fragmentation of the seismic monitoring systems in 1947 and again in 1971 left Bangladesh with little monitoring capacity (a single seismographic station). This was highlighted in February 2001 when a tremor of 4.2(RS) was identified by Indian sources as centered in NE Bangladesh.

Because of low awareness of seismic hazard and weaknesses in enforcing building regulations, there has been little regard to earthquake proofing during the rapid urban expansion since the late 1980s. This has been done, however, in major internationally funded construction projects, such as the Jamuna Bridge and the Ashuganj fertilizer factory.

The reinterpretation of the causes of the 1897 Assam earthquake shows the challenges in undertaking relatively accurate risk assessment in the region because of possibly large buried faults. Positively, the recent Gujarat earthquake in Western India, extensively reported and shown on television in Bangladesh, appears to have transformed attitudes within government and civil society about earthquake hazard. This has implications for public expenditure on seismic monitoring and risk assessment as a public good. Incorporating earthquake resistance into design will also increase investment costs for public and private construction of key infrastructure and commercial property. There is also the insurance option (see Chapter 5). Decisions on the trade-offs between costs and variability would be better informed if improved risk assessment were publicly available.

⁶³ Three national risk zone maps have been produced for Bangladesh since 1967, and the latest 1993 version is reproduced in Benson and Clay (2002) Map 3. Local geologists acknowledge the tentative nature of these assessments, which are based on the inadequate available data. In addition, visual inspection suggests that the latest Bangladesh map is inconsistent with the seismic hazard map produced in India for neighboring West Bengal.

Volcanic hazard in Dominica

There are also institutional issues to be addressed in ensuring adequate support for monitoring. Scientific hazard monitoring and information dissemination have been organized in the Caribbean at a regional level in ways that reflect colonial history. For seismic-volcanic monitoring, Dominica contributes to and relies on the Seismic Research Unit (SRU), based in Trinidad.⁶⁴ There is also a convention of extreme caution in making potentially sensitive information available, at least in those former European colonies without a tradition of open government. The centralized authority had a general responsibility, a contingent liability in insurance terms, in the event of a disaster. In practice, non-exclusion of potential beneficiaries is still seriously qualified by an administrative reluctance to make information available.

Dominica is seismically extremely active. The SRU had successfully monitored volcanic alerts in the 1970s and 1980s and initiated risk assessment and risk mapping. However, when a new volcanic alert began in September 1998, the monitoring arrangements were found to have not been properly maintained and inadequate for an alert that has occurred almost every decade. The monitoring network had to be refurbished as well as enhanced, with additional emergency external support, to provide the appropriate level of seismic monitoring. This suggests that the SRU network was insufficiently funded to enable it to provide enhanced crisis monitoring.

The way the 1998-99 alert was handled raises the difficult but important issue of how scientific information should be disseminated to the wider public to ensure that both public and private sector institutions make rational decisions on natural hazard risk. Despite previous alerts, a volcanic emergency plan had to be specially prepared and emergency exercises were carried out. But little precise information was made available publicly on the nature and extent of the risks posed. There was considerable uncertainty in the private sector and amongst civil society organizations about the precise nature and level of risk posed, how the crisis might evolve and appropriate responses. This resulted in a confused range of reactions. For example, some insurance companies temporarily stopped taking on new business in the southern part of the island, whilst a few did not renew existing (annual) policies. Others continued to provide cover. But positively, and presumably as a result of experience gained in this crisis and also the continuing volcanic eruption in Montserrat, the SRU has begun to make its risk assessments widely and freely available, both on the internet and through public meetings.

The gap between formal science and most of those making public and private decisions is highlighted by the problem of representing an objective assessment of the risks of a volcanic eruption such as that in Dominica in ways that are relatively easily understood (Box 5). Similar issues arise with respect to all categories of hazard risk, because decision makers want clear predictions.

⁶⁴ The SRU is an autonomous entity within the University of the West Indies, St Augustine Campus, Trinidad. It receives its core funding from Trinidad and Tobago, 20% from Barbados and 30% from 6 other countries, Antigua, Dominica, Montserrat, St Lucia, St Vincent, and St Kitts. Additional funds are obtained from specific contracts such as that to provide seismic monitoring for Netherlands Overseas Territories. It has faced pressures to reallocate core staff to university teaching (Clay and others, 1999). The islands of Martinique and Guadeloupe, between which Dominica is sandwiched, are part of the French national monitoring system, and are not part of the same seismic network. The US territories rely upon the US Geological Service. CDERA, which supports disaster preparedness and disseminates information is an organization confined to the former UK colonies and remaining UK Overseas Territories. The OAS, which supports disaster mitigation and loss reduction, does not include European overseas territories.

Box 5: Evidence-based volcanology: application of Bayes' Rule to the Dominica situation in 1998/99

Bayes' Rule provides us with the formula for updating our opinions for judging the relative odds of Scenario A over an alternative Scenario B, given some new evidence about either (or both) these scenarios.

The formula for the new (or posterior) odds is:

$$\frac{\text{Pr (Scenario A | Evidence)}}{\text{Pr (Scenario B | Evidence)}} = \frac{\text{Pr (Scenario A)}}{\text{Pr (Scenario B)}} \cdot \frac{\text{Pr (Evidence | Scenario A)}}{\text{Pr (Evidence | Scenario B)}}$$

where Pr (Evidence|Scenario) means the conditional probability of seeing the evidence given the scenario occurs, and the ratio of the two conditional probabilities in the above expression is referred to as the "likelihood ratio" of the evidence.

Pr (Scenario A)/Pr (Scenario B) expresses our prior odds (or belief), and is sometimes referred to as the "base-rate" (as exemplified in some notorious law cases, ignoring the base-rate can lead to fallacious conclusions about the correct weight to attribute to evidence).

Considering the case of Dominica, where a local earthquake swarm started in 1998:

- ✍ Scenario A might be the hypothesis that there will be an eruption within a short interval (e.g. the next six months);
- ✍ The alternative, Scenario B, would be the hypothesis that NO eruptive activity occurs in the next six months.

The prior odds ratio,

$$\text{Pr (Eruption) / Pr (No_Eruption)}$$

might be estimated from the fact that the last eruption in Dominica was about 685 years ago⁶⁵, and there have been three eruptions on the island in the last 1200 years. From the latter information, the current likelihood of an eruption in any six-month period might be estimated at about 1 in 800 on average (this estimate could be reduced if we had reason to believe that the chance of observing an interval of 685 years or longer is unusual in the distribution of eruption intervals for Dominica). So, for present purposes, the Prior_Odds of an eruption (in any six months) might be estimated at 1 / 800 (i.e. about 799 to 1 against in betting terms).

However, given the start of a seismic crisis, we should now use Bayes' Rule to estimate

$$\text{New_Odds} = \text{Prior_Odds} * \text{Likelihood_Ratio}$$

where the second factor is a ratio of likelihoods that can be derived from additional information available about volcano-seismic crises and eruptions in Dominica. There have been eight seismic crises in Dominica in the last fifty years (before the present episode) and at least twelve in the last 200 years, none of which has resulted in an eruption. So, extrapolating over the last 685 years there might have been between 40 and 110 such non-eruption seismic crises, perhaps more. Let us use 75 as an average estimate, giving an equivalent 'false alarm' probability of about 0.05 in any one six-month period.

⁶⁵ Information on the eruptive history of Dominica from: "Volcano Hazard Report for Southern Dominica: interpretation of 1998-2000 earthquakes and hazard mapping results", Seismic Research Unit, University of the West Indies, Trinidad; May 2000.

Almost all strong eruptions are preceded by some form of seismic activity, which would be detectable by modern instruments, suitably deployed. Let us assume there is no more than a 2% chance of NOT detecting precursory seismic activity before the next eruption in Dominica - i.e.

$$\Pr(\text{Seismic_crisis} \mid \text{Eruption}) = 0.98.$$

Thus, the Likelihood_Ratio:

$$\frac{\Pr(\text{Seismic_crisis} \mid \text{Eruption})}{\Pr(\text{Seismic_crisis} \mid \text{No_Eruption})}$$

is approximately $0.98/0.05 = 19.6$

Hence:

$$\text{New_Odds}(\text{eruption}) = 1 / 1000 * 19.6 \rightarrow 1 / 51$$

or, in betting terminology, 50 to 1 against an eruption in the next six months.

(Even at the much lower non-eruption crisis rate implied by the known 12 episodes in 200 years, these New_Odds would be still about 30 to 1 against an ensuing eruption).

So, even though a notable volcano-seismic crisis has started in Dominica, it is still extremely unlikely that there will be an eruption in the next six months *solely on the basis of the evidence that an earthquake swarm has started, as considered here*. The numbers can be re-worked for other forecast periods; and other evidence, such as the duration, intensity or seismic characteristics of the events involved, or separate independent indicators, such as changes in geothermal conditions, might cause us to modify the probability of this particular episode being a unfulfilled alarm.

These low odds for an eruption can be contrasted with a view that is commonly expressed under such circumstances. As noted above, almost all sudden-onset volcanic eruptions we know about have SOME form of detectable precursory seismic activity and, making allowance for incomplete knowledge, we might guess that this happens in at least 98 out of 100 eruptions at volcanoes of the type found in Dominica. Thus, the equivalent odds of NO detectable seismic activity before an eruption are less than 1 / 50 (Pr ~ 2%), a “statistic” of such low probability that it leads many people to believe, mistakenly, that an eruption must be almost inevitable once an earthquake swarm develops under a volcano. (In evidential matters, this is an example of the fallacy known as the “transposed conditional”, or “prosecutor’s fallacy”).

Source: Derived from Aspinall and others, 2002

4.6 Findings and conclusions

There are several recurring issues about the generation and use of information on natural hazards as a public good.

First, the public good framework is helpful in clarifying the issues for further consideration. The distinction between core and complementary activities is especially helpful. In distinguishing between the generation of information or knowledge and dissemination activities. Dissemination is often not a pure public good, because forecasts or hazard assessments can be provided to restricted groups.

Second, information is most likely to be generated where the hazard is recognized as a global issue. Then developed industrialized countries are taking the lead role in generating of and

promoting the use of information as an international public good. This is most obvious in the cases of climatic variability and also extreme weather events, such as tropical cyclones.

Third, geophysical hazards are a more uncertain area. The funding of the basic research, a core activity, seems not in question, again because of the risks posed in industrialized countries. However, hazard risks are regional or even country specific, so the provision and dissemination of information is more often a national public good, relevant to regulation of land use and building standards. Furthermore, unless there has been a recent disaster, the status of hazard monitoring and use of information in risk management is likely to be the accidental consequence of history.

Fourth, public funding of hazard monitoring and dissemination is worthwhile. Precise cost-benefit calculations are difficult. The case studies suggest that there are considerable potential benefits, but that these are not smoothly distributed. Costs are relatively modest but largely recurrent. The combination of these patterns of benefits and costs makes for difficulties in sustaining national funding in countries with severe budgetary constraints.

Fifth, the use of information is apparently unsatisfactory in many cases. This is partly to do with the probabilistic nature of the information generated by scientific research and monitoring (e.g. Box 5). This raises a series of questions:

- ? What forms of information is it appropriate to make available to various stakeholder groups?
- ? How can scientific information be disseminated in an easily understandable form?
- ? How should scientific information be used and with what implications, bearing in mind that it will be probabilistic and so difficult to take into account?
- ? What role should scientists play in informing the general public and other stakeholders directly about natural hazard risk and uncertainty?

Sixth, and specifically in relation to crisis-affected Malawi and Southern Africa more generally, there is a need to avoid the creation of excessive expectations. Put simply: 'At this time, weather forecasts can prompt governments and international agencies to move to a higher level of preparedness, but cannot effect significant changes in production.'⁶⁶

Finally, there are encouraging examples of improving practice. The concerns about global climatic change have contributed to ensuring interest in and funding on climatic processes. Progress in using information to reduce the impacts of tropical storms is impressive. There is evidence too of institutional learning about the need to ensure wider dissemination of information, such as seismic risk assessments in the Caribbean.

⁶⁶ H. Alderman, personal communication.

Chapter 5

Financing the cost of future disasters

Historically, there has been heavy reliance on aid to meet disaster-related relief and reconstruction costs in the developing world (Chapter 3). However, global aid flows are stagnant while the annual cost of disasters is increasing (see Chapter 1). Global climate change could imply a further rise in the incidence and cost of natural disasters. Questions are therefore beginning to be asked about alternative ways of meeting disaster-related costs. This chapter reviews some ideas and options which are being explored and in some cases applied, relating to risk transfer and their potential relevance and scope for application to developing countries.

5.1 Introduction - risk transfer tools

Risk transfer mechanisms shift financial risk from one party to another. The two basic tools for catastrophe risk are insurance and instruments for spreading catastrophic risk directly to the capital market. An insurance policy provides cash payouts in the aftermath of a disaster, in return for the payment of monthly *ex ante* premiums. Insurance companies, in turn, redistribute their risk to global reinsurers. Over the past five years novel instruments, entailing some form of hedging transaction in the capital market, have also been developed in response to dramatic increases in the cost of insurance and reinsurance, combined with entrepreneurial drive on the part of New York investment bankers. *Weather derivatives* involve automatic and immediate payouts (typically available within 72 hours) upon the occurrence of a predetermined trigger event, irrespective of the scale or nature of damage. *Catastrophe bonds* provide attractive payments to investors, but in the event of the specified catastrophe involve a reduction, and in some cases cancellation, of the principal and/or interest on a bond. Performance of these new mechanisms is largely uncorrelated with other capital market instruments, thus offering investors a potential way of diversifying capital market risk.

The potential advantages of risk transfer mechanisms include:

- ? a reduction in post-disaster pressure on fiscal and external balances;
- ? increased government control over the financing of disasters, possibly including the immediate and timely availability of funds;⁶⁷
- ? greater capacity for government to set its own priorities in the management of relief and rehabilitation;
- ? increased transparency in the delivery of relief and reconstruction funding; and
- ? promotion of mitigation, by making provision of mechanisms conditional on particular structural measures being in place or by offering discounts where they are (Section 5.4).

An increase in public insurance, in whatever form, may also stimulate more extensive and fuller private cover.

In developed countries there are well-established markets for insurance against a wide range of hazards, including the major natural hazards of floods, droughts, cyclones, earthquakes and volcanic eruptions. Newer hedging instruments are also gaining some popularity. Weather

⁶⁷ Insurance payouts can be made in as little as 24 hours after a disaster if the adjusters can be organized quickly.

derivatives have been written on indices of earthquake intensities, temperature levels, cumulative precipitation over a specified period and wind speed. Some catastrophe bonds have also been issued in the USA and Japan.

In some developing countries, some basic form of insurance is often necessary to secure formal sector loans. In Dominica, for example, such policies are required to obtain mortgages and must cover all natural hazards, including windstorms and volcanic risk. However, in many other developing countries catastrophe insurance has to be purchased separately and is often not specifically required for purposes of securing loans. Business interruption and agricultural insurance is also typically severely restricted in availability. Fire and hail is generally available from the markets for commercial farmers and agribusiness. However, it is often difficult to secure multi-peril crop insurance, except where provided under government schemes. Overall, it is estimated that less than 1% of the losses from natural disasters are insured in the world's 'poorest' countries (Freeman and others, 2002: 2).

In the developed world most insurance is taken out by the private sector. Governments the world over typically retain all risks associated with their investments, including those relating to natural hazards. However, whereas governments in richer nations have the resources to absorb risks by adjusting internal funds, their counterparts in many developing countries frequently do not. Instead, they often take the view that, in the event of a disaster, international assistance will be forthcoming, and thus that some form of financial risk transfer mechanism is not required. In reality, this may not always be the case. Nor does this approach guarantee the best response, either in terms of speed or a government's ability to determine the allocation of reconstruction funds. Moreover, there are only finite levels of aid resources and natural disasters are placing increasing demands upon them. The evidence summarized in Chapter 3 suggests that there is little additionality in aid over the medium term, so that disaster assistance largely diverts funds from development.

As a consequence of these various factors, there has been a recent growth of interest in exploring ways to support developing countries in gaining greater access to international risk transfer markets. This chapter briefly explores potential obstacles to greater coverage, namely:

- ? affordability;
- ? demand;
- ? determination of parametric insurance triggers; and
- ? structure of the insurance industry.

The chapter goes on to review some of the solutions that have been sought to overcome these obstacles. In addition, it considers the important issue of the use of risk transfer mechanisms in loss reduction. It draws, in particular, on evidence provided from the three country studies.

5.2 Potential obstacles

5.2.1 Affordability

The current and future affordability of any risk transfer scheme and, related to that, price instability are immediate and obvious potential constraints to greater insurance coverage, particularly in developing countries where there are higher opportunity costs. These in turn reflect lower stocks of capital, implying potentially higher returns to investment on which insurance premiums could otherwise be spent.

In practice, catastrophe insurance premiums can be several times higher than the actuarially determined expected losses (Froot, 1999). This reflects the high variance associated with expected loss. An insurer needs to have sufficient capital to support the risk underwritten and to be able to meet claims in the event of the most extreme event covered.

Capital market instruments are even more expensive than insurance, perhaps even twice as expensive according to some estimates (Swiss Reinsurance Company, 1999). This is due to their high transaction cost. Consequently, these instruments have been primarily purchased by reinsurers to add to their higher-level capacity, increasing their ability to provide cover against very high losses resulting from more extreme events.

The cost of insurance is annually negotiated, unlike most capital market instruments, so rates fluctuate widely, often reflecting the annual global scale of bills incurred by the industry rather than more localized factors. In 1992, for example, premiums rose three or four-fold, as Hurricane Andrew generated record claims. Volatility in rates is particularly high in some regions, such as the Caribbean where some 80-85% of gross property insurance premiums are transferred to reinsurers. Any fluctuations in reinsurance costs – be they caused by local, regional or global factors – are passed directly on to insureds in the region. Country-specific risk factors only seem to come into play where local risks are perceived to be particularly high, often after a series of disasters follow in quick succession.

5.2.2 Demand

Uptake of available risk transfer mechanisms, financial products, offered in a particular market depends on demand – that is, willingness and ability to pay. Demand in part depends on the cost (price) of instruments (see above). The extent of risk aversion, often partly determined by subjective factors, also influences demand. In addition, levels of income play a role in determining demand for private insurance whilst the extent of budgetary constraints will influence demand for public insurance.⁶⁸

In developing countries, willingness to pay may also be influenced by expected flows of external assistance in response to future disaster events. Some perceive a problem of moral hazard in this regard, because the international community accepts a contingent liability in a post-disaster situation. 'Insurance is only an effective tool to reduce risk if the party concerned is willing to pay for the insurance. In the case of catastrophes and developing countries, this party would be the affected poor countries that currently rely on post-disaster assistance' (Freeman and others, 2002: 35). Post-disaster assistance is often highly concessional while, as already indicated, catastrophe insurance is expensive. Freeman and others estimate, for instance, that for Honduras insurance for flood and storm risk for all events occurring less frequently than once every ten years would cost US\$100m annually. They conclude that the only reason why a poor country government might seek to take out insurance would be that it anticipates a reduction in the availability of timely post-disaster external assistance.

Private sector demand for insurance in developing countries is also apparently low, at least as measured in terms of the volume of insurance actually written. Businesses as well as private

⁶⁸ The 'law of demand' states that the lower the price of a product then the greater the amount demanded. The position and shape of a consumer's demand curve – that is, the amount of a product demanded for a given price – will depend on ability to pay as determined by financial resources at their command; and willingness to pay as determined by the utility (satisfaction or need fulfillment) derived from consumption of a particular quantity of a good. Demand curves for all consumers in a market can be aggregated to produce a market demand curve, showing the total amount consumers would like to purchase at each price.

homeowners may require some form of insurance in order to access financial loans. However, the extent to which this must include some form of catastrophe cover varies between countries, in part depending on awareness and understanding of levels of hazard risk (see Chapter 4). Low levels of cover in part reflect lower per capita incomes and also, possibly, cultural attitudes (World Bank, 2002). In addition, to some extent, willingness to pay in the private sector may reflect expectations about likely government post-disaster assistance. Government grants may be available to reconstruct homes and businesses, whether in a direct form or indirectly (for instance, through tax breaks, loan deferral and write off), reducing the perceived need for private businesses and homeowners to secure their own cover.

The rapid expansion of micro-credit programs has given rise to a new important category of at risk institutions, with large portfolios of potentially highly vulnerable clients. Considerable refinancing requirements for micro-credit were borne by the (central) Bangladesh Bank as lender of last resort after the 1998 floods. This disaster, which threatened to destabilize the country's highest profile initiative in poverty reduction, has generated considerable interest in incorporating insurance into micro-credit. Some large micro-credit providers, such as BRAC and the Grameen Bank, could emerge as significant insurance providers. However, as Brown and Churchill (1999) state, 'for mass, covariant risks that occur frequently in the same region, such as floods in Bangladesh, the cost of (reinsurance) coverage will likely be prohibitively high'. Instead, these insurance portfolios will require continued acceptance of contingent liability by the Bangladesh Bank and aid donors. Another possibility might be some form of risk pooling arrangement with other micro-credit institutions in other parts of the world, effectively spreading risks geographically.

5.2.3 Determination of parametric insurance triggers

Derivatives or parametric insurance are intuitively appealing. Payouts can be fast and not dependent on the completion of often lengthy damage assessment procedures. However, they require a careful assessment of the nature of the hazard faced, including sufficient high quality historical data to enable computation of probabilities, and thus the rate of premium charged. To be economically sensible, the trigger event must also be highly correlated with economic losses. This, in turn, requires some understanding of the relationship between types of risk and socio-economic vulnerability, for example, how a particular hazard would affect production of specific crops (Box 6).

Commercial, larger scale agriculture is a well-established insurance user, as confirmed in the three country case studies. The challenge is to find simple instruments, with low transaction costs for smallholders that require the minimum of direct verification. The World Bank has undertaken some initial investigations of the scope for providing support to governments to develop such instruments. It has also explored the scope for provision of some form of parametric weather insurance to individual farmers and associated traders.

In Bangladesh, however, there are new insuperable practical difficulties defining a trigger event. Flooding in Bangladesh is hugely complex. It cannot be measured simply in terms of rainfall at particular weather stations, river flow or depth. Drought insurance, too, poses problems of considerable complexity. The rapid expansion of irrigation may invalidate the attempt to infer losses from historical data. Reflecting the country's considerable agro-hydrological complexity, even within relatively small areas, there are likely to be both large numbers of losers and gainers from a range of interacting weather and hydrological conditions. Furthermore, there are the enormous problems of landholding title, sharecropping and extreme fragmentation that are obstacles to verification and determination of entitlement to compensation. Some of these problems, in particular relating to the determination of trigger events, will exist in many other countries too.

Box 6: WINCROP Banana Crop Insurance Scheme

The Windward Islands Crop Insurance (1988) Ltd., or WINCROP, provides insurance for banana export growers against damage by 'windblows' and tropical storms. The scheme, which covers the entire export crop in Dominica, Grenada, St Lucia and St Vincent, is owned by the banana marketing organizations in the four countries. In 1999 there were over 12,900 'active' growers, producing 131,000 tonnes, averaging some 10 tonnes per grower.

The scheme only provides cover against a small proportion (20%) of any losses, but own labor and delivery often form a large part of the cost of production, and so payouts are sufficient to enable growers to rehabilitate quickly. Collection of premiums is simple and payment assured, as all growers for export are obliged to market through the organizations, which deduct at source. Verification of losses is also easy as the scheme only covers one crop against one hazard of known probability of incidence and intensity and impact on the crop. Losses are assessed by a 5% physical survey of affected growers to obtain the proportion of damaged plants, and benefit is then based on 75% of average deliveries over the preceding 3 years and a value per plant of about 25% of delivery price. The system of verification is not strictly the same but similar to those involving parametric insurance.

The scheme does entail problems of covariant risk, however, with risk insufficiently widely spread geographically. For instance, in 1999 although claims were made against 16 loss events, almost 90% of them were settled against a single event, Hurricane Lenny, which caused damage to several islands. The scheme also has inadequate reserves to cover that part of liability that has not been underwritten. Premium income is on average too low because of covariant risk. These premiums reflect low incomes of producers, and the political difficulty of setting adequate rates. There is partial reinsurance, but this is constrained by costs and again premium income.

WINCROP has also been unable to extend coverage to other crops or to other business on behalf of banana growers. There are legislative restrictions and rates quoted by reinsurers have been discouraging. The scheme's monocrop focus could ultimately threaten its viability as declining banana exports and a squeeze on grower profitability create pressures to keep premiums below the level adequate to cover payouts and operational costs of scheme and, as exports fall, the ratio of overheads rises.

In Malawi it would be practically too difficult to establish a trigger event for payout to smallholders. There is extreme and arguably increasing sensitivity of smallholder agriculture to climatic variability. Furthermore there is considerable intra-country variability in rainfall patterns. Maize, the staple crop, is sensitive to low, erratic and excessive rainfall. These relationships require further agro-meteorological research. Liberalization of grain markets has also been poorly done, with risks to food security from market imperfection. Presently smallholder food production, much for own consumption, is being partially sustained by programs of free targeted inputs. Efforts are also going into strengthening social safety nets. As ability to pay is low and so cost recovery prospects minimal, it would be difficult to distinguish parametric insurance from post-disaster relief. Even the data on agricultural production have been discredited. These are for the moment unpromising conditions in which to look for a simple, alternative risk spreading mechanism.

Overall, these different experiences suggest that the most promising circumstances are when the hazard is readily measured ('known intensity'), insurance is crop or livelihood activity specific and cost recovery is simple, transparent and assured. Good governance is a factor that will determine the transparency and credibility of any public scheme with widespread coverage.

5.2.4 Structure of the insurance industry

Successful insurance requires both that risk is spread and that insurers are sufficiently capitalized to bear potential claims. In reality, the case studies undertaken for the purposes of this research revealed potential structural constraints. Such constraints may well be quite common to other developing countries too.

In both Dominica and the Caribbean more widely there are concerns about the efficiency and underlying strength of the insurance industry, relating to the proliferation of property and casualty insurance players in the region. There is apparently strong competition for property insurance, motivated by the desire to capture reinsurance commission revenues. However, the widespread competition for direct fees discourages primary domestic insurers from accumulating reserves, together with tax disincentives on the sector resulting in a high dividend paying industry, high dependence on foreign reinsurance and continued fractionalization.

The sharp rise in reinsurance premiums in recent years has led to higher commissions, attracting even more insurers and agents into the Caribbean market. A World Bank report (1998b: 20) states that 'the proliferation of small insurers is cause for concern regarding efficiency... but even more regarding safety. Are these small companies sufficiently capitalized for the 15% of the risk they retain? Are they sufficiently careful in choosing reinsurers that can be relied upon to pay up their 85% share? Regulation in this sector needs to be substantially strengthened...'. It suggests, amongst other things, that tougher standards, including an ability to cover maximum probable losses consistent with international industry practice, are required for domestic companies to improve their safety, particularly given the stochastic nature of catastrophic events. To this end, the Eastern Caribbean Central Bank has reviewed the regulatory framework of the insurance industry in the Organization of Eastern Caribbean States and drafted new insurance legislation aimed at providing disincentives to small players and encouraging amalgamation across countries.

5.3 Creative solutions

The preceding list of potential obstacles to increased uptake of risk transfer mechanisms in developing countries, on both the demand and supply side, contains few surprises. Many of the problems are well recognized, and various ways have been tried to overcome them. Some involve initiatives on the part of particular private sector interests to obtain cover at more favorable prices. Others involve efforts on the part of governments and international organizations, in particular the World Bank, to promote increased utilization of risk transfer mechanisms, and so provide alternative sources of disaster financing – as already discussed in relation to weather derivatives.

In the private sector, one of the more common responses to the high cost of insurance premiums has been to establish disaster reserves. In some countries governments deliberately encourage this with related tax breaks. Some governments also make annual budgetary allocations to some form of calamity fund, at least limiting budgetary reallocations in the event of a disaster (Chapter 3). For countries experiencing localized hazards on an annual basis, such practices are highly prudent, helping to strengthen broader financial planning and fiscal discipline.⁶⁹

⁶⁹ For example, a World Bank report (1998b) recommended complementary actions by both public and private sectors, in order to help overcome problems relating to the safety of insurance cover in the Caribbean region. Companies and households in the region should be encouraged to establish financial reserves to supplement insurance and cover uninsurable losses. Governments should consider the establishment of reserve funds that could be drawn upon for infrastructure repairs. The OAS has

Logically, a related measure is to try to purchase insurance for losses only in excess of a particular level, or for a specific layer of cover.⁷⁰ In years of more severe disaster, substantially larger resources may be required, beyond the scope of calamity funds, but by covering restricted levels of loss themselves, businesses or governments can secure some reduction in premiums. Some larger and special risk categories in the Caribbean, such as power utilities, have not been able to obtain full, affordable insurance in recent years. Some have therefore voluntarily devised heavy high self-insurance deductibles, only seeking insurance against higher levels of losses (World Bank, 2000).

Risk spreading within a group is another solution, one that has been tried or at least explored in various guises. For example, members of the Caribbean Hotel Association have created a risk management firm for their own exclusive use. This is based on a Probable Maximum Loss (PML) profile of members' properties that indicated sufficient diversification of risks to allow a regional insurance company to survive a 1.3% probability of a major storm. However, in Dominica the historical record suggests a substantially high incidence of major storms – at least 4% a year of a direct hit by a Category 4 hurricane.

Again in the Caribbean, banana growers' organizations in four countries have pooled risk emanating from storms through the Windward Islands Crop Insurance scheme (WINCROP) (Box 6). This scheme is extremely important in providing a risk spreading mechanism for these growers. The success of group or club solutions such as this suggests a model for micro-credit organizations. The scheme is transparent to members. The group addresses the problem of moral hazard, obliging all to participate and providing peer pressure. However, WINCROP is also a highly context specific mechanism which is confined solely to wind damage to bananas and the attempts to extend coverage to a wider range of risks has proved difficult.

There has also been some debate about the creation of a more general regional risk management tool for the Caribbean, possibly involving some form of contingent funding. In a recent initiative, the World Bank developed a proposal for the East Caribbean that favors an inter-country insurance pooling arrangement. The arrangement would aim to utilize reinsurance and risk-financing resources more effectively by reaping economies of scale and improving capacity to accumulate and retain capital reserves. In the earlier years of the pool, it is recognized that its full capitalization would require guarantee financing, a contingent line of credit for quick disbursement from a multilateral institution or, alternatively, a long-term bond issue in the capital markets.

Other efforts to help promote insurance have involved support to governments to establish some form of mandatory insurance, as in Turkey after the Marmara earthquake.⁷¹ Other countries are also reported to have expressed an interest in establishing some form of mandatory catastrophe insurance, which would involve pools supplemented by various insurance and capital market instruments.

similarly recommended both incentives and requirements for the creation of financial reserves in the Caribbean region.

⁷⁰ That is, for losses exceeding \$x but not for losses over \$y, where x is less than y.

⁷¹ The World Bank is providing a contingent credit line to a compulsory earthquake insurance scheme established in part of the country in the wake of the 1999 Marmara earthquake. The credit line provides initial capitalization of a newly created insurance pool, ensuring its financial solvency should an earthquake occur while funds are being built up.

5.4 Promoting mitigation

Risk transfer mechanisms can be used to help promote risk reduction – that is, to modify the behavior of those insured. As IADB (2001: 11) states ‘insurance is an important part of risk management strategy, and should be promoted not for its own sake, but because it can be a powerful tool to promote risk awareness and enforce risk mitigation measures.’

The issue of catastrophe insurance policies can be made conditional upon the implementation of specific loss reduction measures, as well as adherence to more general building and land-use zoning codes. Catastrophe cover may be required before a business or home loan can be obtained, ensuring that it can be paid off in the event of damage or destruction of the business or property. Weather derivatives also indirectly encourage actions to minimize losses. If the trigger event happens, those covered will receive payouts regardless of levels of loss, and thus it remains in their interest to minimize losses.

In reality, the record on the use of insurance in promoting risk reduction is rather disappointing. In Bangladesh, for example, there are currently no formal premium reduction policies offered against measures to reduce risk, although premium reductions can be negotiated on a case-by-case basis.

In Dominica, catastrophe cover (covering all natural hazards) is mandatory in securing a mortgage. A differential premium structure also exists to some extent, with at least some companies offering discounts against hazard proofing. However, more widespread discriminatory pricing practices, both in Dominica and the Caribbean more generally, are discouraged by low retention of risk, combined with the reinsurance industry’s blanket pricing policy. Large geographic areas are placed in the same PML category, ‘without regard for the topographical features and structure resistance distinctions propounded by regional and international experts’ (World Bank, 2000: 57-58). Meanwhile, individual insurance companies are reported to fear that significant premium discounts for their better-protected risks cannot be balanced by surcharging poorer risks (OAS, 1996). As such, insurance companies – with one notable exception⁷² - typically follow the reinsurance lead, in effect doing little to promote hazard mitigation in the region. More widespread discriminatory premium pricing would require comprehensive hazard mapping, as well as inspection, to determine the vulnerability of individual properties. An apparent exception is Fiji, where, for a developing country, there is a relatively high rate of cyclone insurance coverage in urban areas.⁷³

⁷² The one apparent exception, United Insurance, has actively promoted structural mitigation. Premium discounts of up to 40% are available for retrofitted commercial properties, and 17-25% for retrofitted domestic properties. The program, which was officially introduced only in 1997, has already achieved impressive results. The average cost of claims on affected risks following Hurricane Jose in Antigua in 1999 was equivalent to 10% of the total sum insured, but to only 4.75% of the sum insured in the case of retrofitted projects. Although the program was not intended as a marketing tool, it has also generated new clients for the company in Antigua. However, although United has considered making its mitigation program mandatory for all its insurees, as the sole company offering such a scheme it has concluded that, on balance, it would probably lose clients if it did so.

⁷³ This coverage was estimated by an insurance industry spokesperson at some 90% of businesses (including factories) and 18–20% of households in 1996. The securing of mortgages is conditional upon the acquisition of cyclone insurance whilst cyclone insurance, in turn, can only be secured upon presentation of a certificate confirming compliance with the 1985 National Building Code. However, even then the system may break down in a softer market. As of early 1996, the Fiji market had become highly competitive following record profits the previous year – a disaster-free one – attracting new entrants into the Fiji insurance market. New entrants were rumored to be demanding no cyclone-proofing certification for the issue of cyclone insurance policies.

5.5 Conclusions

Insurance and capital market instruments have played a relatively small role in the transfer of risk in developing countries to date. Risk transfer mechanisms seem to work best at middle range frequencies of risk (World Bank, 2002). Hazards occurring with high frequency require annual allocations of funds to meet their anticipated consequences, as well as mitigation and preparedness efforts. Meanwhile, at the other extreme, there is probably little demand for insurance against geophysical events that are likely to occur centuries apart. However, there is certainly merit in exploring the potential scope for the increased use of risk transfer mechanisms for well-defined hazards in the middle risk range, such as extreme tropical storms. This is particularly valid in view of the significant pressures that such disasters can place on government, international aid and private resources. Indeed, interest in financial risk transfer mechanisms is growing as appreciation of the potential benefits increases.

A larger challenge that is just beginning to be addressed is how to make insurance and related instruments available to the poor. As part of this development, insurance is being explored as a means of protecting local-level savings and micro-credit schemes, such as those run by NGOs in Bangladesh. Perhaps the starting point in micro-credit for insurance is against idiosyncratic shocks such as ill health and death of the borrower. However, the covariant risk associated with natural hazards makes refinancing of losses difficult to avoid and continued acceptance of contingent liability will be required by public bodies and/or aid organizations. This is especially so where a micro-credit scheme is already expanding with concessional or grant funds from aid sources. There is also considerable scope for greater use of risk transfer tools in promoting mitigation.

There are also a number of practical obstacles to be overcome before insurance coverage can be increased substantially. In a number of developing countries there is a need to reform the structure and legal and regulatory framework of the insurance industry, including removal of barriers to entry. The cost of insurance also needs to be both affordable and stable. At the same time, insurers have to remain sufficiently capitalized so as to bear any losses. That, in turn, requires detailed scientific information on current and future risks. This is certainly a challenge in view of both the uncertainty about the precise implications of climate change for the incidence and severity of hazards and also of evidence on increasing vulnerability, as in Malawi. Meanwhile, making insurance available to the poor raises issues not simply of affordability. There are administrative and legal problems too, such as land titles.

The case of Montserrat – if extreme – serves as a reminder that international insurers can withdraw at short notice should the perceived risks become too great. The insurance sector is a for profit business, not the provider of a public good. Globalization is also changing, but not necessarily reducing risks.⁷⁴

In view of all the obstacles, creative solutions need to continue to be sought and tested. Application of some combination of different tools for different layers of loss coverage is a possible way forward. The bundling of different types of hazard under one contract could also reduce premium rates to the extent that better understood risks (e.g., cyclones) are bundled with less well-understood ones (e.g., earthquakes). There are also situations, such as

⁷⁴ Following an escalation of an on-going volcanic crisis in Montserrat in August 1997, there was a sudden cancellation of most insurance policies on the island by international insurers. The small economy was a marginal part of their business, so they could exit with little impact on their overall portfolios. With the cancellation of insurance policies, mortgaged assets immediately assumed a zero value, resulting in the effective collapse of the country's only building society, the locally registered Montserrat Building Society, with multiplier impacts throughout the economy as well as severe societal effects (Clay and others, 1999).

rural Malawi, in which more conventional administrative, publicly funded subsidized livelihood programs and safety nets are still the appropriate way to tackle growing vulnerability and provide basic food and health security.

The success of insurance and risk transfer options assumes a favorable financial environment in which there is transparency, and confidence that contracts will be honored and continuing arrangement not prejudiced by short term political considerations and rent seeking behavior. Institutional stability is required within which insurance and other schemes can be expanded and tested in practice. That raises more general issues of governance.

Developing country governments need to acknowledge explicitly that a decision not to make risk management a priority issue is a policy stance on the handling of risk in society and the economy (Freeman and others, 2002). At first glance, it might appear that, in the event of a disaster, additional external assistance will be forthcoming. However, as this study has shown, ultimately disaster-related external assistance may *not* be additional, but instead displaces funding for development (Chapter 3). Moreover, costs of disasters are rising whilst aid resources are, at best, stagnant. Governments need to be persuaded to take a medium-term perspective on appropriate risk management, including financial planning for future catastrophes.

Chapter 6

Findings and implications for policy and research

The broad objectives of the study have been to increase understanding of the wider economic and financial impacts of natural disasters through the detailed analysis of three countries. Factors are identified which determine the vulnerability of hazard-prone economies. Opportunities are noted for improving the management of risk and obstacles that inhibit their adoption are also identified. This final chapter reviews the findings of the study, their policy implications and areas meriting further investigation.

6.1 Findings

6.1.1 Broad macroeconomic consequences

- ? Major natural disasters can and do have severe negative short-run impacts. Disasters, especially when these reoccur frequently, appear to have negative longer-term consequences for economic growth, development, and poverty reduction, but these effects are more difficult to isolate and quantify.
- ? Patterns and forms of economic vulnerability are distinct for the two broad categories of hazard, in part reflecting differences in frequency of occurrence. The recurrent nature of hydro-meteorological hazards leads to adaptation in economic and social activity. Historical climatological and hydrological records allow formal assignment of risk for use in investment and production decisions that is likely to favor less hazardous locations and risk spreading, and to encourage disaster mitigation. In contrast, geophysical hazards are mostly low probability, seemingly random events, so that risks are widely almost wholly discounted. But such risks need to be recognized in highly exposed countries and regions because their potential costs are rising exponentially with economic development.
- ? Environmental change has not had a discernible impact within the time scale of this study (20-35 years) on hazard risk in terms of the frequency and intensity of extreme events likely to have severe economic consequences. In particular the widely anticipated effects of global climatic change were not yet apparent in the hazard data.
- ? The vulnerability of a country to natural hazards is determined by a complex, dynamic set of influences, relating to factors such as economic structure, stage of development and prevailing economic and policy conditions. Where vulnerability was reduced, this could be linked to appropriate investments in disaster mitigation and favorable developments in the structure of the economy, production technologies and the wider economic and domestic policy environment. Similarly negative trends, notably the increasing sensitivity of Southern Africa to climatic variability (encompassing not just drought but erratic rainfall, extremely high rainfall and related floods), reflect a complex of factors.
- ? Catastrophic events can induce conscious responses, relating to technical progress, policy changes and institutional innovations, in ways that may ultimately increase an economy's resilience.

6.1.2 Budgetary impacts

In view of the lack of previous investigations, the fiscal consequences of disasters were carefully examined, including the composition of public expenditure and revenue.

- ? Natural disasters can create significant budgetary pressures, with potential narrowly fiscal short-term impacts and wider long-term development implications.
- ? The behavior of broad fiscal aggregates, such as total recurrent and capital expenditure, revenue and the budgetary deficit, suggest misleadingly that disasters have little discernible impact in many cases, with the notable exception of drought in low income SSA countries. Droughts have severe impacts on the macro-performance of largely agriculturally dominated economies. The apparent more general insensitivity reflects the successful efforts of many countries to remain within already established pre-shock budgetary envelopes so that disasters often result in widespread – if largely non-transparent – immediate and inter-year *reallocations* of resources.
- ? Reallocation is the primarily fiscal response to disaster:
 - ⊗ The brunt of financial reallocations appears to fall primarily on capital expenditure and social sectors.
 - ⊗ There may be considerable in-kind reallocation of human and physical resources under recurrent expenditure.
 - ⊗ With a few exceptions, reallocations are typically poorly documented and cannot be easily quantified.
 - ⊗ The conditions under which decisions on post-disaster reallocations of budgetary resources are made are typically far from ideal.
- ? In all of the eight countries studied by the authors, it has been impossible to ascertain actual levels of expenditure on either mitigation and preparedness or post-disaster response.
- ? Foreign assistance: available data suggest that disasters have *little* impact on trends in *total aid flows*. Many donors appear to respond to disaster crises by reallocating resources and bringing forward commitments under existing multi-year country programs and budget envelopes.

6.1.3 Information and disaster reduction

- ? The international public good framework is helpful for exploring the issues of the generation of knowledge and the dissemination of information about hazard risks.
- ? Knowledge is most likely to be generated and monitoring to be sustained where the hazard is recognized to be a global issue, as in the case of climatic variability and extreme weather events, such as tropical cyclones. The adequacy of geophysical hazard information is less assured, because risks are regional or even country-specific, and especially if there has not been a recent disaster.
- ? There are encouraging examples of improving practice in uses of hazard information. The concerns about global climatic change have contributed to ensuring interest in and

funding on climatic processes. Progress in reducing the impacts of tropical storms is impressive. There has been institutional learning about the need to ensure wider dissemination of information.

- ? Nevertheless, the use of scientific information in public and private sector risk assessment is unsatisfactory in many cases. This is partly to do with the probabilistic nature of the information generated by scientific research and monitoring. For example, there is a need to avoid the creation of excessive expectations about the precision and potential uses of climatic forecasting, specifically in relation to crisis-affected Southern Africa. At this time, weather forecasts can prompt governments to move to a higher level of preparedness, but cannot effect significant changes in agricultural production.

6.1.4 Financing future disasters

- ? Insurance and capital market instruments have played a very small role to date in the *ex ante* transfer of catastrophic risk in developing countries, despite increasing interest in them.
- ? There are potentially significant obstacles to greater coverage, in part relating to affordability, attitudes to risk and the current structure of the insurance industry in a number of developing countries.
- ? The record on the use of insurance in promoting disaster mitigation appears rather disappointing in many developing countries, with a few notable exceptions.

6.2 Policy implications

6.2.1 National development policy and the macro-economy

Natural hazards require more serious consideration in the formulation of national economic policies and strategies. Risk assessments should be made from a broad macroeconomic standpoint, exploring areas of both sensitivity and resilience. Assessments should seek to understand underlying factors determining vulnerability, including the potentially complex and dynamic interlinkages between different influences and scope for risk reduction. Assessments must consider vulnerability according to specific types of hazard. More specific recommendations are based on case study findings.

- ? Regular assessment of hazard risk is required to ensure that risk management strategies are appropriate. From a macroeconomic perspective, vulnerability can shift quickly, particularly in countries experiencing rapid growth and socio-economic change, including urbanization.
- ? For geographically large countries, where nation-wide disasters are rare, regional analysis is potentially more appropriate in seeking to understand vulnerability and designing relevant policies.
- ? Natural hazards risk management should be integrated into the broad development process, in the determination of priorities, policies and strategies. This requires an assessment of vulnerability from a macroeconomic perspective that distinguishes between potential short- and longer-term impacts and takes into account knock-on or multiplier impacts. Particular efforts need to be taken to minimize any adverse impacts of disasters on priority areas of policy, such as poverty reduction (Box 2).

- ? Risk management necessarily involves the private sector, civil society as well as the public sector. The private sector should be encouraged and supported in enhancing its understanding of natural hazards risks and adopting appropriate risk management tools. Both structural and non-structural measures may be required. As part of this process, there should be adequate investment in risk mapping, monitoring, assessment and dissemination, with information provided in an easily understood and usable form (see below 6.2.3). Services, including financial institutions, as well as productive sectors should be included in initiatives to promote adequate risk management.
- ? Post-disaster reconstruction needs to be better planned and carefully orchestrated to exploit potential organizational, technological and other improvements that could be made in re-building an economy, whilst keeping priority development objectives on track. Governments should consider pre-planning possible reconstruction and rehabilitation programs based on disaster scenarios and, within that, to identify critical projects that should receive priority in post-disaster funding. There is a case for exploring possible economic policy options through disaster scenarios, - for example, the likely effect of fiscal changes and monetary measures - in order to develop guidelines for policy makers in responding to disasters (see below Section 6.2.2).
- ? National or economy-wide disaster impacts, including total financial losses, should be reassessed as a matter of course 12-18 months after an event. For example, this task might be undertaken as part of an end of project report for a recovery loan or for a paper for consideration at an annual consortium or round table meeting.
- ? Lessons learned from particular disasters need to be understood and, where necessary, acted upon. Disasters can induce policy changes and institutional innovations that are ultimately beneficial, not only in reducing vulnerability but also in supporting economic growth and development.

6.2.2 Public finance

The overall budgetary envelope is a key fiscal policy issue. An expansionary response may be appropriate where aggregate demand is likely to be depressed by disaster impacts. This is most obviously so for a drought shock. However, the domestic and international sources of funding for additional public expenditure need careful and explicit consideration to avoid crowding out private sector demand. Financially destabilizing and inflationary pressures also need to be guarded against. Where a disaster causes much damage, which might quickly stimulate a reconstruction boom, but limited disruption to economic activity a more cautious approach, largely reliant on temporary reallocations, is indicated.

- ? A disaggregated approach should be taken in reviewing the public finance implications of disasters.
- ? The nature of both post-disaster reallocations and also of disaster relief and rehabilitation expenditure needs to be closely monitored and reported. In particular, the income distributional consequences of such decisions need to be carefully assessed and implications for pro-poor policies analyzed.
- ? Reallocations of budgetary resources post-disaster should occur through a formal process, in the context of a careful strategic review. Four things are required to ensure that this process is rational and cost-effective: a clearly defined and applied policy framework; an already established system of prioritization for investment projects; up-to-date and reliable

information on the current demand for and availability of resources; and a considered assessment of the broader macroeconomic impact of the event.

- ? Better documentation of expenditure on all aspects of *ex ante* risk management is also needed, together with data on post-disaster response and the results of macroeconomic vulnerability assessments, helping to inform governments and the international community of appropriate spending levels on mitigation and preparedness and areas that might be under-funded (or over-funded). Relevant activities and related expenditure should be tagged.
- ? Risk management concerns need to be integrated with the annual budgetary process and appropriately reflected in the allocation of financial resources.
- ? Where disaster-related expenditure occurs regularly, the use of pre-designated calamity funds should be explored.
- ? Greater use of financial risk transfer instruments is also required to help meet the cost of larger rehabilitation programs, alleviating some of the pressure on budgetary resources.
- ? Sub-Saharan African governments may require particular support in planning for and dealing with the consequences of disasters, due to a combination of limited administrative capacity, being weakened by the HIV/AIDS pandemic, and exceptionally severe budgetary constraints. More generally, low-income countries are at their most vulnerable, financially and economically, to disaster shocks when there are problems of governance and poor fiscal and monetary management. The international community needs to be especially alert to potential disaster in such circumstances.

6.2.3 Knowledge and information as public goods

Good quality, trustworthy data is a necessary condition for effective natural disaster risk management and all areas of public action. The generation of knowledge about hazards and the sustaining of global and regional information systems on risks have to be international priorities. The international community should also concern itself with the adequacy of funding and the quality of complementary programs for risk monitoring and dissemination of information in both low-income and extremely hazard vulnerable middle-income countries. Special attention should be given to the risk exposure of poor people and communities. As a national public good, risk information should be identified as a thematic issue in periodic public expenditure reviews. More specific recommendations reflect these general conclusions.

- ? Natural hazard risks require regular, perhaps five-yearly, reappraisal because of the interacting influences of socio-economic and environmental change on vulnerability.
- ? There is much to be done to make better use of scientific information on natural hazards in public policy at country, regional and international levels. This is illustrated by examples of climatic forecasting, volcanic hazard monitoring and riverine flood warning.
- ? The usefulness of *climatic forecasting* would be increased by the following steps:
 - ∞ Forecasting should to be focused on climatic variability more broadly. This requires more research, downscaled to zonal levels, and intra-seasonal timescales.
 - ∞ More specific information should be derived from real time monitoring on the weather situation as it evolves. This would be of value to those user groups that can

- quickly modify their actions, such as commercial farmers and those managing food security stocks and water resources.
 - ⌘ Greater agronomic-meteorological collaboration would help national and international institutions make more effective use of forecast information in their food security and agricultural support decisions.
 - ⌘ More rapid reporting of intra-seasonal variability would help secure more rapid responses to an evolving situation.
- ? *Volcanic hazard assessment* has a strongly regional and national focus, and so lacks an international institutional framework comparable to that for meteorological issues. Consequently, International assessment and perhaps supervision are required on the adequacy of regional and national level monitoring systems.
- ? *Flood hazard warnings* for major regional river systems pose special problems in not being an international public good because of the potential trade-off between the interests of stakeholders at each level of the system. Some recent disasters have highlighted weaknesses in monitoring and hazard warning, especially in including both upper and lower riparian levels.
- ⌘ International efforts need to be sustained to ensure strengthening of the knowledge base for hazards on major river systems.
 - ⌘ Special efforts are required for strengthening regional co-operation and co-operation at a national level, between different central and provincial authorities.
- ? Hazards that are likely to be entirely within country, especially geophysical hazards, as well as landslides and flash flooding, require separate attention because of the likelihood of underfunding of national hazard information systems in developing countries.
- ? Governments in geophysical high risk zones should be encouraged to develop hazard plans that include *ex ante* risk reduction measures, preparedness and post-disaster reconstruction scenarios.

6.2.4 Financing future disaster costs

Governments need an appropriate risk management strategy that includes *ex ante* financial planning for future disasters over an 8 – 10 year time horizon, beyond the normal medium-term planning period of 3 to 5 years. Disaster-related external assistance for immediate response or reconstruction *cannot* be assumed to be additional. The strategy should seek to extend the basis of funding. However, there are some situations where more conventional administrative, publicly funded and subsidized programs to protect livelihoods and provide safety nets are still the appropriate way to tackle extreme and possibly growing vulnerability. This protection is likely to be part of the assurance of basic food and health security provided by government, civil society organizations with, as appropriate, international support. Within these broader recommendations specific suggestions are made for achieving the wider funding basis for meeting disaster costs.

- ? The increased use of risk transfer mechanisms for well-defined hazards, particularly in the middle risk range, should be promoted and efforts continued to design initiatives and instruments that would support greater uptake.
- ? The application of a combination of mechanisms for different layers of loss coverage is likely to be constructive. Options for risk sharing should be considered as one of the range of potential mechanisms.

- ? Strategies for insurance should be used to promote risk reduction more effectively. For example, the issue of insurance policies for buildings and equipment or business interruption should be made conditional upon the implementation of specific loss reduction measures, as well as adherence to more general building and land-use zoning codes. Premium discounts could also be offered for better-protected risks. Both insurance providers and governments, through legislation and provision of land zoning and building codes, have complementary roles to play.
- ? Fresh initiatives to make insurance and related instruments available to poor households and communities are needed and should be actively encouraged and appropriately supported by governments and international institutions. But it should be recognized that acceptance of some form of contingency liability may be required from the central bank or donors. Options for some form of risk pooling arrangement with other micro-credit institutions, including across borders, should also be explored.

6.2.5 Good governance

Many of these policy recommendations fit within the broader framework of initiatives to promote “good governance”. There is clear evidence that weaknesses in governance have contributed to heightened disaster vulnerability. Four aspects of good governance are highlighted that would contribute to disaster reduction.

- ? *Efficient and accountable public sector institutions, including strong public expenditure management systems*: for example better reporting of relevant expenditure and post-disaster reallocations, and enhanced capacity to respond effectively and efficiently to disasters whilst also protecting priority areas of government spending.
- ? *‘Good’ policy making* including taking risks emanating from natural hazards into account in policy and strategy formulation and seeking to reduce vulnerability, both at a micro- and broad macro-economic level.
- ? *Predictability of policies* through long-term commitment to mitigation and preparedness, including investment in and maintenance of structural mitigation measures, sustained expenditure on scientific monitoring and forecasting and continued commitment to an optimal bundle of financial risk transfer mechanisms.
- ? Elimination of corruption or more realistically curtailing rent-seeking behavior, for example the introduction and enforcement of appropriate land use and building codes.

6.3 Directions for future research

It was recognized at the outset that this study was investigating a complex and multi-faceted subject and thus would probably highlight many areas worthy of further, separate examination, beyond the scope of the current study. This has proved true and the study has, indeed, indicated a number of such areas.

6.3.1 Macroeconomics of disasters

Three methodological approaches are commonly used to investigate the macro-economic impacts of natural disasters: the narrative case study, quantitative modeling and cross-sectional statistical analysis. Considering their strengths and limitations, these different

approaches should be regarded as complementary rather than alternative ways of exploring the complex consequences of natural disasters. Natural disasters are dynamic in the sense of being events over time, events that are shaped by environmental processes and contingent policy and structural circumstances which themselves are constantly changing and, in the process, modifying the vulnerability of an economy.

An extremely worthwhile project would be to try to integrate these different approaches within an exemplary investigation for a highly disaster-prone country. The study would explore the longer term economic and poverty implications of hazard vulnerability. To be feasible within a realistic budget and time frame this investigation would require the availability of relatively good time series data on hazards, income distribution and poverty, as well as on the economy. It would need to be able to draw on substantial intellectual investments in exploring longer term development and poverty processes at both micro- and macro-levels. If the relative strengths of different computable models for exploring future disaster scenarios are to be compared, then these would also need to be available for use.

The implications of disasters for poverty involve not only direct impacts on affected people and communities but also effects transmitted through the impacts of disasters on the wider economy. Further research is needed combining both micro-socio-economic and macro-economic analyses. More specifically, investigations should include:

- ? Analysis of regional or provincial impacts of natural hazards in geographically larger countries and how these impacts feed into the national economy.
- ? Analysis of the medium- to longer-term impacts of geophysical events, extending up to several decades beyond particular events, to explore the extent to which and in what ways the impacts of such shocks may be positive and to support efforts to ensure that any potentially positive benefits are maximized.
- ? Examination of the implications of deregulation and globalization for levels and forms of vulnerability, sectors and socio-economic groups requiring particular support and potential opportunities that could be exploited for economic gain.

6.3.2 Public finance

The budgetary impacts of natural disasters are complex and multi-faceted, and this study has only begun to scratch at the surface of this subject. There are a number of areas worthy of further investigation, the findings of many would help support broader initiatives to promote and sustain good governance as well as to manage natural disasters more effectively.

- ? Real time studies of a government's response to a disaster, documenting how key decisions are made and the crisis handled through the recovery phase and drawing lessons for future occasions. This proposal is similar to the 'learning support office' concept, developed for humanitarian operations by ALNAP (2002).
- ? Detailed analysis of the budgetary impacts of disasters in SSA, exploring why the fiscal impacts of such disasters are more readily discernible in order to support improved fiscal management of climatic variability.
- ? Detailed investigation of the impact of disasters on autonomous and semi-autonomous agencies. Improved knowledge and understanding of such impacts, which are not apparent from central government budgetary reports, is important in seeking to establish financially sustainable public risk management policies.

- ? Analysis of risk management at provincial and local government levels, exploring the balance between the cost of responsibilities and funding availability, and implications for regional disparities in the standard and level of provision of services and infrastructure.
- ? Examination of the relationship between disasters and aid flows, exploring the extent to which post-disaster response entails additional aid resources; the balance of resources going to relief and rehabilitation needs; and the effectiveness and efficiency of financial instruments such as the IMF's compensatory financing facility and the EC's post-Stabex, Cotonou, supplementary grants, relative to conventional project-type relief and rehabilitation assistance.

6.3.3 Information and disaster reduction

The benefits and costs of knowledge generation for each of the main types of natural hazard deserve fuller investigation. The object is to determine priority areas for support as international public goods (IPG) in terms of global poverty reduction goals and developing country priorities.

- ? Review of the adequacy of support for research on and monitoring of natural hazards as a requisite part of every country disaster reduction strategy or plan.
- ? Review of the patchy performance of recent efforts to strengthen national information systems, especially through external technical co-operation. This review could provide a better basis for international assistance.
- ? More systematic research into the relationship between climatic variability and economic performance, especially the rural economy in low income countries. Research should cover relationships relating not only to drought but also to erratic rainfall as well as very high rainfall and crop performance in Southern Africa, and probably SSA more widely. Climatic change is expected to bring increased rainfall to some areas and the consequences are not necessarily unambiguously beneficial. So such investigations are needed to better inform assessments of the consequences of global climatic change at both regional scales and country levels.

6.3.4 Financing future disasters

Insurance and capital market instruments have played a relatively small role in the transfer of risk in developing countries to date. There is merit in continuing to explore the possibilities for their greater use, particularly in view of the significant pressures that such disasters can place on government, international aid and private resources and, ultimately, on sustainable development.

- ? Investigation of the potential scope for increased use of risk transfer mechanisms for well-defined hazards in the middle risk range, such as extreme tropical storms.
- ? Exploration of ways of making insurance and related instruments available to the poor, including the role of micro-finance institutions.

ANNEX A

DOMINICA: NATURAL DISASTERS AND ECONOMIC DEVELOPMENT IN A SMALL ISLAND STATE

Introduction and Country Profile

1. The study of Dominica focuses on hazard events since independence in 1978, including major hurricanes, tropical storms, a landslides and the volcano alert, in place since 1998.
2. The Commonwealth of Dominica is a small lower middle-income Caribbean island state, with an estimated population of 76,000 (30% of whom were estimated in 1996 as living at or below the poverty line). There is a long established pattern of net out-migration. The island is of volcanic origin, and the most mountainous of the eastern Caribbean islands, with dense vegetation, very high rainfall and a large number of deeply incised, narrow river valleys and steep ridges. Slopes of 30 degrees or more are found in at least 60% of the island. Reflecting this topography, most of the population and infrastructure is on the coast, and vulnerable to strong winds and high seas. Dominica is a member of various regional organizations whose purpose is co-operation in trade and economic development. Preferential trading arrangements on bananas with the UK and EU have been a significant factor in the island's development.

Natural Hazards and Disasters since Independence in 1978

3. Lying well within the Atlantic hurricane belt, the most common and historically most significant of the natural hazards facing Dominica are tropical storms and hurricanes. Since 1978, the island has suffered the damaging effects of seven hurricanes (three of them Category 4 with sustained wind speeds in excess of 210 km/hour) and 3 tropical storms. The most extreme disaster event since 1978 was Hurricane David in 1979. Landslides are common and, like the Layou River Valley landslide in March-November 1997, can have substantial socio-economic impact, as well as the potential for loss of life. Although there has been only one volcanic event in Dominica's recorded history, the island is now in a period of increased seismic activity and the risk of volcanic activity remains relatively high, particularly in the south of the island where 20% of the population live. There is a related risk of earthquake. Droughts, storm surges, floods, bush fires and tsunamis have been regarded as lesser hazards. However, any of these could assume major proportions if physical conditions or social activity altered levels of vulnerability. There is much uncertainty about natural hazard risks, which need to be regularly reappraised. For example, Hurricane Lenny caused extensive unexpected damage in 1999, when the storm tracked west to east, 150 miles from the island. No hazard warnings were issued because the "normal" approach would be from the east and at the distance involved, a hurricane would not "normally" affect Dominica.

Environmental Impacts of Natural Hazards and Global Climate Change

4. It is beyond the scope of this study to consider natural hazards as part of continuing geophysical processes. But the study does need to explore some aspects of the environmental impact of natural hazards as well as the vulnerability implications of environmental and global climate change because of their economic and financial implications.
5. Dominica's increasingly important eco-tourism sector is closely tied to its image as the 'Nature Isle of the Caribbean', with a wealth of flora and fauna, rich marine biodiversity, an expanse of forest area and surface evidence of its volcanic origins. This environmental resource wealth is vulnerable to natural hazards. Hurricane David damaged an estimated five million trees and studies indicate that species numbers have taken 20 years to recover from its impact. Hurricanes and tropical storms can also accelerate erosion, damaging beaches and reefs. Moreover, human activity - e.g. through forestry management practices, or the excavation of deltaic sites for building materials - may increase the

vulnerability of Dominica's environmental assets to natural hazards. There are also concerns that a rise in global air and sea temperatures in the Caribbean basin could very substantially damage the marine environment as well as giving rise to more frequent and powerful hurricanes. Environmental change in the short term may be so small as to be barely perceptible; but over a period of several decades the cumulative effect could be considerable.

6. Enhanced environmental monitoring is needed to secure robust baseline data and to measure the precise ecological impacts of natural hazards and climate change on resources such as forests and fauna; and thus provide the impetus for measures to reduce vulnerability. In the meantime, expert advice is that there are measures which need to be taken - e.g. in relation to forestry management - to reduce the vulnerability of important environmental assets to future hurricanes and storms.

The Macro-economy

Economic Performance and Natural Hazards

7. Dominica has a small, very open economy, still heavily reliant on a single export crop - bananas - which represented a third of total merchandise export earnings in 1997. Although its GDP share reduced from 37% in 1977-78 to 20% in 1997-98, the agricultural sector remains the major productive sector, and is the major source of livelihoods. Despite limited growth since the mid-1970's other private sector activity remains small. Manufacturing output rose from 3.9% to 8.2% of GDP between 1977 and 1998, and there has also been promising growth in the burgeoning offshore financial services industry. Along with tourism, which by the late 1990's accounted for an estimated 35% of external earnings, these have helped to meet the substantial deficit on the external visible trades account.

8. Analysis of annual fluctuations in Dominica's agricultural, non-agricultural and total GDP alongside the incidence of major disasters demonstrates the major impact of natural hazards on the island's economic performance since 1978. This is confirmed by the results of a more formal regression analysis. The combined impact of Hurricanes David, Frederick and Allen in 1979 and 1980 was particularly devastating, reflecting an already weak economy, the scale of physical damage and disruption and the resulting budgetary pressure. Real GDP plummeted by 17% in 1979 while agricultural GDP alone fell by 32%, with a further 2.1% decline in agricultural GDP in 1980. Hurricane David was a significant factor in forcing the country into a Structural Adjustment Programme (SAP) aimed at achieving a sustainable rate of economic growth, reduced unemployment, better living standards and strengthened fiscal and balance of payments positions. Relatively high rates of growth between 1986 and 1988, averaging 7% per year, reflected the success of the SAP, rapid increases in banana prices and volumes of exports, and high levels of aid flows. But Hurricane Hugo in September 1989 destroyed some 70% of banana production and an unfavorable exchange rate movement reduced the value of banana exports. Overall, GDP fell year-on-year by 1.1% in 1989 with agricultural GDP alone falling by 14.6%. The visible trade deficit increased to a figure equivalent to 38.5% of GDP. Non-agricultural GDP rose by 4.4%. During the 1990's the GDP growth rate averaged 2.4%, the weaker performance reflecting difficulties in the banana industry and adverse weather conditions. The fact GDP continued to grow reflected compensatory manufacturing and service sector expansion and agriculture's reduced share in GDP.

Economic Development Strategies

9. Dominica is one of the most vulnerable countries in the world to both natural hazards and other external shocks. It is vitally important, therefore, that risk reduction becomes an integral part of policies to achieve social and economic stability both in Dominica and in other similar small island developing states. Achieving this remains one of Dominica's biggest challenges.

10. Since before Independence, the Government of the Commonwealth of Dominica (GoCD) has placed a central emphasis on economic diversification: away from banana production within the agricultural sector, and also into non-agricultural sectors. The aim has been to create a more resilient economic structure. There has also been explicit recognition, notably following Hurricane David, of

the dangers of the one-crop economy in terms of vulnerability to natural hazards. However, in practice, there is little evidence that this vulnerability has been addressed. Hurricane David in fact furthered the shift into banana production: so long as the GoCD failed to actively promote diversification - e.g. through incentives - bananas offered the quickest, low-cost way to restore agricultural production and export income. Banana production continued to be profitable through the 1980's and during this period the GoCD did not explore potential opportunities for developing the services sector and diversifying within the manufacturing sector.

11. The declining profitability of bananas in the 1990's has forced a re-examination of the composition of the agricultural sector. However, there is still no clear-cut growth strategy; and risks emanating from natural hazards are still not being effectively taken into account in the formulation of economic strategies and policy. This is true not only of Dominica but also more generally within the Caribbean region. This deficiency needs to be addressed because the evidence from Dominica indicates real scope for reducing the structural vulnerability of the economy, provided the opportunities are grasped. The reduced importance of the agricultural sector in the economy has helped to reduce the impact of recent storms and the burgeoning international financial services sector could also play a significant role in reducing hazard vulnerability. More information and analysis on the economic and financial impacts of natural hazards would assist in integrating risk reduction concerns into medium and long term economic and financial planning, and thereby contribute to sustainable growth.

Sectoral Impacts

12. The macro-economic analysis above shows that not all sectors and sub-sectors of the Dominica economy have been equally vulnerable to natural hazards. The study has explored in more detail the impacts in relation to the major productive and commercial sectors of the economy. Critical factors in reducing economic impacts at the sectoral level include action to build disaster mitigation features into facilities and to spread risk through insurance. The protection of key infrastructure is vital.

Agriculture, Livestock, Fisheries

13. Around half the population of Dominica is still directly dependent on agriculture so damage to agricultural production and markets impacts immediately and deeply on the welfare of the majority of the population. The dominant crop, bananas, is especially sensitive to damage from winds of 40mph or more so that even fringe impacts of less severe storms can cause serious damage. However, despite this sensitivity, a number of factors have combined to reinforce the concentration on banana production - to the exclusion of other crops that could significantly reduce the overall sensitivity of Dominica's agricultural sector to natural hazards. With replanting, banana production levels can be restored quickly, within 6-9 months following a complete loss of the crop; a compulsory insurance scheme, applied only to banana production, has returned farmers about 20% of the value of lost production; and there has been an assured export market. The livestock sector is small and reasonably resilient, although meat imports increase temporarily following storm damage. The fishing sector, by contrast, is highly vulnerable and slow to recover. Though declining, fishing is important in a diverse economy and provides the main livelihood of many poorer families.

Manufacturing, Tourism, Construction and International Financial Services

14. Although the manufacturing sector grew by an annual average of 7.1% between 1977 and 1999, the GoCD still regarded it in 2000 as being in an embryonic state, and heavily concentrated on coconut-based soap and detergent production. (Soap and dental products overtook bananas in 1996 as the largest merchandise export in value terms.) Importantly, natural disasters are not seen as a major constraint on growth in the sector, although some individual products may be sensitive to weather conditions. There is some evidence of effective risk management measures (e.g. higher construction standards for the Dominica Coconut Products Lt. jetty to withstand storms); but a major failure in risk management is inadequate business insurance cover.

15. Tourism expansion has been a central plank of development strategy for Dominica for the last 20 years. Assessing natural hazard impacts and drawing lessons for the future for this sector is therefore particularly important. Hurricane David had a devastating impact, halting tourism growth for 5-6 years. Infrastructure investment following the hurricane, including measures to limit damage to cruise ship facilities, was helpful in supporting rapid growth from the late 1980's and reducing vulnerability. However, under-insurance – particularly where, as in Dominica, the sector is composed entirely of locally-owned sole proprietorships and partnerships – is still a problem, most notably in the event of an extreme event such as Hurricane David. Uncertainty about hazard risks, for example of a volcanic eruption or earthquake affecting the strongly tourism focused business in the south, may also present difficulties in securing insurance cover and investment funding. The massive increase in the growth of the cruise ship business suggests that tourism may now be more sensitive to the impact of natural hazards on the wider Caribbean regional tourism market.

16. Construction is the one industry where disaster brings increased activity, but there is no evidence of a wider post-disaster construction-led boom, perhaps reflecting Dominica's reliance on imported building materials.

17. Since the mid-1990's the GoCD has sought to make Dominica an offshore financial center, and the sector has grown rapidly. Although vulnerability reduction was not a factor in the Government's decision to promote the financial services sector, it is likely to be largely unaffected even by major disaster events. Continued expansion of the sector should therefore represent a further reduction in broad economic vulnerability.

Infrastructure and Buildings

18. From 1950 to 1978, Dominica was transformed from an underdeveloped plantation cum subsistence colony into an independent middle-income economy. Key to achieving this was rapid infrastructure development. With severe financial constraints, development was achieved at the lowest possible construction costs. The investment took place following more than 20 years without any major hurricane impacts. The result was construction without adequate hazard proofing, with devastating consequences when Hurricane David struck. Following Hurricane David, there was wider interest in reducing vulnerability by incorporating more effective mitigation measures into design and construction. Since then, there has been substantial but uneven progress in reducing vulnerability in all areas of infrastructure and building. There has been some exemplary investment. However, financial constraints and an emphasis on restoring facilities to normal use as quickly as possible post disaster have meant that initial construction, repair and restoration work have often not incorporated fully effective hazard proofing features. The long-term effect has been higher overall costs and increased pressure on limited resources. The rehabilitation costs of major storms since 1979 is estimated at EC\$380m (US\$140m), at 1999 prices, equivalent to EC\$18m per year, and for key infrastructure alone, at around EC\$10m per year.

19. The history of the deep-water port at Woodbridge Bay, built between 1974 and 1978, highlights the value-for-money case for designing new infrastructure and buildings to withstand hurricane damage. An internal rate of return of 13% was achieved by a very substantial scaling down of the original design; this despite evidence of a high risk of storm conditions potentially far more damaging than that provided for in the sea defenses incorporated within the port design. Subsequent rehabilitation costs, following damage caused by Hurricane David, were equivalent to 41% of the original costs. Had the original structure been built to withstand a category 4 hurricane, the initial investment costs would have been only 11% higher. Under continued financial pressure, hazard risk again seems to have been underestimated in an expansion of the port. The case raises some awkward questions in relation to economic analysis.

20. Most of Dominica's road system runs along the narrow coastal strip very near to the shore, rendering it potentially highly vulnerable to storm damage. Other key infrastructure networks – telecommunications, electricity, and water transmission and distribution – run alongside the road and

are similarly vulnerable. The record of investment in sea defenses to protect this infrastructure and more robust standards for roads is patchy. In places, there have been some exemplary investments to higher storm resistant specifications. Elsewhere the road system remains highly vulnerable. The apparent slow progress in providing sea defenses partly reflects the scale of investment financing required and partly a lack of donor coherence, with piecemeal projects focused on particular coastal sections, perhaps reflecting different donor priorities –e.g. to tackle overall economic development or to target poorer geographical areas – and involving different design and construction processes. All three key public utilities systems were devastated by Hurricane David and were again partially disrupted by coastal damage during Hurricane Lenny in 1999. Their vulnerability to natural hazards now varies, reflecting the degree of mitigation investment that has taken place and associated practical and funding issues.

External Account

21. There are clear and direct links between disaster shocks and export earnings. The links with imports are more inferential. Dominica has typically had a real trade deficit equivalent to 12-13% of GDP. In some years the deficit has been much higher, reflecting variability in export levels and post-disaster surges in imports, notably of building materials equipment and food. The declining trend in banana export earnings since about 1989 has reduced the sensitivity of the trade account to disaster shocks. Despite the loss of banana earnings in 1995-96, total export earnings increased because of the growth in earnings from soap and detergent products and from relatively resilient non-factor services, such as offshore banking and tourism. The shift shows how the nature of an economy's sensitivity to natural disaster shocks can change rapidly. Governments and international organizations need to take account of this and regularly reappraise their disaster response policies. For example, arrangements for buffering the effects of natural disaster shocks have focused on compensating for primary commodity export earnings. Easily accessible mechanisms for countering shocks in other sectors may now be equally important.

22. Disaster-related increases in capital inflow following hurricane years have typically overcompensated for downward pressures on the trade account, and contributed to reconstruction investment.

Investment and Domestic Consumption

23. It is difficult to discern evidence of the impact of natural disasters on total investment or consumption in Dominica, other than in the aftermath of Hurricane David in 1979, when the scale of both losses and reconstruction funds created an opportunity to replace and update much of the island's infrastructure and commercial, productive capital, following years of inadequate maintenance and limited investment. Gross domestic investment increased by almost 25% year-on-year in 1979, and by over 65% in 1980, falling again by over 25% the following year. The fall off in private investment from 1981 onward was marked, suggesting that, once repairs had been completed, the hurricane may have deterred new investment. Subsequent hurricanes have not resulted in any comparable infusion of reconstruction capital.

24. Nevertheless, the World Bank attributes the relatively high level of consumption volatility in the Caribbean region as a whole to the fact that, in the face of high vulnerability to a range of external shocks, countries are not spreading their risks optimally, despite having relatively well-developed financial systems. It concludes that financial and insurance markets need to be developed further, including through closer harmonization within the region's financial and insurance markets, strengthening of securities markets, pension reforms and the more efficient transfer of risks to the international market.

Financial Aspects

25. The study has examined how natural disasters impact on financial systems and how private and public financial institutions cope with the pressures.

Banking and Credit Institutions

26. Banking and credit systems can help to spread risk in disaster prone countries. Natural disasters also place pressure on banking and credit institutions as money is withdrawn, loan repayments are be deferred or defaulted on and increased credit is sought to finance uninsured rehabilitation costs and disruptions in income flows. In extreme cases, the result may be the collapse of part of the banking sector. There is no national central bank in Dominica. Instead the Eastern Caribbean Central Bank (ECCB) conducts monetary policy for the Organisation of Eastern Caribbean States (OECS), supervises and regulates commercial banks in the member states and is lender of last resort – although it has never been called upon in this capacity. Within Dominica, there are five commercial banks, one national bank, a rapidly growing network of credit unions and several non-profit making bodies involved in loans and credit.

27. Available data suggests that natural disasters have had relatively little overall impact on Dominica's banking and credit sector. However, the sector's limited and fragmented ability to spread and transfer risk both in Dominica and the Caribbean region more generally is a serious concern and measures are being explored to address the problem. Within the OECS, some services are being initiated that will facilitate risk sharing as banks in the regions shift increasingly into syndicate lending. There has also been some discussion about the establishment of a jointly owned lending subsidiary that could diversify across territories and fund loans that are too large for individual banks. In Dominica, banks and credit institutions are also seeking to reduce risk exposure by limiting levels of agricultural lending, though this may make post-disaster recovery more difficult.

Inflation

28. With the exception of Hurricane David (when the food index alone was reported to have increased by over 45% between 1978 and 1979), natural disasters have had only limited impact on the rate of inflation, which has remained low over the past 20 years. Dominica's reliance on imports for most construction material may have helped to constrain post-disaster hikes. Legislation allows prices to be fixed for some essential products, but it is not clear if this law has been applied.

Insurance and Other Risk Transfer Mechanisms

29. In comparison to many other developing countries Dominica's insurance industry is relatively well developed. However, there is a major problem of under-insurance, partly reflecting the high and volatile cost of insurance in the Caribbean region. Some 80-85% of gross property insurance premiums in the region are transferred to reinsurers, with any fluctuations in reinsurance costs – whether locally, regionally or globally caused - passed directly on in the form of premium changes. Premium rates have typically increased three to four-fold between the 1970's and 2000, although fluctuating considerably between years. Data on underinsurance specific to Dominica is not available, but it is estimated that 25-40% of dwelling stock in the Caribbean region is uninsured, and much of the insured dwelling stock may be underinsured. Take-up of business interruption policies is also very low – perhaps as low as 5%. Insurance of public property is almost certainly limited by budgetary constraints. The proliferation of insurance players in the Caribbean, some of them very small, has led to concerns about the efficiency and, more importantly, the safety of the insurance industry.

30. New insurance legislation to be enacted across the OECS aims to address some of the main concerns: through disincentives to small insurance players, incentives to encourage amalgamation of insurance operators, and regulations on minimum levels of share capital required for registration. The World Bank has also recommended that companies and households in the region establish reserve funds to finance uninsured disaster losses. For a number of years now, various regional and

international organizations have also been debating the creation of some form of regional risk management tool, such as an inter-country insurance pooling arrangement.

31. To date there has been limited use of insurance as a mechanism for promoting mitigation through differentiated premiums to reflect lower risks on strengthened land and buildings. More widespread discriminatory premium pricing would be valuable; but it would require comprehensive hazard mapping and inspection of individual properties.

Public Finance

32. Since Independence in 1978, an objective of the GoCD has been to strengthen and stabilize public finances through tighter control on spending and increasing revenue. However, the high costs of providing an infrastructure and public services network to a small and dispersed population, together with the costs implied by Dominica's extreme vulnerability to natural hazards place huge burdens on limited resources. It has been very hard to balance the budget. The Government's ability to increase money supply to reduce public debts is also strictly limited by the ECCB, which is responsible for monetary policy across the OECS. Aid and other foreign funding have contributed significantly to both capital and recurrent expenditure with, for example, local duty accounting for only around 60% of total revenue over the period 1978/79 – 1997/98.

33. Aggregate budgetary figures suggest that disasters have had little impact on public finances except following the most extreme events such as Hurricane David. Until the 1990's expenditure on mitigation and preparedness also appears to have been low. In reality, although largely unrecorded, the costs of meeting more urgent needs in the aftermath of disasters have tended to displace planned investment, with the extent of necessary reallocation exacerbated by the absence of any calamity reserve fund. Over time, cumulative reallocations and disaster-related damage and destruction to public infrastructure and other facilities have had an adverse effect on the pace and nature of physical and economic development, making it more difficult to attract and sustain new productive investment. Against this background, it is essential that the budgetary impacts of disasters are measured more explicitly and risk reduction concerns built into medium and long term economic and financial planning. In this way, a more rational response to risk and disasters will be possible, including more soundly-based reallocation decisions and better targeting of external assistance.

External Assistance

34. External assistance accounts for a large proportion of the GoCD's public capital spending and some current expenditure support. Although there has been considerable short-term variability in the level of total aid flows, there are no discernable trends during the period since Independence. Disaster-related aid is often received some time after the event, and to some extent aid in the aftermath of a disaster is diverted from non-disaster related projects. Apart from Hurricane David, which was severe enough to attract widespread international publicity, aid levels have not altered very significantly in response to public expenditure pressures following natural disasters.

Social Issues and Poverty

35. At the household level, poverty is the single most important factor determining levels of vulnerability to natural hazards. This reflects housing quality (location, building materials used, and failure to provide adequate support for low cost housing in the aftermath of disasters); the primary source of household income; limited financial resources; and lack of access to risk spreading mechanisms. Although issues of social vulnerability and the impacts of natural hazards at household and community level are very important, there has been little research to date in this area in Dominica. These issues need to be better understood so that a risk management strategy can be

developed which addresses the fact that poorer households are particularly vulnerable and that poverty can be caused or exacerbated by natural disasters.

36. In Dominica, several highly vulnerable economic sectors are particularly important to the livelihoods and income of poorer households. For example, a large number of extremely small marginal producers are involved in the banana industry, which has been a way for many poorer households to re-establish an income following disasters; but the compulsory insurance scheme disproportionately benefits the larger producers. Huckstering (trading activity between Dominica and surrounding islands which forms an important part of the informal labor market and is typically undertaken by women, often from poorer rural households) is highly vulnerable to natural hazards; but no insurance cover is available for huckster consignments. Fishing is another extremely vulnerable sector involving some of the poorest households in Dominica; but the evidence is that little has been done to recompense or rehabilitate affected households. On the positive side, there is an increasing recognition of the importance of tackling vulnerability to natural hazards as part of a poverty reduction agenda for the region, and the GoCD has identified the need for further investigation into the nature of poverty in Dominica.

Disaster Management

37. There has been considerable progress in Dominica's state of preparedness for natural disasters over the last 20 years. The 1996 National Disaster Plan is a substantial and detailed document focused on disaster preparedness and immediate post-disaster responses. Lead responsibility for the Plan and disaster preparedness lies with the Ministry of Communications, Works and Housing. Individual Government Departments are then responsible for undertaking post disaster impact assessment while donors interested in supporting particular aspects of relief approach the relevant Ministry.

38. However, the National Disaster Plan largely overlooks long-term mitigation and prevention issues and measures to address economic impacts and promote economic recovery. Overall there does seem to be a good awareness of disaster issues. However, the generalized concern and commitment has not been translated into a coherent overall strategy for disaster reduction. Such a strategy would need to include or use information which has not so far been available: comprehensive and robust assessments of potential physical damage, macro-economic impacts and social impacts; mitigation and preparedness plans; implementation plans to support affected groups; and a comprehensive rehabilitation plan. It would require consultation with local stakeholders and NGO's and cooperation with regional bodies and funding agencies.

39. Experience in Dominica and more widely in the region, suggest that a high level, well resourced interdepartmental task force responsible for disaster management would be more effective both in the crisis and in planning for future disaster than the existing department-based arrangements.

40. Environmental assessment of hazards poses particular problems for small developing countries. Concerns about the increasing exposure to risks highlight the need for increased assessment and monitoring, and also for clear and accessible information to be provided about hazard risk. Dominica has no capacity to undertake this independently. The necessary regional approach is now emerging in work being done under the auspices of the Organization of American States, involving international funding and expertise.

41. A particular cause for concern in Dominica's disaster mitigation and management arrangements is that the opportunities for highly cost effective hazard proofing through design and construction standards have not been grasped. Regional civil engineering experts have estimated that spending 1% of a structure's value on proofing measures can reduce probable maximum loss from hurricanes by, on average, one third. However, there is currently no formal Building Code in Dominica; the

island's infrastructure remains vulnerable to tropical storms; land use planning is weak; and there is evidence that as recently as 1996 new housing was built without adequate fastening of roofs to walls.

Conclusions and Policy Implications

42. The country study draws a number of key conclusions:

- ? There is considerable uncertainty and unpredictability about natural hazards: for example, established patterns of hurricanes may not be followed in a particular case, causing unforeseen damage; and a series of disasters may strike after a long period of calm. Risks require regular reappraisal.
- ? The Dominica economy's vulnerability is constantly changing, reflecting both changing levels of development and capital investment in the island and the structure and composition of economic activity. Measures can be taken to reduce the structural vulnerability of the economy. Greater integration of hazard risks into medium and long-term economic and financial analysis and planning could substantially reduce the economy's vulnerability to natural hazards and contribute to sustainable growth.
- ? In the immediate aftermath of a disaster, public and private sectors face choices between pursuit of rapid recovery and reductions in longer-term vulnerability. Similar choices arise in determining the quality and standard of development investments. In Dominica, with limited public and private resources and without the political impetus or financial incentives for investment in mitigation and changes in land use, the emphasis has been on quick recovery and least cost investment. But the opportunities for reducing vulnerability need to be seized. Improved information on the budgetary impact of disasters is needed to facilitate the cost-effective allocation of resources and to emphasize the importance of integrating hazard concerns into medium and long-term planning.
- ? The unsatisfactory levels and forms of hazard risk information available in Dominica have hindered effective risk-averting decision-making. Issues that require urgent action include ensuring sufficient investment in monitoring, assessment, mapping and dissemination activities. There is also a need for clear and accessible public information. Achieving these information objectives for a small island economy requires regional and international cooperation.
- ? There are wider implications for small island states. The vulnerability of a small open economy can alter rapidly, reflecting the significance of external factors. In considering appropriate disaster mitigation measures, it is important to recognize the physical characteristics underlying the island's economy and society. Encouraging less vulnerable areas of economic activity and strengthening key infrastructure will help to secure long-term sustainable growth and minimize disaster impacts. A lot more needs to be done in the Caribbean region as a whole to spread and reduce hazard risks through insurance and other financial risk transfer mechanisms. Donor agencies can also secure better returns to investments in disaster mitigation by adopting more joint programs and agreeing lead agencies on particular projects, rather than working in parallel; supporting regional solutions; and reducing the micro-management of some projects.

ANNEX B

BANGLADESH: DISASTERS AND PUBLIC FINANCE

Introduction

1. This is an abridged version of a study on natural disasters and public finance in Bangladesh. It focuses mainly on the period since 1980, including 5 “major disaster” events, which triggered a national and international emergency response. The study uses the available past data to examine movements around trends and to compare economic performance (forecast and actual) before and after disasters; and sets these findings into the economic and social policy context of Bangladesh. It is breaking new ground in that although the immediate, emergency and short term budgetary implications of individual natural disasters have been the subject of much study, this is the first study to investigate the recurrent longer-term aspects which are particularly relevant for disaster-prone countries.

Natural disasters and hazards in Bangladesh

2. Bangladesh is one of the most disaster-prone countries in the world. Most of its large, densely settled population of 130 million people is at significant risk to more than one form of natural hazard. In terms of area and number of people directly affected, impact on economic activity, and damage or destruction of assets, the types of disaster which have been most important since Independence in 1971 are: exceptionally widespread riverine flooding; severe tropical cyclones and associated coastal storm surges; river bank erosion and drought. Official estimates are that 139,000 people were killed during the 1991 cyclone, and 31 million directly affected by the 1998 floods. Rapid on-set flash flooding, tornados, and landslides are frequent causes of more localised but intense human suffering and loss. Severe earthquakes have been rare but are a potentially catastrophic hazard. Around 50% of Bangladesh’s population is classified as poor and around 34% as living in extreme poverty. These people are typically living and working in areas most at risk from natural disasters. At household level, poverty is still the single most important factor determining hazard vulnerability.

Risk and Probability

3. The exceptional complexity of the natural environment which results in Bangladesh’s disaster-prone status makes it extremely difficult to assess the risks of major disasters or to forecast levels of physical damage or losses from disruption of economic activity. It is difficult to make robust, quantitative assessments of the probable levels of risks associated with the major natural hazards in Bangladesh. Three of the reasons are:

- ? the obvious limitations of historical data;
- ? environmental changes, some recorded and others only so far identified as the possible consequences of global climatic change;
- ? Human activity in Bangladesh and the immediate region, which is possibly altering the likelihood of specific events as well as, more obviously, the associated effects.

Current understanding of the risks of extreme, catastrophic events and problems of assessment vary widely according to the particular hazard.

4. *River flooding*: there have been 4 extreme events in 30 years – 1974, 1987, 1988 and 1998. Other very high floods in 1976 and 1984, though less severe when measured in terms of height, maximum flow and proportion of area inundated, caused widespread suffering and losses and elicited an international emergency response. The implied annual risk of an extreme flood is a

high 10 – 20%. Historical data on heights and flows for the major rivers are of doubtful quality and only available for one station on the Ganges since 1934, and for one station on the more unstable and recently more threatening Brahmaputra since 1956. The 1950 Assam earthquake also upset the Brahmaputra flow and the Jamuna section is continuing to move its course westwards. There have been massive upper riparian interventions in neighbouring countries since 1950, so far mostly for the Gangetic system, and potential impacts were highlighted by the 2000 floods, the worst in 80 years in SW Bangladesh.

5. *Cyclones and storm surges*: There is a record of over 100 years of storm tracks and approximate intensities for the Bay of Bengal. There were at least 14 very severe storms that impacted Bangladesh with an implied annual risk level of over 10%. There can be clusters of storms – such as 6 major storms affecting Bangladesh between 1960 and 1970- within the otherwise random series. So far there is no evidence of changes in the frequency or intensity of storms in the Bay of Bengal. But if there were a rise in mean sea level, this would increase the expected severity of impact of a cyclone, including an associated storm surge. Human intervention, including deforestation in the Sundarban and the network of often poorly maintained embankments, may change the incidence of impacts.

6. *Earthquakes*: Bangladesh is part of a high risk region. Minor tremors are common and one of the most extreme events, the 1897 earthquake (8.8 RS) had its epicentre in the nearby Shillong Plateau of the Indian State of Meghalaya. Local assessments provide only highly tentative risk zoning within the country in map form because of the inadequacies of available data.

7. *Drought*: The estimation of risks and likely impacts on the basis of historical data is likely to give seriously inaccurate results. There have been 7 reported droughts in Bangladesh since 1971 with an implied frequency of almost every fourth year. Such repeated reports of drought suggest widespread problems of lower than average rainfall, causing moisture stress and limiting crop growth. Drought as a disaster category should be restricted to extreme, uncommon events. Furthermore, agriculture may now be less sensitive to rainfall variability within a wider range than previously, because of the rapid spread of irrigation and irrigated Boro rice becoming in the late 1990s the main crop. However, the consequences of draw-down of the water table in an exceptionally dry year might imply both a different seasonal pattern and overall intensity of impacts on agriculture, other water-intensive activities and human water supply. Finally, there are the potential impacts of climatic change, which could lower the risk of extremely low annual rainfall patterns that have historically caused agricultural drought.

8. *River bank erosion* is a continuous rather than intermittent problem that can be predicted with some degree of accuracy. The high level of risk makes insurance of assets or production impracticable. The most effective mitigation measure is strict land use zoning, but this is currently unenforceable. Consequently both NGOs and, more recently, Government in the National Water Management Plan in 2001 have moved towards supporting micro-scale protection and non-structural measures.

9. *Flash flooding* is an annual phenomenon. There is considerable scope for predicting areas of likely incidence and timing. This would involve combining GIS, local ground confirmation and real time information on rainfall and river levels that would require international co-operation to communicate and assess information on at least a daily basis.

10. *Tornadoes and lines squalls* are a common, localized phenomenon, traditionally associated with the Bengali New Year in April. The risks are potentially computable in terms of risk zoning and expected frequency, making insurance of assets a possibility.

The impact of major disaster shocks on the economic development of Bangladesh

The Bangladesh economy

11. Since Independence the Bangladesh economy has achieved impressive rates of growth. It achieved rapid recovery in the late 1970s from the devastating effects of natural disasters, war and famine in the years 1970-75; and an average real annual growth rate in GDP of 4.2% in the decade 1980-90 rising to 5% in the decade 1990-2000. Average annual per capita GDP growth rose from an average of 1.7% in the 1980s to 3.3% in the 1990s, reflecting higher GDP growth and declining population growth. At the same time there has been a change in the structural composition of the economy: agriculture's share of GDP has declined while the industrial and service sectors have expanded, resulting in a sharp shift in the composition of the country's exports. A gradual process of structural adjustment and trade liberalisation alongside more disciplined monetary management resulted in the 1990s in an inflation rate kept in single digits and an annual current account deficit below 2.5% of GDP. The reforms have also helped to increase private sector development and foreign direct investment. Fiscal policy has not been so successful: a World Bank report points to large fiscal deficits, a low tax-to GDP ratio and relatively poor quality spending.

12. Several features of Bangladesh's economy are particularly relevant to the public finance impacts of disasters:

- ? A high level of public sector involvement in the economy means that government ultimately bears a substantial share of any disaster-related losses.
- ? High reliance on imports for industrial development and production and a large proportion of government revenue generated from import earnings mean that performance of imports, exports and levels of foreign exchange availability are important determinants of the level of resources available to the government; The export base remains narrow and therefore vulnerable to external shocks. The shift from agricultural to manufacturing exports may not have reduced the vulnerability of export earnings to natural disasters. (For example, as the world's primary jute producer, Bangladesh could help set prices, even in times of disaster. In contrast, as a ready-garment maker it faces severe competition. Disruption of production results in loss of export revenue and overseas markets.) The level of foreign exchange reserves has periodically emerged as a critical issue, in part owing to its vulnerability to natural hazards and other shocks.
- ? External assistance has played an important role in funding a major share of public investment (and by implication of total investment) as well as meeting the country's large trade gap, and contributing significantly to post-disaster relief and rehabilitation.
- ? There is a growing debt to GDP ratio (from 6% in 1973 to 47% in 1998) as fiscal debts have been financed through borrowing. Any further growth in domestic borrowing – e.g. arising from disaster related budgetary difficulties – would lead to pressure for cuts in discretionary areas of recurrent spending, and then potentially cuts in programmes of post-disaster rehabilitation.

Natural disasters and macroeconomic performance

13. A simple assessment of the sensitivity of Bangladesh's economic performance to major disasters in terms of fluctuations in GDP, and rates of growth in agricultural and non-agricultural sector product highlights some key issues:

- ? In the period 1965-75, there was extreme volatility in the economy and a very clear link with catastrophic natural disasters as one destabilising influence.
- ? With the notable exception of the 1998 floods, major disasters have resulted in a downturn in the agricultural sector annual rate of growth.
- ? The impact on the non-agricultural sector looks much less significant – though longer term impacts of disasters are not reflected in inter-yearly fluctuations: if resources are

diverted from productive investment to disaster management, the pace and nature of development will be adversely affected.

- ? The sensitivity of both agricultural and non-agricultural components of GDP to disasters appears to be declining over time, suggesting greater resilience.

Of course, the economic impacts do not reflect or parallel the severity of disasters in terms of loss of life and human tragedy.

Impacts of Disasters on Public finance: budgetary process and performance

14. Public finances are highly centralized in Bangladesh, with central government accounting for some 97% of total revenues and 93% of public spending in the mid 1990's. The following analysis is restricted to central government operations.

15. The movement of broad budgetary aggregates – revenue expenditure, development spending, central government revenue and the level of budget deficit – in the period since 1981, suggests that disasters have had little impact on central government finances. Revenue and development spending along with central government revenue have risen gradually over the period and the overall budget deficit remained fairly stable until the 1998 flood, when it rose markedly. However, closer analysis of expenditure and sources of finance gives a rather different picture.

The budgetary process

16. Responsibility within central government for public finance planning, allocation and monitoring is shared between a number of government departments. Procedures in place for tracking and controlling total annual public expenditure (equivalent to US\$ 3bn) have not offered the clear lines of responsibility and delegation necessary to respond effectively to the shocks of disaster. For example: the distinction between revenue and capital spending is somewhat artificial; revenue projections and expenditure forecasts have typically been over-optimistic; and financial reporting systems mean that public accounts tend to underestimate the full extent of disasters on public finance. Changes now underway to improve monitoring of spending, should facilitate more cost effective reallocation of resources, provided there is also a clear system for prioritising projects.

Development spending

17. The Annual Development Plan (ADP) is the basic instrument for public capital investment planning and implementation, covering expenditure allocations against specific central government projects as well as the investment projects of public enterprises funded with government and foreign aid contributions. ADP spending has increased over time, with foreign aid accounting for a declining but significant share (on average 45% between 1980/81 and 1998/99). Over the same period actual expenditure has averaged 89% of the ADP budget, with little apparent linkage between the incidence of disaster and the ratio between actual and budgeted spending. The tendency to under-spend reflects factors such as project delay (due in turn to counterpart funding constraints), staff shortages, complex bureaucratic and procurement procedures, land acquisition delays, donor cross conditionalities and poor monitoring. Delays lead to cost increases and a higher level of exposure to natural hazards. (Unfinished projects are more vulnerable to damage.)

18. Over time the composition of the ADP has changed. Investment in roads, water and sanitation has assumed increased importance. When cutbacks have been necessary, agriculture, rural development, water resources and infrastructure have generally been spared as far as possible with social and industrial sectors taking the largest cuts. The fact that disasters have not forced a significant increase in spending on ADP suggests that disasters have instead led to reallocation of resources and/or to delays in on-going projects. If that is happening, it is important that reallocations are done in a way that minimises their long-term developmental impact. This requires:

- ? A clearly defined and applied policy framework, linked to defined and achievable objectives;
- ? A sound system for prioritising projects;
- ? Reliable information on resource availability, and full and accurate damage assessments;
- ? Proper evaluation of post-disaster rehabilitation and reconstruction projects.

19. The basic medium term strategic planning tool for capital spending in Bangladesh has been the Five Year Plan. A Three Year Rolling Plan was introduced in 1991/92. ADP projects are examined in terms of compatibility with the strategic plans and of cost, technical quality and economic viability. But the composition of the ADP may also reflect political pressure, the availability of external assistance and donor priorities. Heavy dependence on aid has logically led to less government control of a development vision.

20. Effective reallocation of resources depends on a clear ranking of projects according to a level of priority. In theory projects known as 'core' projects have been prioritised under the ADP. A formal 'core' programme of projects was introduced in 1983, but the practice was informally in place by the mid-1970s. During the early period, priority was given to quick yielding projects and those in advanced stages of completion. Sectorally, agriculture (particularly labour intensive small-scale drainage schemes) and resource exploration projects had priority. Draining and dredging of small rivers and canals took priority over work to control major rivers and small-scale irrigation projects were preferred over large scale ones. In reality, across-the-board cuts were generally imposed to restrain expenditure, rather than focusing cuts on lower priority projects.

21. When the formal 'core' projects system was introduced in 1983, there were no specific guidelines for prioritisation, but criteria for selection included proximity to completion, production and employment potential, level of donor support, and links with other projects. By the late 1980s, the World Bank concluded that these priorities were being reflected in the ADP composition. But they were not being applied effectively to determine preferential access to funds. Following the 1987 and 1988 floods, available funds were again spread more thinly across existing projects, rather than allocated to prioritised projects. With the introduction of Three Year Rolling Plans, core projects are now designated for priority funding and other projects are ranked. But despite this, the World Bank's assessment is that more consistent use of objective criteria based on an economic rationale is needed to prioritise expenditure priorities between and within the various sectors. Only by strengthening this area of public and financial planning can the Government of Bangladesh (GoB) be confident that development projects actually undertaken represent best value for public good and for longer-term growth and income. Donors who play a large part in project design have a responsibility for helping to secure improvements in this area.

Revenue budget

22. Since 1987/98 the revenue budget has typically accounted for over half of total central government spending. Gradual budget increases have reflected rising non-discretionary expenditure on pay and debt servicing, together making up almost half of total revenue spending. Despite budget growth, some non-discretionary spending areas covered have been consistently under-funded. (Particularly highlighted by commentators have been low levels of operations and maintenance (O&M) expenditure.) Discretionary expenditure is by definition more vulnerable to cutbacks, including cuts arising from natural disasters.

23. Surprisingly, growth in the revenue budget has not been substantially higher in disaster years. Disaster-related expenditure seems to have been met within the existing budget envelope by drawing on existing unallocated resources (e.g., to meet needs for agricultural subsidy) and diversion from other use (e.g., redeployment of government staff). The real and underlying

implications of disasters for revenue spending can only therefore be understood with a more detailed knowledge of decisions taken at the time of a disaster.

Government revenue

24. The revenue structure in Bangladesh is very weak. Total revenue averaged only 6.9% of GDP in the 1980s and 9.3% in the 1990s. External grants and loans have supplemented revenue, increasing the total available by an average 40% in the 1990s. Tax revenue has accounted for the largest part of total revenue, with an overwhelming dependence on indirect taxes, particularly import duties. (Income tax accounted for only 15% of tax revenue between 1992/3 and 1997/8.)

25. The available evidence suggests that natural disasters have had little impact on aggregate tax performance. At a more detailed level there were adjustments. In response to the 1987 and 1988 flooding, the GoB increased some taxes to meet additional costs of disaster aid while at the same time reducing the tax burden on other parts of the economy to stimulate growth and help recovery. Since the late 1980s, various measures - such as the introduction and subsequent extension of VAT - have been taken to widen the tax base and to reduce exemptions, although it is widely agreed that the GoB still needs to increase its tax revenue further - perhaps to 13-14% of GDP. However, higher reliance on taxes to fund public expenditure will also imply that disasters will cause greater tax losses if there is no change in the tax composition. This would have consequences for alternative financing requirements and place further pressures on expenditure. Longer-term tax reforms in Bangladesh therefore need to aim at reducing the overall vulnerability of tax revenue to disasters as well as increasing revenue.

Funding the government deficit

26. Since Independence Bangladesh has run large, but gradually declining, public expenditure deficits. In recent years the costs of funding this deficit have been increasing with an increasing reliance on higher cost domestic debt instruments rather than foreign assistance. Time series statistics show no discernible relationship between disaster shocks and patterns of expenditure and funding sources, though there is some evidence of lags in the impact of shocks on public finance.

Major flood disasters and public finance performance: the 1987, 1988 and 1998 floods

27. It is worth highlighting some public finance impacts of the most extreme recent floods and some aspects of the GoB's response. The impacts of the 1987 and 1988 floods are examined together. Those of the 1998 floods are looked at separately.

28. A comparison between forecast levels of revenue and expenditure and actual outturn levels suggests that public financial impacts of both flood crises were limited. In both cases, GoB sought to limit the budgetary impact of the floods. Domestic revenue was augmented by the introduction of specific measures to increase tax revenue (although there were also targeted fiscal measures to assist recovery) and action was taken to contain revenue spending. Outturn figures for revenue, expenditure and budget deficit were relatively close to budget.

29. The main adverse public finance impacts of both flood crises are to be seen in ADP expenditure which was very substantially lower than budgeted, in part reflecting the GoB's normal practice of relying on the ADP to bear cutbacks in total expenditure. In the case of the earlier floods the limited availability of local currency resources also constrained the scope of the ADP and may have led to under-utilization of donor funding. On both occasions, the introduction of flood-related reconstruction and protection projects placed additional pressures on available resources for planned projects. The substantial pledges of foreign aid were critical to the recovery programmes but notwithstanding the generosity of donors, there was a lag between the commitments and availability of funds in the ADP budget in both cases. The system for reallocating resources from lower to higher priority projects was applied more effectively following the 1998 floods than in the aftermath of the 1987 and 1988 floods. Expenditure on rural

development and institutions, and on transport increased as a result of the reallocations (consistent with efforts to repair and rehabilitate damaged infrastructure) while there were reductions in spending on health, population and welfare (again in line with the tendency in the aftermath of disasters to reduce spending on social sectors). But, given the priority accorded to social sectors in the poverty reduction strategy, such reallocations need to be carefully considered.

30. Two important consequences of the 1987 and 1988 floods were a comprehensive review of flood policy by GoB and the international community; and deregulation of private agricultural investment, which quickly led to more investment in lift irrigation and a rapid growth in rice production.

31. A key difference between the two major flood crises was that there was much more detailed information available in 1998 to assist planning, and management of the crisis was more transparent. The consequences of the 1998 floods were much more closely examined within Bangladesh than the floods a decade earlier, and this greater understanding offered an opportunity to mitigate and more effectively manage future effects of natural hazards. The experience of these flood crises highlights the need for standardised guidelines to assist with disaster damage assessment and reporting. The 1998 floods again exposed the uncertainties of post flood forecasting and the need for a full reassessment 18 to 24 months after the disaster. (Box 7).

Box 7: Uncertainties in post-disaster economic forecasting in Bangladesh

Following the 1998 flood in Bangladesh, a sequence of adjustments was made to annual economic forecasts for the year. Prior to the flood, there had been a sense of optimism, at least on the part of the GoB, that a high rate of growth would be sustained. The GoB forecast an annual GDP growth rate of 6.3% for 1998/99 (GoB, 1999b). Other GoB goals included containment of the rate of inflation at 5%, the rebuilding of reserves to US\$2bn and a budget deficit of 5.3% of GDP. Instead, the 1998 floods had a devastating impact. The GoB (1999b) estimated the total loss at US\$2bn in output and damaged infrastructure, equivalent to 6% of 1997/98 GDP, while agricultural activities were also disrupted. Rehabilitation costs were estimated at US\$1.5bn (UNDP/GoB, 1998).

The GoB rapidly announced a series of measures intended to address various macroeconomic implications of the floods, including new commitments of balance of payment and other forms of external assistance as well as steps by government to raise revenue and reduce expenditure. Revised economic forecasts released in October/November 1998 by the World Bank (1998a) and IMF, taking these measures into account, estimated a GDP growth rate of 3.3%, an 8% rate of inflation and year-end foreign reserves of US\$1.7bn. Revised forecasts for 1998/99 were again released in April 1999, this time by the GoB. These were more optimistic, suggesting better GDP growth (3.8%) and visible trade performance than had been previously forecast.

In the event, actual economic performance was even better than expected, including a growth rate of 4.9%. This outcome was primarily due to a record post-flood, dry season, irrigated Boro rice crop and also a bumper wheat crop. Agricultural output expanded 4.8% in real terms, reflecting producer response to *aman* crop losses and a comprehensive program of agricultural rehabilitation. In volume terms, foodgrain production was 5.6% higher year-on-year, compared with a pre-flood projection of only 2.4% growth and initial post-flood assessments of a 10-11% decline in output. Construction activity also remained strong, boosted by the rehabilitation process, with an annual growth rate of 8.9%, although recovery was less rapid in certain other sectors, particularly non-agricultural processing sub-sectors of the manufacturing industry. Import growth was lower than had been expected in the aftermath of the flood, while foreign remittances increased more than anticipated. However, export growth was much lower than forecast and foreign exchange reserves fell to US\$1,525m in FY1999, equivalent to only 2.3 months of imports. Annual inflation stood at 8.9%.

The Food Account and Food Operations

32. A distinctive feature of Bangladesh's public finances is the maintenance of separate set of food accounts for public sector operations. The origins lie in the post World War II ration system and the historic reliance of Bangladesh on food as commodity aid. In this study, our focus has been on exploring:

- ? how far food operations are related to disaster management; and
- ? whether a separate food account helps to insulate public accounts (especially the development component) from damaging volatility; or whether it would now be preferable to incorporate the food account into the budget and apply conventional accounting practices.

33. Our conclusion is that food operations are an important, even essential, part of disaster management and poverty alleviation in Bangladesh. This is illustrated by looking at the clear association between major natural disasters and foodgrain off-take, both for sale (monetised) and for direct distribution (non-monetised). In the case of grain for sale, the link is clearest for the 1984, 1987 and 1988 floods and the 1991 cyclone. Monetised operations played no role in the government's response to the 1998 floods because private imports and non-monetised distribution together kept domestic prices from moving above import parity prices. The direct distribution of food has become the key instrument in the GoB's disaster response, with peaks in direct distribution following all the country's major disasters.

34. As to whether a separate food account remains a helpful means of managing public food operations, our conclusion is that there would now be advantage in properly incorporating food into the budget because food operations now represent a smaller share of public expenditure and revenue, and there are already close links between food operations and other budgets,. Financing of the public food operations has also become more complex over time. Adopting resource based accounting would offer greater transparency and assist financial planning and budgetary control.

External Aid

35. External aid has been a major source of finance in Bangladesh, totalling US\$ 38bn (real 1999/2000 prices) between 1980/81 and 1999/2000. External aid (loans and grants) comes directly to government and publicly owned bodies as well as through non-governmental organisations (NGOs). The GoB categorises aid as project aid (which largely appears as approved development activities under the ADP), food aid (received in the form of commodities for relief or development) or commodity aid (a residual category covering assistance including balance of payments support). During the 1970s, food and commodity aid were the largest categories of external assistance but during the 1980s project aid emerged as the primary form of planned aid, accounting by 1999/2000 for 89% of total commitments and 81% of total disbursements.

36. There has typically been a substantial gap between projected aid and actual expenditure, reflecting factors such as procedural difficulties, project staff changes, procurement delays, and lack of resources locally for counterpart financing. In 1998/99, total aid commitments rose by 46%, but disbursements increased by only 22%. Available data suggests that many donors have responded to disaster crises by reallocating resources and bringing forward commitments. Foreign aid commitments have typically increased in the year of, or immediately following a major disaster, but have then fallen sharply in the following year. Food aid commitments have generally peaked in rapid response to major disasters. Project aid has tended to drop in disaster years as aid is shifted to more quickly available emergency assistance. This can delay progress of on-going projects and put back the start of new development projects. This aspect of the relationship between disasters and foreign aid merits further investigation.

37. A major, though highly variable, amount of aid now flows via NGOs rather than direct to government. Figures suggest that, in the period immediately following a major disaster, at least a quarter of all aid is channelled through NGOs, some of which operate both as funding and operational organisations and also support smaller NGOs with funding. NGOs have in effect established a parallel structure for international support for disaster relief and rehabilitation. Available evidence from the aid response to the 1998 floods confirms NGOs' heavy involvement in R&R, and that most of this represented additional funding for R&R and additional overall expenditure. The developing role and importance of aid channelled through NGOs, and issues of co-ordination and of the information basis for aid action and allocation also merit further investigation.

Public Agencies and Financial Institutions

38. This study is focused on central government operations, but there are other important bodies involved in public finance operations, on which the effects of natural disasters also impact.

Local Government

39. Government in Bangladesh remains highly centralised. Local government lacks substantial sources of revenue of its own. Localised investment is so reliant on central funding that allocation and prioritisation decisions have been influenced by central authority. This in turn has led to unequal access to services. The fifth Five Year Plan envisaged extensive decentralisation of policies but there has been very little practical action, despite the transfer of some major urban flood prevention to local agencies. A fuller exploration of the implications of disasters for local government would be helpful.

State-owned enterprises (SOEs)

40. There is extensive state ownership of industrial and trading enterprises in Bangladesh. Profits from these enterprises could in principle be a major source of non-tax revenue. In practice, SOEs have generally had persistent and mounting losses, placing a continuing burden on public resource management. Disasters may have contributed to the poor performance of SOEs, and assessments of the full public cost of disasters need to include the impact on SOEs and the knock on effects on public finance.

Financial institutions

41. Despite a policy of financial liberalisation and increased private sector involvement, the public sector continues to be very substantially involved in the financial sector. The long history of subsidised credit, loan amnesties and debt restructuring has placed heavy costs on the budget, although there is a lack of transparency with regard to the precise level of public support to the banking system post-disasters. However, it is important to note a major shift in response to disasters following the 1998 flood. Although agricultural credit was increased significantly in 1998, it was also made clear that payments on existing loans would be deferred but no longer waived, as they had been during the 1980s floods. Case studies, perhaps focusing particularly on banks specializing in agriculture and industry, are required to investigate the impacts of disasters on financial institutions and the lessons to be learned.

Microfinance Institutions (MFIs)

42. MFIs were pioneered in Bangladesh in 1976. There are now over 1,000 NGOs operating microfinance programmes and substantial public sector involvement – through government departments, public agencies and banks – as part of a broad strategy of to tackle poverty. MFIs can play a very constructive role, but are also vulnerable to damaging liquidity problems in times of disaster. Further analysis is needed to explore ways of improving the resilience of MFIs to disasters, while maintaining responsible attitudes to debt repayment and ensuring access to credit post disaster to those most affected.

Disaster Mitigation – Long and Short Term

Defining the Strategy for Mitigation and Preparedness Investment

43. There has been substantial GoB and international community investment in disaster mitigation and preparedness, focused historically on flood protection, drainage and irrigation. This focus reflects a strategy first applied when Bangladesh's population and economy was almost entirely rural. The objective was to protect and promote agricultural development, particularly food-grain self-sufficiency. It was a multi-purpose approach to mitigating the effects of all four main disaster types. The cyclone protection strategy for high-risk coastal areas at the time of the 1960s, 1970 and 1991 cyclones was based on the construction of safe areas and solidly built community shelters. Many people survived the 1991 cyclone by sheltering in public buildings. The evacuation strategy was even more successful in face of a cyclone of similar intensity in May 1997 when there were only 100 fatalities. The strategy now is to design - and rehabilitate - cyclone shelters for multi-purpose use, mainly schools.

44. Social and economic transformation (population shifts from rural to urban areas and the increased economic importance of industry and services compared with agriculture) together with a critical evaluation of the effectiveness of the strategy following the floods of the 1980s and 1990s has led to a review of inherited strategies. The new strategy for water management (2001) gives priority to protection of concentrations of people and high value assets in urban and peri-urban areas against extreme flood, cyclones and river erosion. The strategy for rural areas is still being formulated, but coastal areas are a priority. Overall, there is a fresh emphasis on a more decentralised approach, on the involvement of disaster-prone communities themselves, and on disaster preparedness. The strategy which seems to be emerging would be more financially realistic. Central government investment requirements are reduced and the unbridgeable gap between O&M requirements and Revenue Budget resources is addressed by introducing beneficiary responsibility and cost contributions to help meet O&M costs. These necessary radical changes pose major challenges for the Government and civil society.

Land use controls and building regulation

45. The most effective mitigation strategy against all major hazards, drought excepted, is strict land use zoning and building regulation. Because of social pressures there is no serious attempt to restrict the use of highly vulnerable rural areas for economic activity or human occupation. The need for controls in urban areas is well understood and urban planning directorates, such as the Dhaka and Chittagong Improvement Trusts, were established with responsibilities to regulate siting and method of construction of buildings. But the trusts have been unable to do this because of massive problems of governance. Instead the response of government has been to provide protection through structural measures, such as embankments and, in coastal storm surge areas, cyclone shelters. Building regulation, particularly in relation to seismic hazard, has been an issue of rising concern. Serious risk has been taken into account in the design of, for example, the Jamuna Bridge in the late 1980s. A seismic zone map was incorporated into the national building code in 1993. Further investigation is needed into the hazard risk posed in the rapidly expanding stock of domestic and communal buildings in the main urban areas .

Rehabilitation and Reconstruction decisions

46. A potential problem in the aftermath of disasters is that, in order to fast-track assistance, new projects are not properly designed or appraised. The opportunity costs of investments, in terms of other investment foregone, are not considered. It may be entirely appropriate to review investment priorities, but care needs to be taken to ensure that disaster-related projects do not displace other high priority activities in the ADP, which are more viable and affordable as well as being necessary to support long-term growth.

Financing future disaster costs: insurance and risk spreading

47. Historically, in Bangladesh and elsewhere, there has been heavy reliance on donor funding to meet disaster-related costs. Donor resources are now declining globally, and countries are beginning to explore alternative ways of meeting disaster-related costs. The World Bank has been at the forefront in helping to develop and apply appropriate risk transfer mechanisms to cushion against natural disaster-related costs. Mechanisms under consideration typically involve some form of market-based insurance, entailing a large share of reinsurance in order to transfer risks to the international market. Various insurance methods might apply, including conventional catastrophe damage insurance and more innovative tools such as weather derivatives and catastrophe bonds.

48. In Bangladesh, it is useful to distinguish between localized hazards, which affect some part of the country annually, and more severe, less frequent disasters. Costs relating to the former are met (largely on an ad hoc basis) from the revenue budget. There is a strong case for more pre-assigned funds for this purpose. The World Bank has suggested establishing a disaster sinking fund on the revenue budget, financed from regular appropriations and external financing. Surplus funds in any particular year could be used to build up reserves.

49. In years of more severe disaster, resources beyond the means of GoB are required. Financial risk transfer mechanisms could potentially play a major role in helping manage costs and spread related expenditure over time. At present there is little use of even conventional catastrophe insurance by either the public or private sector. Total annual insurance premiums amount to an equivalent of only 61 US cents per capita and natural hazard cover, which is not included in basic fire and allied policies, is much less. However, significantly increased hazard insurance would require structural reform of the insurance industry in order to be viable. The industry is presently highly regulated and almost entirely domestically based. Furthermore, a full 50% of reinsurance has to be placed with the state-owned reinsurer. Flood or weather index-based insurance may present insuperable problems in Bangladesh because of the practical difficulties in defining appropriate trigger events and of determining entitlement to compensation. Initially at least, there may be more scope for insuring assets – agricultural machinery, commercial buildings etc. - in urban and rural areas.

50. A possibility, because of the moral hazard issue that has dogged all credit programmes, is to build some form of highly subsidised insurance element into formal, already subsidised lending. Micro-credit is a possible priority area for at least pilot schemes. If there were even a partial insurance element in the contract, this might encourage, when losses occur, an orderly response, based on an entitlement to refinancing, rather than a damaging disorderly collapse in recovery rates.

51. Insurance cover against losses in the event of disaster can only be developed and applied successfully if the GoB and people of Bangladesh are convinced of the merits. Thus far, additional external assistance appears to have been available to meet the costs of disasters. But this study has shown that ultimately, disaster related external assistance is very largely not additional but displaces funding for development.

Disaster Reduction: findings, policy options and research implications

52. Main Preliminary Findings and Policy Options

- ? Major disasters have had clearly demonstrable, negative macro-economic impacts on Bangladesh. The relative severity of the impacts has considerably diminished since the 1970's, largely due to structural change in the economy: agricultural output is more resilient; non-agricultural sectors are more important and less severely affected; and trade liberalisation and integration of food markets are reducing price effects.

- ? There have been improvements in disaster response by government, donors and civil society. However, some reorganisation of public finance reporting (e.g. on food operations) would help to clarify and perhaps improve budgetary practice.
- ? The 1998 floods were better handled than earlier disasters by GoB and NGOs, with substantial and timely foreign aid. Better assessments of losses helped.
- ? Aggregate public finance effects of disasters have been progressively contained. However, the response has largely involved reallocations of budgeted spending to relief – often cutting expenditure across the board without regard to effects on longer-term economic growth. Development projects funded through the ADP have been particularly affected.
- ? There is increasing recognition of the need to reflect policy objectives – such as poverty reduction – in the way strategies for disaster management and mitigation are developed.
- ? Investment planning and project prioritisation needs to be strengthened. Disaster mitigation ought to be part of project design. Increased expenditure on O&M could also be a cost effective means of reducing disaster impacts.
- ? Much foreign aid has involved reallocating and bringing forward commitments, rather than additional funding. There have been shifts from project aid to food and commodity aid, and concern that some donors have held to their own project priorities rather than have regard to wider implications.
- ? Newer forms of spreading the financial costs of disasters, including disaster earmarked contingency reserves and market based instruments for risk spreading, merit further consideration. Risk spreading could safeguard more public finance resources for development and also strengthen micro financing operations, which have a key role in the poverty reduction strategy.
- ? There is a need for better natural hazard risk assessment (including of earthquakes) and for strengthened regional co-operation.

53. Research Implications

- ? The consequences of the 1998 floods were much more closely examined than the floods a decade earlier and this helped to mitigate and manage the effects. There is a need for agreed and generally adopted guidelines covering post-disaster and mitigation assessments. This is a task for Bangladesh.
- ? Further economic research into natural disasters would be useful. The use of regression analysis to quantify short-term impacts of disaster shocks on national accounting aggregates could be extended to public finance and external assistance. It would also be useful to extend quantitative economic investigations to consider public expenditure and revenue implications of disaster shocks.
- ? The specific focus of future investigations of disaster impacts should be on the composition of public expenditure to identify key areas of capital and recurrent expenditure that need to be protected as well as areas where additional spending is needed to assist immediate crisis management, recovery and disaster mitigation.
- ? The full cost of disaster impacts should embrace public enterprises, agencies and public finance operations. Case studies would be needed to explore this area more fully because a useful composite analysis is not possible given the limited data available.
- ? A full inventory of aid from all external donors and agencies and of the ways they assist following disasters would be a useful contribution to the integration of disaster reduction into longer-term development strategy. The classification of types of aid also needs to be up-dated.
- ? Natural hazards are extremely complex. State-of-the-art scientific and technical advice is needed to make sense of many issues. A review of the adequacy of support for research on and monitoring of hazard vulnerability is desirable.

ANNEX C

CLIMATIC VARIABILITY, ECONOMIC PERFORMANCE AND THE USES OF CLIMATIC FORECASTING IN MALAWI AND SOUTHERN AFRICA

Introduction

1. This study, undertaken between November 2001 and July 2002, focuses on climatic variability and the usefulness of climatic information in southern Africa, including a country study of Malawi. This study area was chosen because of the reported progress in seasonal climatic forecasting, the attention given to the El Niño phenomenon, and concern about long term climatic change.

2. Malawi is a small, land-locked country in Southern Africa, with an estimated population in 2000 of 10.8 million. It is one of the poorest countries in Africa with around 65% of the population below the national poverty line and 28% in extreme poverty. Health and social indicators are also among the lowest in Africa. Infant mortality in 2000 was 134 per 1000, compared with an average of 92 for Sub-Saharan Africa, and average life expectancy (now 37 at birth) is declining as a result of HIV/AIDS, which in 1999 affected 16% of the adult population and 31% of women in ante-natal care. Adult literacy is under 60% and only 78% of children attend school. Agriculture accounted for some 40% of GDP in 2000 and its share of GDP has been increasing since the early 1990s with industrial stagnation and contraction of the public service sector. Some 89% of the economically active population is classified as rural. Malawi is heavily dependent on maize, which is the main food staple and in a normal year probably accounts for about three quarters of calorie consumption for Malawi's population. Export earnings are dominated by tobacco (61%), tea (9%) and sugar (8%). This dependence on rainfed crops makes Malawi very vulnerable to variations in rainfall and temperature as well as commodity price shocks.

Malawi's 2002 Food Crisis – How might better climatic forecasting have helped?

3. The 2002 food crisis in Malawi, which was emerging during the course of the study, highlights both the important potential gains that good climatic forecasting offers in terms of managing the risks associated with climatic variability; and also the problems which need to be overcome to develop and make full, effective use of meteorological monitoring and forecasting in the region. It provides a highly relevant starting point for examining the linkages and issues at the heart of the study.

4. The impetus for improving drought risk management at a regional level for Southern Africa – involving regional bodies, national governments and the international community – stemmed from the droughts of 1991/92 and 1994/95. By 1997/98, a formal process for consensus-based 'long-lead' or seasonal climatic forecasting had emerged, managed through the Southern African Climatic Outlook Forum (SARCOF). Within Malawi, the Department of Meteorological Services (DMS) was providing 10 day bulletins on rainfall, temperature and sunshine for the met stations under its control. However, despite this progress, the meteorological input into anticipating and assessing the scale of the emerging crisis seems to have been quite limited. SARCOF's forecasts were for above average rainfall in the region in 2000-01 and broadly average rainfall in 2001-02. Because the overriding concern in the region has traditionally focused on risks of drought, the potentially negative impacts of higher than average rainfall were not recognised. Policy decisions taken in Malawi were therefore predicated on a normal or favourable climatic outlook, and what turned out to be an over-optimistic view of the likely maize crop. In apparently favourable conditions, a poverty reduction scheme, which provided all small-scale subsistence farmers with a minimum package of seeds and fertiliser, was halved in order to reduce public expenditure. As a result, many farmers were unable to respond to the early onset of the main rains and this contributed to reduced

production. On the advice of the International Monetary Fund, and with World Bank agreement, Malawi sold two-thirds of its Strategic Grain Reserve, which in 2000 was at near capacity, to reduce its debt. The decision was taken prematurely, while planting was still underway and the maize crop was uncertain. In the event the crop yields were low, with dangerous consequences in terms of food security; and the Government had to make replacement purchases of grain which wiped out savings from the disposals.

5. The 2002 crisis is a result of many factors, of which climate is only one. But a better understanding of agro-meteorological relationships, reliable crop production data, and less generalised climatic forecasts to inform economic and food security decisions would undoubtedly have helped to avoid some of the extreme consequences of the low crop yields. There was apparently little understanding of how fragile society and the economy in Malawi had become. There was insufficient appreciation of the sensitivity of the maize and tobacco crop to weather *through* the season and the damaging effect of erratic rainfall levels. There was an over-concentration throughout the region on risks of drought, leading to “undue confidence” in the light of highly generalised forecasts of average or above average rainfall. There were financial and human resource constraints, which meant that data collected from the meteorological stations within Malawi was not analysed and interpreted to draw out the agro-meteorological linkages or permit the closer monitoring of weather on a local basis throughout the growing season. This more robust data monitoring is essential to assess and address the vulnerability of the important smallholder agricultural sector.

6. As the 2002 crisis demonstrates, there are major benefits to be derived from strengthening climatic forecasting regionally and at a country specific level. Using evidence up to the late 1990s, this study:

- ? Reassesses the economic consequences of climatic variability in the light of experience such as the El Niño event in 1997/98; and
- ? Takes stock of the current capacity of climatic forecasting and progress in research to review the range of potentially useful outcomes; and the institutional capacity and financing issues which arise if effective use is to be made of strengthened forecasting ability.

Climatic variability, agriculture and economic performance in Southern Africa

7. The droughts of 1991/2, 1994/95 and 1997/98 were all associated with the El Niño Southern Oscillation phenomenon (ENSO). Climatologists have established a highly significant relationship between ENSO and inter-annual variations in rainfall in Southern Africa. But it is not a simple canonical relationship: not every El Niño event brings low rainfall; and in some years extremely low annual rainfall is not clearly linked to El Niño events. Much less well-understood oceanic-atmospheric interactions in the Indian Ocean and Southern Atlantic are now recognised as important influences on rainfall patterns.

8. Cereal production, especially maize, is central to food security in Southern Africa. It is also highly sensitive to drought and climatic variation more generally. In a crisis, assuring maize supply is likely to take priority over other trade considerations and in public spending decisions. So it makes sense to look first at the impact of climate on cereal and maize production and how that in turn impacts on the economies of Southern Africa. South Africa is by far the largest agricultural producer in the region, accounting for 64% of cereals and 62% of maize production during 1993-98. Cereal production performance in South Africa and the rest of the region is correlated, generally moving in the same direction.

9. The relationship throughout the region between production volatility and climatic events is striking. But the pattern is more complex than that of drought caused by El Niño in turn resulting in low crop yields. Different sequences in drought impacts at country level – some ahead of ENSO linked droughts – are reflected in year- to-year changes in maize yields and agricultural GDP. In 1997/98 the risks associated with the very strong ENSO event led climatologists to forecast severe

drought in Southern Africa and very low crop yields. In fact, though regional crop yields were lower than normal, the rainfall associated with oceanic activity in the Indian Ocean resulted in more favourable conditions in countries in the north of the region, and crop yields were higher than had been anticipated by scientists using only El Niño based models. The conclusion we draw from this is that total rainfall is a better explanatory variable than El Niño in analysing crop yield variations. Obviously there are other important factors. Nevertheless, focusing on rainfall and output provides a better understanding of the consequences of climatic variability historically and in the future – with implications for food security and economic policy.

10. Drought has been commonly seen as the main climate issue in the region. However, the recent disastrous floods in Mozambique and the role which the extremely high rainfall in 2000/01 played in the lead up to the food crisis in 2002 have highlighted the risks associated with high rainfall. Plotting annual cereal and maize outputs against the south east African rainfall index suggests that outputs plateau at about 15% above the 1960-90 mean rainfall levels. Above that level there is increased probability of reduced production. A parallel analysis for Zimbabwe showed a similar pattern. However, in the case of Malawi, which is at the northern margin of the climatic region, there was no significant relationship between crop yields and either the regional rainfall index or ENSO variables. There was however a link between crop yield and country specific rainfall levels for the critical month of February rather than total annual rainfall. Our conclusion is that climatic forecasting and Early Warning Systems need to give more attention to potentially extremely high rainfall events; and that localised monitoring and agro-meteorological interpretation of data is needed to reflect the significant variations between and within countries in the region and inform critical decisions.

11. The wider economic impacts of droughts in the region largely reflects multiplier and linkage effects from the agricultural sector and are felt in the following year with a lag of 6 – 12 months.

Costs of climatic shocks

12. As is the case with most natural hazard risks, the livelihoods most affected when disaster strikes are those of the poorest in the population. The clearest impacts of drought are on cereals – especially production and trade in maize. The most extreme 1991/92 drought reduced maize production by 10 million tonnes and cost US\$ 1 billion in cereal losses at import parity prices and US\$ 500 million in actual logistical costs of importing cereal into affected Southern African countries. There were also severe wider GDP and agricultural sector impacts over 12 months of at least double this magnitude. The climatically less severe 1994/95 drought involved costs of US\$1 billion in cereal losses because of higher prices in a tighter international cereal market. The 1997/98 El Niño event also caused significant but less serious losses. The impacts of the 2002 crisis are beyond the scope of the study but as El Niño develops again, emergency cereal import costs have already exceeded losses in 1997/98. Costs of this scale require action at national, regional and international levels to prepare an economic strategy and to discuss aid policy. The value of climatic forecasting lies in offering early evidence of enhanced risk of a major shock, and in anticipating the costs and the scale of measures that may be needed at the national and regional level.

Climatic variability and the Malawi Economy

13. Periods of below average or erratic rainfall were less extreme and less general in their impacts in the 1970s and 1980s than in the 1990s. The droughts of 1991/92 and 1993/94 impacted very severely on agriculture in Malawi, particularly the smallholder sector, which accounts for the major part of maize production. Maize production declined by around 60% in 1991/92 to the equivalent of only 45% of average production levels for the previous five years. High and well distributed rainfall, combined with policies to assist smallholders, resulted in a bumper maize crop and record tobacco crop in 1992/93. In order to avoid the producer disincentives, which might result from these very high yields, Malawi's Agricultural Development and Marketing Corporation (ADMARC) made record purchases (over 375,000) tonnes of maize, adding to financial pressures on the government.

But in 1993/94, following low and erratic rainfall in key growing areas, maize production again fell sharply. In 1994/95 while South Africa and Zimbabwe were affected by lower and poorly distributed rainfall, Malawian agriculture largely recovered. These zonal differences in the pattern and timing of drought impacts during 1994 and 1995 highlight important climatic variations within the country as well as regionally. Most recently in 2000/01, maize production fell by 30% and tobacco was down 16%, following exceptionally high rainfall and widespread flooding.

14. The wider economic consequences of a drought in a Sub-Saharan economy such as Malawi include direct impacts on agriculture and on other productive sectors reliant on water, such as hydro-electricity; and indirect multiplier relationships. The overall pattern of drought impacts on public finances in Malawi has been broadly consistent with standard expected patterns. Drought severely reduced agricultural production towards the end of one financial year, with financial effects in terms of relief and recovery assistance following in the next financial year. Flawed or problematic data has made it difficult to undertake in-depth sector or wider economic analysis of the effects of climatic shocks or to isolate the effects of drought. Nevertheless the evidence suggests that Malawi's economy was among the most sensitive to drought shocks of any in the region.

15. Prior to the 1991/92 drought, there were signs of improvement in Malawi's economy with export revenue rising and public expenditure falling. However, in 1991 the combined effect of the refugee and trade impacts of the Mozambique conflict; increasing political difficulties within Malawi which temporarily halted non-relief development aid; and the extreme drought in 1991/92 resulted in a near chaotic budgeting situation. Public expenditure rose by 30% in real terms between 1991/92 and 1994/95, and the rate of inflation rose from 12.5% in 1990/91 to 75% in 1994/95. Fiscal measures combined with better agricultural performance led to a temporary stabilisation in 1995/96 and 1996/97. However, public finances in Malawi have continued to be very volatile. Upward pressures on expenditure have intensified in recent years. Foreign aid levels, on which development funding depends, have been influenced by political and governance issues as well as economic and humanitarian considerations, and this has also been a factor in Malawi's relatively unstable public finances.

Understanding Climatic Variability in Southern Africa and the Links to Wider Climatic Processes

16. At a general level, the effects of destabilizing climatic hazards are increasingly understood and increasingly predictable. However, there are still important gaps in our knowledge. The study has examined climate variability and links to wider global processes in the light of recent research and events in the study area.

17. In the predominately semi-arid Southern African region, rainfall varies significantly from year to year, with a pronounced seasonal cycle. The rainy season generally extends from October/November to April, reaching a peak between December and February. Rainfall distribution during the rainfall season is also variable, depending on the interplay between tropical and mid latitude weather systems and convective variability. As a result of increased temperatures and higher water evaporation rates, future global climate change is likely to alter short-term climate variability and to change rainfall patterns, reducing water availability. The peak of the wet season is likely to increase, but with offsetting decreases in the drier months. Both droughts and floods may become more likely, but there is greater uncertainty.

18. Fluctuations in seasonal rains are linked to regional sea surface temperatures and the global ENSO phenomenon. The links between ENSO and regional weather system are robust and relatively well understood. Models can predict ENSO up to a year in advance; and using ENSO, useful predictions of southern African rainfall can be made at lead times of up to five months. During El Niño events south-eastern Africa (SEA) is likely to experience a 50-60mm shift towards drier conditions. During La Niña, models show above normal rainfall in SEA for all rainy season months except February. By contrast, equatorial east Africa (EEA) is likely to experience relatively wetter

periods during El Niño events, and relatively drier phases associated with La Niña events. The severity of the impacts depends on different types of El Niño pattern. Climate zones, of course, do not follow national boundaries: Malawi lies between the core zones of SEA and EEA, indicating the difficulties of climate forecasting in Malawi. Moreover, it is changes in distribution of rain during the wet season associated with El Niño events rather than total rainfall amounts which are crucial to understanding agriculture impacts. These changes are complex and difficult to predict, limiting the precision which forecasts can provide.

19. Of course, ENSO is not the only factor affecting rainfall in Southern Africa. Regional sea surface temperatures (SST) and topography are also important. Predictions of Indian and Pacific Oceans (SST) are used to produce seasonal forecasts for South Africa; and the South Atlantic also helps shape atmospheric circulation. Despite advances in forecasting capability, for some areas of Southern Africa predictability or the 'skill' of the forecast may still be relatively low.. Certainly, there are complex relationships which go beyond the influence of El Niño and which need to be taken into account in reviewing the potential and actual roles of climatic forecasting.

20. As has already been noted, drought has been seen as the main climatic hazard. This is reflected in the importance accorded to drought management in macro-economic policy and in the institutional arrangements for disaster management. More recent events (including the 2002 food crisis in Malawi) have highlighted other important climate risks:

- ? Erratic rainfall, particularly an extended halt in rains at the critical flowering time, can considerably reduce crop yields, even if total annual or seasonal rainfall is at or near normal. Food security implications are particularly serious if there is excessive dependence on a single crop, such as maize. Further investigation is needed into the extent and frequency of the phenomenon of mid-seasonal dry spells. With increasing cultivation of marginal lands, a useful climate forecasting product would be a probability assessment of the likelihood of an erratic rainfall pattern, with the risk of extended dry periods. Are extended dry periods at critical points in the growing season closely linked to below average overall rainfall, or are there other influences on the short-term distribution of rainfall?
- ? Extremely high rainfall can also reduce crop yields, either through flooding or perhaps reduced solar radiation levels as a result of extended and denser cloud cover. Cloud cover is not regularly monitored in terrestrial meteorology, so this effect can only be confirmed by correlating remote sensing and agronomic data. Excessive rainfall will also disrupt infrastructure and communications, with associated costs.
- ? The emphasis on drought risks is understandable, given the devastating effect of drought. But it has led, for example, to a perhaps over simplified concentration on and interpretation of the impact of El Niño events on Southern Africa's climate, and an assumption that if drought is not in prospect then the agricultural season will be good. It may also be that the water management strategy was so focused on building up capacity to ensure adequate flows in the dry season, that when emergency releases from overfull reservoirs were needed in 2000 these exacerbated downstream flooding in Mozambique.
- ? Households and the national food system are operating within increasingly narrow margins, because of socio-economic pressures – demography, the HIV/AIDS pandemic and economic adjustment. These systems are potentially more fragile and sensitive to erratic intra-seasonal distribution of rainfall, which is difficult to predict.

21. In summary, drought remains the most likely source of food crisis and climate related economic shock. Nevertheless, it is now clearer that the food system, the livelihoods of the poor majority of the largely rural population, and the wider economy are more generally sensitive to any destabilising climate risks. In these circumstances, the value of well-resourced and well co-ordinated work to improve our understanding of the evolving weather situation and climate forecasting capacity for the region is clear.

Climatic Forecasting

22. There has been considerable progress towards better integration and strengthening of meteorological systems within the South African Development Community (SADC). The South African Regional Climatic Outlook Forum (SARCOF) now provides a formal process for consensus based 'long-lead' or seasonal climatic forecasting. The SARCOF forecasts rely heavily on forecasts from global statistical models, reflecting partly the behaviour of ENSO, with additional details from national meteorological services. They are made seasonally, in September for October to December and for January to March, with the January to March forecast re-assessed in December. SARCOF provides forecasts in three broad probability bands for below normal, near normal and above normal total rainfall for the relevant periods; and forecasts are shown for spatial zones with similar rainfall response.

23. The precision of SARCOF forecasts is still very limited, with probabilities more difficult to assign for zones further away from the core areas of south-eastern Africa. For example, in the 2001/02 forecasts, the assigned probabilities varied from 20-60%, with around 40-50% probability for the most likely outcome band. The forecasts are difficult to downscale and imprecise about the risks of erratic rainfall patterns that are critical to crop performance. Implicitly the focus of attention has continued to be on the risk of major drought. On the other hand, the greater attention now paid to forecasting and monitoring weather through the season ensures that scientific data on a ten daily basis is more rapidly available to inform assessment and decisions. Global climatic developments are also closely watched and assessments quickly disseminated through the internet. A real problem is that decision-makers would like very clear predictions – this climatic event will lead to this pattern of weather in the coming months – particularly when food security depends on good crop growing conditions. The reality is that the complexity of weather patterns and impacts mean that forecasts often have to reflect a lack of certainty. For example in 2002, forecasters may identify a high probability of a relatively weak El Niño event towards the end of the year, but there is great uncertainty about what this may mean for the 2002/03 wet season. In effect, the models are saying that decisions about an already difficult food security situation have to be taken in circumstances of more than usual uncertainty.

24. It is difficult to place a robust value on climatic forecasting. However, qualitatively, its usefulness is clear. Climatic forecasting work has:

- ? Provided a scientific consensus process;
- ? Integrated and strengthened meteorological systems in the region;
- ? Provided systems for assessing climatic risk that can feed into decision making processes;
- ? Established systems for closer monitoring and reporting of weather through the year;
- ? Identified priorities for further research to improve forecasting ability.

25. The study has not assembled a complete costing for forecasting work. The financial costs attributable to the whole forecasting effort for Southern Africa are around US\$ 5 million, spread across services and research institutions inside and outside the region. These costs are modest compared with the economic costs imposed by climatic variability in the region, which are estimated to be at least US\$ 1 billion a year. Regional climatic forecasting needs to be sustained as a learning process. Long-lead forecasting is still in its infancy, and climatic research is making rapid progress – for example, towards including oceanic influences of the Indian Ocean and South Atlantic into forecasting models. Importantly, the benefits are not confined to the region. The private sector, the international community of donors and financial institutions are all involved in managing the effects of climatic variability.

26. The ultimate test of the usefulness of information is whether and how it is used and with what results. A survey of potential and actual users of forecasts, undertaken as part of the study, has confirmed the value of forecasts. Foremost, country-specific forecasts can alert international and national agencies and NGOs to the need for precautionary measures to safeguard food security and

water supplies, and to reduce the cost of potentially financially destabilising crisis measures. But the survey also highlighted problems which at present limit the value of forecasts. For example: the spatial scale is often not detailed enough; there is insufficient detail about the distribution of rainfall within the wet season; information about the start and end of the rains is needed; there needs to be sufficient time to respond to forecasts; and users would like more information about the accuracy of past forecasts. Presently only some commercial farmers are able to respond to more specific seasonal forecasts. Smallholders lack the technical options and resources to modify significantly their choice of crop, seed variety or traditional planting practices. The use being made of climatic forecasting is promising, but it still needs considerable institutional strengthening, technical capacity building, more systematic application of current scientific knowledge and investment in data and equipment.

Conclusions and Recommendations

A. Climatic Variability, Agriculture and Economic Performance

- ? ***Agriculture and the economies of Southern Africa are highly sensitive to climatic variability*** – The 2002 food crisis has underscored the vulnerability of the region, and especially the rural poor, to food insecurity resulting directly from climate instability and shocks.
- ? ***The Southern African region's agricultural economy is more sensitive to climatic variability than previously appreciated*** – The intense impact of droughts between 1981/82 and the mid 1990s led to a too narrow preoccupation with drought rather than the broader problem of climatic variability. Agricultural performance is also sensitive to rainfall 25% or more above average, and to intra-seasonal variations in the distribution of rain. The region is likely to perform best only with annual rainfall within a 90% - 120% band of long term mean total rainfall. High rainfall as well as drought should signal the need for increased concern about regional food security.
- ? ***El Niño and La Niña are both important influences*** – Increased risk of an extreme El Niño event should put the region on the alert against a possible drought and related food crisis, particularly in countries near the core of the south east African climatic region. However, El Niño events alone are not a good predictor of agricultural performance. The floods and poorer agricultural year 2000/01 were associated with a La Niña event. Countries to the north of the region are more sensitive to erratic intra-seasonal rainfall distribution than to relatively rare low rainfall or drought years. Climatic variability at country and sub-regional level needs closer monitoring.
- ? ***Southern African agriculture is becoming more sensitive to climatic shocks*** - There is evidence of increasing volatility in agricultural indicators such as maize yields and macro-economic performance. Factors contributing to this fragility include:
 - Non sustainable agricultural practice: stagnation in cereal production due to failure to follow cropping patterns that sustain soil nutrient levels and increased fertilizer applications to compensate for the effects of intensified land use and environmental degradation.
 - Structural change in agriculture. A shift in production to smallholders has not been accompanied by sufficiently successful attempts to establish a viable credit system, support in providing seeds etc and a supportive marketing structure for smaller producers.
 - Institutional weaknesses, which constrain smallholder agriculture and contribute to food insecurity and malnutrition.
 - Political instability, which has affected countries in the region.
 - The fact that foreign aid has been influenced by political and governance issues as well as directly economic and humanitarian needs.
 - The effects of HIV/AIDS on human resources, which are insidious but so far largely unquantified.

- ? ***Climatic change*** - Although there is as yet no conclusive evidence that the region is becoming drier or suffering more frequent extreme climatic events, both are anticipated as consequences of global climate change. A fuller understanding of the environmental and socio-economic consequences of variability is needed in order to isolate the forms of climate change and their implications.

B. Climatic Forecasting

- ? ***There is an urgent need to reduce vulnerability to climate variability and the threat posed by climate change*** – Critical to achieving this is improving the information on which decisions at all levels are made, from smallholder to national and international bodies. What has been achieved? What is still to be done? How worthwhile are such efforts? Should climatic forecasting be a priority for international aid and the use of scarce human resources within Southern Africa?
 - o Efforts have continued to improve regional forecasting and provide better frameworks for disseminating information.
 - o The costs of forecasting (presently estimated at around US\$ 5 million for long term forecasting for Southern Africa) are modest compared with the very high economic losses caused by climatic variability. Even a small reduction in losses through improvements to public decisions and private risk management justifies investment in strengthening forecasting.
 - o There is no doubting the usefulness of forecasting (see paragraph 24). At the same time there is some disappointment about what has been achieved so far. First, because the discovery of El Niño effects created unrealistic expectations about the power and precision of forecasting. Secondly, the full extent of increasing sensitivity of the region's agricultural economy to variability in general rather than just drought had not been appreciated. And thirdly, while users can see the value of forecasting, their ability to respond is often limited.

C. Increasing the usefulness of climatic forecasting information

- ? Forecasting needs to be focused on climatic variability more broadly. This requires more research, downscaled to zonal levels and intra-seasonal timescales.
- ? More specific information on the evolving weather situation would be of use to specific groups such as water system managers, commercial farmers and the public institutions and NGOs working with small farmers.
- ? Greater agronomic - meteorological collaboration is needed to help national and international institutions make more effective use of forecast information in their decisions, including decisions on food security and agricultural support.
- ? More rapid reporting of variability would help secure more rapid responses to an evolving situation.
- ? More systematic research is needed into the relationship between erratic rainfall, and also very high rainfall and crop performance.

D. Information and Public Action

- ? ***Weaknesses in statistical data*** – meteorological, agricultural and economic – have hampered this study. These deficiencies have become more serious during an extended period of near budgetary chaos in Malawi and underfunding of statistical and scientific information systems. The HIV/AIDS epidemic may also be eroding the human resources needed for this work. Poor quality information has been an important contributory factor to the 2002 food crisis in Malawi and perhaps more generally in Southern Africa.
 - ? ***Good quality, trustworthy data is a necessary condition for effective natural disaster risk management and all areas of public action.*** Strengthening and sustaining information systems as a public good in low-income countries has to be an international priority.
 - ? As soon as there is evidence of an enhanced risk of an extreme event, the international community as well as SADC countries need to use the available information to prepare for aid policy discussions and to develop economic strategies for the countries involved. Experience of the 1991/92 drought led to greater efforts to ensure food security, assess the need for humanitarian aid and prepare for wider economic and financial consequences. However, as the 2002 crisis has again demonstrated, ***there is much to be done to make better use of climate information in public policy at country, regional and international levels.***
-

REFERENCES

- Aghion, P. and P. Howitt. 1998. *Endogenous growth theory*. Cambridge, Mass: MIT Press.
- Ahmed, N. and others. 2000. 'History of public food interventions in Bangladesh'. In Raisuddin. Ahmed and others (ed.). *Out of the shadow of famine: evolving food markets and food policy in Bangladesh*. Baltimore: Johns Hopkins U.P.
- Albala-Bertrand, J. M. 1993. *The political economy of large natural disasters with special reference to developing countries*. Oxford: Clarendon Press.
- Alexander, David. 1997. 'The study of natural disasters, 1977–1997'. *Disasters* Vol 21 (4) pp284-304.
- ALNAP. 2002. *Annual review 2002. Humanitarian action: improving performance through improved learning*. London: Active Learning Network for Accountability and Performance in Humanitarian Action, Overseas Development Institute.
- Anderson, Mary B. 1991. 'Which costs more: prevention or recovery?'. In A. Kreimer and M. Munasinghe, *Managing natural disasters and the environment: selected materials from the Colloquium on the Environment and Natural Disasters Management*. Washington, D.C. : World Bank.
- /Apthorpe, Raymond. 1984. 'Agriculture and strategies: the language of development policy'. In Edward J. Clay and Bernard Schaffer (ed.) *Room for manoeuvre*. London: Heine mann.
- Aspinall, William P. and others. 2002. 'Evidence-based volcanology: applications to eruption crises'. *Draft*.
- Atkins, J. P., S. Mazzi and C. D. Easter. 2000. 'A Commonwealth vulnerability index for developing countries: the position of small states'. *Commonwealth Economic Paper Series 40*. London: Commonwealth Secretariat.
- Benson, C. 1994. 'Book review of *Political economy of large natural disasters with special reference to developing countries* by J.M. Albala-Bertrand'. *Disasters* 18 (4) pp383-386.
- Benson, C. 1997a. 'The economic impacts of natural disasters in Fiji'. *ODI Working Paper No. 97*. London: Overseas Development Institute.
- Benson, C. 1997b. 'The economic impacts of natural disasters in Viet Nam'. *ODI Working Paper No. 98*. London: Overseas Development Institute.
- Benson, C. 1997c. 'The economic impacts of natural disasters in the Philippines'. *ODI Working Paper No. 99*. London: Overseas Development Institute.
- Benson, C. 1998. 'Drought and the Zimbabwe economy, 1980-93'. In Helen O'Neill and John Toye (ed.). *A world without famine?* London: MacMillan.
- Benson, C. 2003. 'Macroeconomic concepts of vulnerability: dynamics, complexity and public policy'. In G. Bankoff, G. Frerks and T. Hilhorst (ed.). *Mapping vulnerability: disasters, development and people*. London: Earthscan.
- Benson, C. (forthcoming). 'The economy-wide impact of natural disasters in developing countries'. London School of Economics. *Draft doctoral thesis*.
- Benson, C and Edward J. Clay. 1998. 'The impact of drought on Sub-Saharan African economies: a preliminary examination'. *World Bank Technical Paper 401*. Washington, D.C. : World Bank.
- Benson, C. and Edward J. Clay. 2000. 'Developing countries and the economic impacts of natural disasters'. In A. Kreimer and M. Arnold (ed.) *Managing disaster risk in emerging economies*. Disaster Risk Management Series 2. Washington, D.C.: World Bank. pp11-21.

- Benson, C. and Edward J. Clay. 2001. 'Dominica: natural disasters and economic development in a small island state.' *Disaster Risk Management Working Paper Series No. 2*. Washington, D.C.: World Bank <http://www.proventionconsortium.org/files/dominica.pdf>
- Benson, C. and Edward J. Clay. 2002a. 'Bangladesh: disasters and public finance.' *Disaster Risk Management Working Paper Series No.5*. Washington, D.C.: World Bank. <http://www.proventionconsortium.org/files/Bangladesh.pdf>
- Benson, C. and Edward J. Clay. 2002b. 'Disasters, vulnerability and the global economy'. Paper prepared for ProVention/World Bank conference on *The Future Disaster Risk: Building Safer Cities*, Washington, D.C., December 4-6, 2002.
- Briguglio, L. 1995. 'Small island developing states and their economic vulnerabilities'. *World Development* 23(9) pp1615-1632.
- Brown, W. and C. Churchill. 1999. *Providing insurance to low-income households. Part I: a primer on insurance principles and products*. Calmeadow: Microenterprise Best Practices.
- Catling, H. David. 1994. *Rice in deep water*. London: Macmillan.
- Chapman, Graham P. and Kalyan Rudra. 2002. 'Society and water: Bengal's millennium flood.' Dept. of Geography, Lancaster University, Lancaster, UK and Dept. of Geography, Habra S.C. College of Commerce, West Bengal, India.
- Charvériat, Celine. 2000. 'Natural disasters in Latin America and the Caribbean: an overview of risk.' *Research Department Working Paper 434*. Washington, D.C.: Inter-American Development Bank.
- Clay, Edward J. 1985. 'Floods in Bangladesh 1974 and 1984: from famine to food crisis management'. *Food Policy* 10 (3).
- Clay, Edward J. and others. 1995. 'Evaluation of ODA's response to the 1991-1992 Southern African drought.'. *Evaluation Report, EV 568*. London: Overseas Development Administration.
- Clay, Edward J and others. 1999. 'An evaluation of HMG's response to the Montserrat volcanic emergency'. 2 Vols. *Evaluation Report EV635*. London: Department for International Development.
- Clay, Edward J., Louise Bohn, Enrique Blanco de Armas, Singand Kabambe and Hardwick Tchale. 2003. 'Malawi and Southern Africa: climatic variability, economic performance.' *Disaster Risk Management Working Paper Series 7*. Washington, D.C.: World Bank. http://www.proventionconsortium.org/files/malawi_full_doc.pdf
- Cochrane, H. No date. 'Disasters, indebtedness and faltering economic growth'. Boulder: Hazards Assessment Laboratory, Colorado State University. *Draft*.
- Cornes, Richard and Todd Sandler. 1996. *The theory of externalities, public goods and club goods*. 2nd ed. Cambridge: Cambridge University Press.
- del Ninno, C, P A Dorosh, L C Smith, and D K Roy. 2001. 'The 1998 floods in Bangladesh: disaster impacts, household coping strategies, and response'. *IFPRI Research Report 123*. Washington, D.C.: International Food Policy Research Institute.
- Denison, E F. 1967. *Why economic growth rates differ: postwar experience in nine Western countries*. Washington, D.C.: Brookings Institution.
- Devereux, Stephen, Kay Sharp and Yared Amare. 2002. 'Destitution in the North-eastern Highlands (Amhara Region)'. Interim Report for discussion at policy consultation workshops in Bahr Dar and Addis Ababa, November, 2002. Brighton: Institute of Development Studies and Addis Ababa: SC-UK.

- Devereux, Stephen. 2002. 'The Malawi famine of 2002: causes, consequences and policy lessons.' Brighton: Institute of Development Studies.
- Diamond, Jared. 1998. *Guns, germs and steel: as short history of everybody for the last 13,000 Years*. London: Vintage.
- Drèze, Jean and Amartya Sen. 1989. *The political economy of hunger*. Oxford: Clarendon Press.
- EC. 1993. *The Courier*. No 139, May-June. Brussels: European Commission.
- ECLAC/IADB. 2000. 'A matter of development: how to reduce vulnerability in the face of natural disasters'. Paper prepared for seminar on *Confronting natural disasters: a matter of development*, New Orleans, 25-26 March, 2000. Mexico City and Washington, D.C.: Economic Commission for Latin America and the Caribbean and Inter-American Development Bank.
- ECLAC/IDNDR. 1999. *Manual for estimating the socio-economic effects of natural disasters*. Mexico: Economic Commission for Latin America and the Caribbean, and Geneva: (United Nations) International Decade for Natural Disaster Reduction. [www/proventionconsortium.org/toolkit.htm](http://www.proventionconsortium.org/toolkit.htm).
- Ernst and Young. 1991. 'Booming and busting'. In *Economic Forecast*. Australia: Asia-Pacific Economics Group.
- Ferroni, Marco and Ashoka Mody, (ed). 2002. *International public goods: incentives, measurement, and financing*. London: Kluwer Academic Publishers/World Bank.
- Fischer, Gunther, Mahendra Shah and Harrij Van Velthuisen. 2002. *Climate change and agricultural vulnerability*. Laxenburg: International Institute for Applied Systems Analysis.
- Fischer, S and W Easterly. 1990. 'The economics of the government budget constraint'. *The World Bank Research Observer* 5(2) pp127-42.
- Foster, M and Adrian Fozzard. 2000. 'Aid and public expenditure: a guide'. *ODI Working Paper* 141. London: Centre for Aid and Public Expenditure, Overseas Development Institute.
- Fozzard, Adrian, M. Holmes, J. Klugman and K. Withers. 2001. 'Public spending for poverty reduction'. *Poverty Reduction Strategy Program. Draft*. www.worldbank.org/poverty/strategies/sourctoc.htm.
- Freeman, Paul K., L. A. Martin, R. Mechler and K. Warner. 2002. 'Catastrophes and development: integrating natural catastrophes into development planning'. *Disaster Risk Management Working Paper Series No. 4*. Washington, D.C.: World Bank.
- Freeman, Paul K., L. A. Martin, J. Linneroot-Bayer and K. Warner. 2003. 'National systems for the comprehensive management of disaster risk financial strategies for natural disaster reconstruction'. Prepared for the 1st and 2nd meetings of the Natural Disasters Network, March 6 – 7, 2003. Washington, D.C.: Inter-American Development Bank.
- Froot, K.A. 1999. 'Introduction'. In K.A. Froot (ed.). *The financing of catastrophe risk*. Chicago: University of Chicago Press.
- Gallup, J L and J D Sachs. 1999. 'Geography and economic development'. *Consulting assistance on Economic Reform II Discussion Papers* 39. Cambridge, Mass: Harvard Institute for International Development.
- Gilbert, Roy and Alicia Kreimer. 1999. 'Learning from the World Bank's Experience of Natural Disaster Related Assistance'. *Urban and Local Government Working Paper Series 2*. Washington, D.C.: World Bank, May.
- GoB. 1999. *Annual Budget 1999-2000 – Budget Speech: Part I*. Presented by Shah M. S. Kibria, Finance Minister, on June 10, 1999. Dhaka: Ministry of Finance, Government of Bangladesh.

- GoB. 2000. *Memorandum for Bangladesh Development Forum 2000-2001*. Dhaka: Economic Relations Division, Ministry of Finance and Planning Commission, Ministry of Planning, Government of Bangladesh.
- GoB. 2002. *Bangladesh: a National Strategy for Economic Growth and Poverty Reduction*. Dhaka: Economic Relations Division, Ministry of Finance, Government of Bangladesh.
- GoCD. 1998. *Dominica: medium-term economic strategy paper*. Roseau: Government of the Commonwealth of Dominica.
- GoCD. 2000. *Dominica: medium term strategy 2000-2002*. Roseau: Government of the Commonwealth of Dominica.
- Government of Malawi. 2001. 'Malawi poverty reduction strategy paper.' Lilongwe. *Draft*.
- Haacker, Marcus. 2002. 'The economic consequences of HIV/AIDS in Southern Africa.' *IMF Working Paper* No 02/30. Washington, D.C.: International Monetary Fund.
- Handmer, J and P Thompson. 1997. 'Economic assessment of disaster mitigation: a summary guide'. *Resource and Environmental Studies* 13. Canberra: Centre for Resource and Environmental Studies, Australian National University.
- Harriss, John. 2002. 'The case for cross-disciplinary approaches in international development'. *World Development* 30 (3) pp487-496.
- Hicks, Deborah. 1993. 'An evaluation of the Zimbabwe Drought Relief Programme 1992/1993: the roles of household level response and decentralized decision making'. Harare: World Food Programme.
- Hossain Mahabub, Manik Lal Bose and Alamgir Chowdhury . 2001. 'Changes in agriculture and economy in the flood-prone environment in Bangladesh, 1988-2000: insights from a repeat survey of 16 villages'. *Joint IRRI-BRRI Workshop on Flood-Prone Environments*. Los Banos: International Rice Research Institute.
- Hulme, Mike and others. 2001. 'African climate change: 1900-2100.' *Climate Research* 17 pp145-168.
- IADB. 2001. 'Preparatory group meeting on natural disasters: disaster prevention and risk reduction' *Working Paper of Working Group on Financing, Inter-American Committee on Natural Disaster Reduction*. Washington, D.C.; Inter-American Development Bank.
- IDC. 2003. 'The humanitarian crisis in Southern Africa'. House of Commons, Session 2002-3, 3rd Report, together with the Proceedings of the International Development Committee, Evidence and Appendices. London, 4 March..
- IFRC. 1999. *World disasters report 1999*. Geneva: International Federation of the Red Cross and Red Crescent Societies.
- IFRC. 2002. *World disasters report 2002*. Geneva: International Federation of the Red Cross and Red Crescent Societies.
- IPCC. 2001. *Climate change 2001 – Synthesis Report*. Cambridge: Cambridge University Press for the Intergovernmental Panel on Climate Change.
- Islam, Nurul. 1997. *Development planning in Bangladesh: a study in political economy*. London: Hurst.
- Jovel, J R. 1989. 'Natural disasters and their economic and social impact'. *CEPAL Review* 38 (August) pp133-145.
- Kanbur, Ravi, Todd Sandler and Kevin Morrison. 1999. 'The future of development assistance: common pools and international public goods.' *Policy Essay No. 25*. Washington, D.C.: Overseas Development Council.

- Kaul, I., I. Grunberg and N. Stern. (ed.) 1999. *Global public goods: international cooperation in the 21st century*. Oxford and New York: Oxford University Press.
- Kelly, Charles. and M.H. Khan Chowdhury. 2002. 'Poverty, disasters and the environment in Bangladesh: a quantitative and qualitative assessment of causal linkages.' *Bangladesh Issues Paper*. Dhaka: Department for International Development, UK
- Khan, A. R. and M. Hossain. 1989. *The strategy of development in Bangladesh*. Basingstoke and London: Macmillan.
- Klugman, J. 2002. 'Overview'. In World Bank. *Poverty reduction strategy handbook. Volume 1 – Core techniques and cross-cutting issues*. Washington, D.C.: World Bank.
- MacKellar, L., Paul Freeman and T Ermolieva. 1999. 'Estimating natural catastrophic risk exposure and the benefits of risk transfer in developing countries'. Laxenburg: International Institute for Applied Systems Analysis.
- Munich Re. 2002. *Topics annual review: natural catastrophes 2002*. Munich. www.munichre.com/pdf/topics.
- OAS. 1996. *Insurance, reinsurance and catastrophe protection in the Caribbean*. Working paper prepared in collaboration with the World Bank by A. F. Evans and others. Washington, D.C: Caribbean Disaster Mitigation Project, Organization of American States.
- Pantelic, J. and others. 2000. 'Promoting community-based disaster mitigation in Bangladesh'. Washington D.C.: Disaster Management Facility, World Bank. *Draft*
- Philippine NLUC. 1992. *National Physical Framework Plan, 1993-2022*. Manila: National Land Use Committee, National Economic and Development Authority.
- Quah, D. 1993. 'Empirical cross-section dynamics in economic growth'. *European Economic Review* 37 pp426-434.
- Rahman, A. and others. 2000. *The budget and the poor*. Study commissioned by IDPAA, Proshika and conducted by Shamunnay. Dhaka: University Press.
- Rahman, M. 2000. 'Performance of the external sector in FY2000: growth dynamics and emergent concerns'. Paper presented at two-day dialogue on *State of the Economy and Governance: Budget Responses 2000*, Dhaka, June 17-18, 2000. Dhaka: Centre for Policy Dialogue.
- Royal Society. 1992. *Risk: Analysis, Perception and Management*. London.
- Sandler, Todd. 2002. 'Financing international public goods' In Marco Ferroni and Ashoka Mody (ed). *International public goods: incentives, measurement, and financing*. London: Kluwer Academic Publishers/World Bank.
- Sobhan, R. (ed.) 1998. *Crisis in governance: a review of Bangladesh's development 1997*. Dhaka: Centre for Policy Dialogue & University Press.
- Solow, R. M. 1956. 'A contribution to the theory of economic growth'. *Quarterly Journal of Economics* 70 pp65-94.
- SRU. 2000. *Volcano hazard report for Southern Dominica: interpretation of 1998-2000 earthquakes and hazard mapping results*. Trinidad: Seismic Research Unit, University of the West Indies.
- Stewart, Frances, V. FitzGerland and Associates. 2001. *War and underdevelopment – Volume I: The economic and social consequences of conflict*. Oxford: Oxford University Press.

Swiss Reinsurance Company. 1999. *Alternative risk transfer (ART) for corporations: a passing fashion or risk management for the 21st century?* Zurich.

Te Velde, Dirk Willem, O. Morrissey and A. Hewitt. 2002. 'Allocating aid to international public goods.' In Marco Ferroni and Ashoka Mody, (ed). *International public goods: incentives, measurement, and financing*. London: Kluwer Academic Publishers/World Bank.

Thomson, Anne. 1994. 'The impact of drought on government expenditure in Namibia in 1992/93'. *Mimeo*. London: Overseas Development Institute.

Thomson, Anne, Penny Jenden and Edward J. Clay. 1998a. 'Information, risk and disaster preparedness: responses to the 1997 El Niño event'. *DFID, ESCOR Research Report* No AG1215. London: SOS Sahel.

UNDP. 1999. *Disaster Reduction and Recovery Programme: Progress Report and Plan of Action*. Geneva: Disaster Reduction and Recovery Programme, United Nations Development Programme.

UNISDR. 2002. 'Natural disasters and sustainable development: understanding the links between development, environment and natural disasters'. *Background Paper 5*. Geneva: United Nations International Strategy for Disaster Reduction.

Vermeiren, Jan, Steven Stichter and Alwyn T. Wason. [1999]. *Costs and benefits of hazard mitigation for building and infrastructure development: a case study in small island developing states*. Washington, D.C.: Caribbean Disaster Mitigation Project, Organization of American States.

World Bank. 1989. 'Bangladesh: PER – Public resource management during the fourth Five-Year Plan, FY91-95'. *Report no. 7545-BD*. Asia Country Department I, Washington, D.C.

World Bank. 1996. 'Bangladesh public expenditure review.' *Report no 15905-BD*. Country Operations Division, Country Department 1, South Asia Department, Washington, D.C.

World Bank. 1998. *OECS Financial sector review. Report no. 17554-LAC*. Washington, D.C. : Finance, Private Sector and Infrastructure Unit, Caribbean Country Management Unit, Latin America and the

World Bank. 2000. 'Managing catastrophic risks using alternative risk financing and insurance pooling mechanisms'. *Discussion draft*. Washington, D.C.: Finance, Private Sector and Infrastructure Department, Caribbean Country

World Bank. 2001. 'Global development finance: building effective coalitions for effective development finance'. Washington, D.C.: Management Unit, Latin America and Caribbean Region.

World Bank. 2002. 'An evaluation of the applicability of risk transfer and funding mechanisms for natural disaster losses – Concept Paper'. Washington, D.C.: South Asia Region.

Yunus, Md. 1998. *Banker to the Poor: The autobiography of Muhammad Yunus, founder of the Grameen Bank*. Dhaka: University Press.

—