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Disasters, Climate Change, and Economic Development in Sub-Saharan Africa

Lessons and Future Directions

Evaluation Brief 3

IEG WORLD BANK
INDEPENDENT EVALUATION GROUP

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Contents

Abstract

This paper explores the links among natural disasters, climate change, and economic development. It attempts to outline a framework for thinking about these links. The paper summarizes the limited knowledge of the long-term economic impact of natural disasters. It is necessary to draw links among disasters, conflicts, resource management, and other transmission channels to develop an appropriate response to natural disasters. The paper argues that African governments, along with their development partners, need to develop a more robust adaptation and response capability to disasters as part of their overall development planning. The paper makes the case for more market-based financing mechanisms than have been used hitherto and for an emphasis on forecasting research. It also argues for more work on the links between climate change and disasters and a new way of looking at disaster resilience as a continuum to development strategies.

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CHAPTER 1
Introduction

The Increasing Costs of Natural Disasters

Worldwide, the risks linked to natural hazards have increased sharply in recent decades. In constant dollars, the costs of natural disasters between 1990 and 1999 surpassed US$650 billion in material losses, which is more than 15 times higher than the cost from 1950 to 1959 (IEG 2006). Over this period some 2 billion people were affected by disasters in one way or another. Natural hazards are an increasing hindrance to the development of many developing countries, especially but not exclusively in Sub-Saharan Africa, and need to be addressed.

How much of the growing vulnerability to disasters is caused by human actions and how much is brought about by nature has been a subject of some debate. This paper argues that hazards are created by nature but disasters are largely manmade, and that development and disasters are closely interlinked. Moreover, while great attention is given to very visible cataclysmic events such as earthquakes, floods, and tsunamis, we must become more aware that disasters also often result from the slow buildup of human pressure on resources, which in turn is affected by choices made in strategies for economic development.

Before going forward with the analysis, the concept of *vulnerability* needs to be clarified. Vulnerability to natural hazard can be decomposed into two main components: exposure to shocks and resilience. The degree of *exposure to shocks* is a function of the frequency and size of natural hazards that affect the population and the proportion of the population affected by the hazard; that proportion is, in part, determined by choices people make about where they live. The degree of exposure is therefore the result of the frequency and intensity of natural hazards, which are mainly exogenous, and where people choose to live. In some cases the choice is voluntary—for example, people prefer to live in coastal areas or along riverbeds. In other cases the choices are involuntary, as when population pressure drives people to live in marginal areas. *Resilience* is the capacity to cope with natural disasters, including both preparedness (land and building codes and better forecasting) and response to disasters (such as financing mechanisms and postdisaster relief).

Therefore:

$$V = f(NH, P, R),$$

where V is vulnerability, NH is the number and intensity of natural hazards, P is the population exposed to disaster, and R is the level of resilience. It is expected that NH and P increase vulnerability, while R reduces it. Note that in this framework, climate change can affect V by increasing the intensity and frequency of NH and by increasing the proportion of the population that will be affected by disasters.

There is also growing evidence of links among conflict, security, and disasters, with the pressure on resources often leading to the increased probability of conflict. Although much focus has been on the scramble for natural assets—including diamonds, oil, and forest resources—as the source of conflict, conflict and insecurity have also arisen from the slow buildup of disasters that result from lack of resources, and sometimes from the increased vulnerability seen following a disaster. This is evident in some of the conflicts in Central Africa and more recently in the Darfur region of the Sudan, where the rebellion began in the 1970s,

right after Africa's greatest famine. Given the multiple interconnections among disasters, security, and economic development, a much more comprehensive view of the links is a key element to adapting long-term strategies.

Finally, Africa is being affected by choices made by others on the nature of economic development through the impact of these choices on climate change. Although Africa itself is not a major contributor to climate change, it is one of the areas that is most vulnerable to its effects. There is now growing evidence of the link between climate change and disasters. The Intergovernmental Panel on Climate Change (IPCC) has issued some of the most consistent reports on the evolution of the climate. According to that organization's predictions, despite considerable uncertainty, it is very likely that temperatures and sea levels will continue to rise, thus increasing the frequency of extreme events.

The IPCC expects the following impacts of climate change to be seen in Africa:

- Decreased grain yields
- Affects on major rivers such as decreased average runoff and water availability
- Exacerbated desertification
- An increase in droughts, floods, and other extreme events
- Significant extinction of plant and animal species
- Coastal erosion and inundation caused by rises in sea levels.

In a recent comprehensive review of the impact of climate change, Stern (2007) estimates a global impact on economic activity that is much higher than previously predicted, including by the IPCC. According to Stern, in the long run, "business as usual" could result in a permanent reduction of global gross domestic product (GDP) of as much as 20 percent. Moreover, the review states that poorer regions in Sub-Saharan Africa and South Asia will be more severely affected than better-off areas. For Sub-Saharan Africa, the review summarizes the impact as follows:

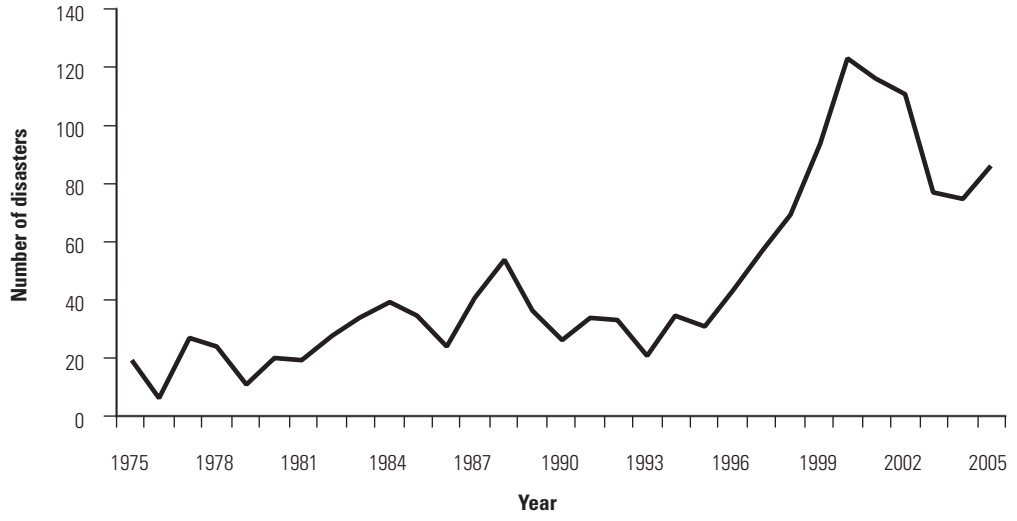
> *Sub-Saharan Africa will be under severe pressure from climate change. Many vulnerable regions, embracing millions of people, are likely to be adversely affected by climate change, including the mixed arid-semiarid systems in the Sahel, arid-semiarid rangeland systems in parts of eastern Africa, the systems in the Great Lakes region of eastern Africa, the coastal regions of eastern Africa, and many of the drier zones of southern Africa (Stern 2007, p. 104).*

The Stern review is the subject of intense debate. Some critics argue that climate change and its links to human activity are subject to wide margins of error and that Stern has taken the most extreme scenarios and low discount rates to estimate high costs in the future and to increase the present value of very long-term benefits. This debate will intensify in the coming years. Although the direct and incontrovertible link between the increase in disasters and climate change is still debated, the links between climate change and certain categories of disasters, particularly hydrometeorological events, are being more closely scrutinized. Even if we accept that the links between climate change and economic activity are subject to wide margins of error, we can observe that some of the changes in the increased intensity and number of disasters have already begun. A simple way to observe this is to pay attention to the increasing number of disasters in Sub-Saharan Africa.

The aim of this paper is to highlight the interactions between development and vulnerability to natural hazard in order to foster research that will improve future decision making.

The second section of the paper reveals the limited knowledge of the long-term economic impact of natural disasters. Based on recent theory, a number of scenarios are proposed that may represent the long-term impact of a disaster on GDP. These scenarios have yet to be tested. The third section stresses the reciprocal influence of development and vulnerability, highlighting

Figure 1.1: Number of Natural Disasters in Sub-Saharan Africa since 1975



Source: The Center for Research on the Epidemiology of Disasters.

Note: Disasters include the following events between 1975 and 2005: drought, earthquake, flood, insect infestation, earth slides, volcanic eruptions, waves or surges, and wind storms. For a disaster to be entered into the database, at least one of the following criteria must be fulfilled: 10 or more people reported killed; 100 people reported affected; a call for international assistance; or declaration of a state of emergency. Some but not all of the increase may be due to better reporting. (The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium.)

the possibility of a vicious circle: a highly vulnerable poor country may suffer frequent disasters that preclude development gains, and thus prevent improved resilience. The fourth section relates three case studies that provide examples of either poorly or well-managed disasters. The fifth section provides growing evidence of the link between climate change and disasters.

These cases, combined with theory and other evidence, lead to the next section, which discusses better mechanisms for coping with natural disasters. The focus here is on better financial mechanisms and better measures for preparedness that have been overlooked.

Finally, we end with some ideas for further research on the topic. This research is needed to better develop some of the linkages identified in this paper, along with country case studies to help us better understand how development choices have led to differing levels of vulnerability.

CHAPTER 2

The Long-Term Economic Impact of Natural Disasters

Several studies have evaluated the short-term costs of natural disasters. An exhaustive assessment of these costs must include both direct costs (damage to buildings, crops, social infrastructure) and indirect costs (lost output and investment, macroeconomic imbalances, increased indebtedness). The World Bank estimated that from 1990 to 2000, natural disasters caused damage representing between 2 and 15 percent of an exposed country's annual GDP (World Bank 2004). With such large costs—in many countries the total is much larger than their aid budgets, and in some cases the percentage is larger than the country's investment rate—it is important to increase the focus on the impact of natural disasters, their relationship to economic development priorities and strategy, and better coping mechanisms.

There is little doubt that most natural disasters have severe short-term consequences for the economy. But very few studies have assessed the long-term consequences of natural hazards. This chapter outlines study findings, developing theoretical as well as empirical analyses of the long-term economic impact of natural disasters.

Theory and Alternate Scenarios

The Possibility of a Positive Impact on the Path of Growth

Because natural disasters are frequently succeeded by higher growth rates, which seem to compensate for the economic impact of the disaster, one could expect disasters to be a temporary disruption of the development process and to have no impact on the long-term development of the country. Aghion and Howitt (1998) provide a theoretical explanation for this observation with a Schumpeterian model of endogenous growth. In the model, growth is generated by technological change favored by the capital replacement needed after the disaster. As a result, a natural disaster could lead to a positive overall impact on the economy.

Some authors have tried to model the long-term effects of disasters. Using arguments of economic linkage and substitution effects, Albala-Bertrand (1993a) constructed the first macroeconomic model of the economic impact of a natural disaster. In this model, a first step was to set an upper limit on output for the impact of a one-time disaster, assuming that all losses are to the capital stock, which is homogenous and irreplaceable in the short term. The basic result is that the reduction in the output is proportional to the reduction in the capital stock. The author then modifies some assumptions, considering, for example, that loss is split between capital and output, that capital loss is estimated at replacement cost, and that capital is heterogeneous. The author now finds that there is a much smaller impact on output, which he considers much more realistic than the first result. The implication is that a natural disaster is unlikely to have a long-term impact on growth. It explains why macroeconomic indicators improved during the years following the disaster, then quickly returned to their normal level.

Arguments for a Negative Impact on the Path of Growth

Benson and Clay (2004) come to the opposite conclusion. They argue that resources used after a disaster are not necessarily additional and can have a high opportunity cost. They provide a number of channels through which natural hazard can influence the path of growth and development:

- The stock of capital and human resources can be damaged (through migration and death) or

their productivity reduced by disruption of infrastructure and markets.
- Increased spending can lead to higher fiscal deficits and cause inflation.
- Reallocation of expenditures may draw funds from planned investments.
- Even when repair or recovery is funded by aid, this aid may not be entirely additional. Donors tend to advance commitments within existing multiyear country programs and budget envelopes. As a result, the amount of aid provided following the natural disaster is diverted from development aid flows.
- Consecutive natural disasters create an atmosphere of uncertainty that discourages potential investors.

Another main channel that is absent from most of the studies deserves investigation: the occurrence of a natural disaster increases the risk of civil war through its economic and social impact. Using a panel of 41 African countries from 1981 to 1999, Miguel, Satyanath, and Sergenti (2004) found that a negative growth shock of 5 percentage points (caused by extreme rainfall variations) increases the likelihood of conflict by 50 percent the following year.

Some models have been developed that focus specifically on one of these transmission channels. For example, the International Institute for Applied System Analysis modeled the potential impact of disaster on capital accumulation. Applying the World Bank's Revised Minimum Standard Model projection tool to Argentina, Honduras, and Nicaragua, the results demonstrate that postdisaster financial resource gaps reduce future growth (Benson and Clay 2004). Cochrane (1994) explored the impact of disasters on a country's indebtedness. Using a recursive Keynesian growth model, Cochrane assumes that the recovery costs are entirely funded by external borrowing, and hence generate an increase in interest rates. The consequence is an increase in debt stock as well as a reduction of long-term investment and growth.

All these studies have been subject to some criticism. Lavell (1999) points out that models such as those presented here should be submitted to an *a posteriori* analysis and evaluation to compare real with projected performance. Insufficient empirical work has been done on these issues.

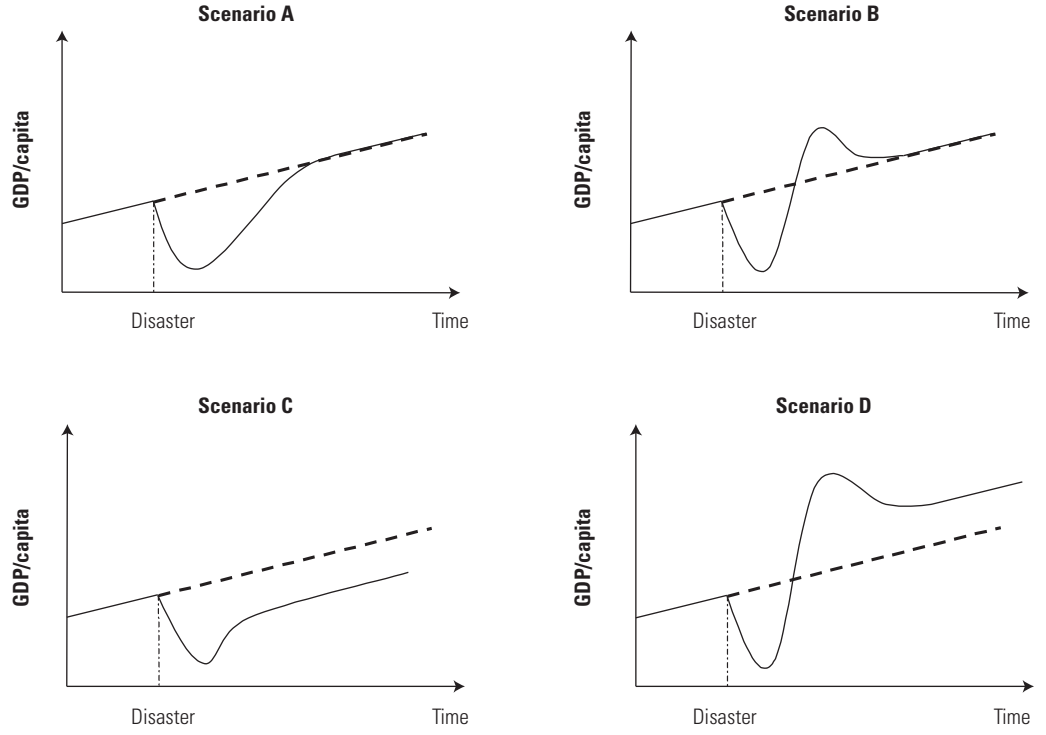
Possible Scenarios

A common problem in preparing an economic assessment following a disaster is the confusion caused by mixing stock losses with changes in flows. A distinction is necessary: Physical and human capital and public debt are examples of such stocks; they can be hit directly (for example, infrastructure and livestock can be destroyed) or indirectly. In the latter case, the variation of a flow causes the variation of the corresponding stock. An increase in the public deficit (a flow) would add to the public debt, or a diversion of investments (a flow) to fund relief costs would reduce the stock of physical capital. In return, annual flows are dependent on stocks, and physical and human capital stocks are determinants of the GDP (a flow). These multiple and complex interactions need to be considered in the evaluation of the economic impact of a disaster.

Because of contradictory effects, theory does not provide clear-cut conclusions about the impact of natural disasters on a country's long-term growth rate. It may be useful to outline different scenarios that would then need to be tested (see figure 2.1).

Disasters reduce the stock of capital, which leads to immediate losses in annual production. This short-term reduction in GDP can also be direct—for example, when a drought reduces agricultural production. If a negative impact is commonly observed in the short term, the medium-term and long-term impacts of disasters are still subject to debate. The scenarios in figure 2.1 represent the possible impacts of a disaster on the long-term growth rate of GDP. In scenarios A and B, the disaster does not influence the long-term growth path of income: The shock has a negative impact on the GDP, eventually followed by an expansion during reconstruction, and the production level returns to its long-term state of equilibrium. In scenario C, the disaster has permanently reduced the stock of capital, and the

Figure 2.1: Possible Long-Term Impact of a Disaster on GDP per Capita



Source: Authors.

new long-term equilibrium is established at a lower level of GDP. Finally, in scenario D, the restitution of capital brings with it technological change that enhances the long-term growth rate of the economy.[1] It should be noted that different types of disasters could be associated with different scenarios. For example, an earthquake is most likely to be associated with scenario B or D because it is generally followed by considerable reconstruction that may trigger an expansion and eventual technological change. Conversely, scenario A or C could represent a drought, because when the loss is generally restricted to annual production and household livelihood, it is unlikely to lead to greater production potential unless it prompts major investments in irrigation or other drought-reducing technologies. Empirical testing of these assertions would be useful.

Empirical Evidence

Because of considerable methodological difficulties, different studies have led to varying findings. No consensus has emerged about the long-term consequences of natural hazard.

One of the first empirical evaluations of the long-term impact of disasters on the economy was by Albala-Bertrand (1993b). In a statistical analysis of 28 disasters in 26 countries from 1960 to 1976, he found that the long-term growth rate and other key variables were not affected by disasters. Benson and Clay (1998) have noted the lack of assessment of the nonagricultural or economywide macroeconomic impacts of droughts in Sub-Saharan Africa. Even if the direct impacts of droughts are the most easily observable, indirect and secondary impacts on the nonagricultural economy and the macroeconomy should not be neglected. These effects are often not examined as recurrent issues that could potentially affect the rate and pattern of development.

Benson and Clay (1998) try to fill the gap despite the considerable methodological difficulties of establishing a nondrought counterfactual to isolate a natural hazard's effect. They find that drought shocks have a large economywide impact, but that the extent of the impact varies tremendously according to a number of factors. Among those factors, the level of complexity of the economy and increased intersectoral linkages increase the risk that a disaster will affect not only the agricultural sector, but the whole economy.

In a cross-sectional study including 115 countries, Benson (2003) found that the average growth rate from 1960 to 1993 was lower in countries that experienced more natural disasters. A main criticism of this study was that the more developed countries have experienced less disaster, and the results might therefore reflect the finding of a polarization toward a bimodal distribution (Quah 1993). Indeed, Quah observed a long-term divergence of income between developed and developing countries. Hence, the lower long-term growth rate in countries with frequent disasters (mostly developing countries) is not sufficient to draw conclusions about causality. It is generally difficult to isolate the impact of natural hazard from other factors that influence the path of growth and development, because countries with stronger institutions have a higher growth rate. They are also better able to handle natural hazards. Therefore, they are better able to reduce the probability of devastating disasters.

Given the difficulties of isolating the impact of natural disasters in macroeconomic studies, microeconomic results can provide valuable insights concerning their long-term consequences. Using a panel data set from Zimbabwe, Alderman, Hoddinott, and Kinsey (2004) found that children between 12 and 24 months of age during the 1982–84 drought had a higher probability of being stunted[2] (a manifestation of malnutrition) during their preschool years than other children. This group was found to be 2.3 centimeters shorter and to have completed 0.4 fewer grades of schooling 13–16 years later. This study highlights the long-term, irreversible consequences of natural disasters on human capital in poor countries. Dercon (2007) explains that this situation suggests the existence of poverty traps linked to human capital, resulting in a permanent state of low human capital and earnings.

Another issue that has received insufficient attention is that different types of natural disasters have different consequences. For example, Benson and Clay (2004) note the need for a distinction between geological and hydrometeorological disasters. Geological events, which are less frequent but often more cataclysmic, are more likely to generate Schumpeterian innovation and stimulate postdisaster growth, while hydrometeorological disasters are generally more frequent, creating an atmosphere of uncertainty that hurts the investment climate and requires adaptation costs. Indeed, in Albala-Bertrand's study (1993b), most of the countries that achieved higher growth rates in the two years following a disaster, compared with the two preceding years, had experienced earthquakes. Other disaster events were mainly succeeded by a lower postdisaster growth rate.

Using simulation-based econometric methods in a growth model applied to panel data from rural Zimbabwe, Elbers and Gunning (2003) found that risks associated with disasters reduced the mean capital stock in the observed region by 46 percent. The most innovative part of their work comes from the distinction between ex post (observed directly after the shock) and ex ante effects of risk (the costly behavioral response to risk, such as discouraging investment). Elbers and Gunning show that the ex ante effect represents two-thirds of the negative effects of risk, stressing the inadequacy of most of the existing studies, which focus on the ex post effect of risk. This also explains how frequent disasters can generate significantly different effects than would a huge, one-time disaster (which would have no ex ante effect).

When estimating the overall cost of natural hazard, too much attention has been paid to major events. Lavell (1999) stresses the impor-

tance of smaller-scale disasters. These are much more frequent than larger ones, but are not registered in statistical databases because they are small enough not to involve the central authorities and are typically handled by local governments. According to Lavell, "The cumulative losses associated with the 'smaller disasters' may be as significant as [those] attributed to large-scale disasters."

Moreover, many "progressive disasters" around the world result in little action to address the problem. This issue is different from vulnerability to natural disasters but is also accentuated by climate change and human behavior. Although different from vulnerability to natural disasters, progressive disasters such as land degradation and soil erosion are also accentuated by climate change and human behavior, and have increasing consequences for the poor. In Uganda, for example, the exposure to natural hazards has led to land degradation and has accentuated the impact of climate variability on crop output. In the most affected districts (Kabal, Kisoro, Mbale), which are also the most densely populated, with a density of more than 250 inhabitants per square kilometer, between 80 and 90 percent of the area is estimated to be affected by soil erosion (Uganda National Environment Management Authority 2002). Land degradation is a worldwide issue: a World Bank report (1997) estimated that 80 percent of the poor in Latin America, 60 percent of the poor in Asia, and 50 percent of the poor in Africa live on marginal lands characterized by poor productivity and high vulnerability to natural degradation and natural disaster.

Given the methodological difficulties linked to empirical analysis, several studies have focused on qualitative evidence. Clay and Benson (2004) have provided a number of case studies that highlight the long-term negative effects of disasters. For example, the Bangladesh government has recognized that "inadequate infrastructure to deal with floods [has] been a constraint on investment in productive activities as well as on utilization of installed capacity" (Bangladesh 2000). Similarly, the Philippines has faced tremendous difficulties in improving the country's transport system and meeting the social infrastructure needs of the population because of an extremely high exposure to natural hazards, mainly floods and wind storms. Dominica (1979) and Montserrat (1995–98) are examples of a considerable loss of human capital through emigration linked to natural disasters. Clearly, more qualitative and quantitative work is needed to further explore these issues.

Notes

1. Postwar reconstruction has also seen this type of response, with the rapid recovery of countries that were devastated by the Second World War attributed to, among other factors, new capital stock embedded with better technology.
2. A child is considered stunted if his or her height, given his or her age, is two standard deviations below international norms.

CHAPTER 3

The Interactions Between Development and Vulnerability

Development Strategies and Their Impact on Vulnerability to Disasters

Hewitt (1983) and Blaikie and colleagues (1994) have made major contributions to the recent study of natural disasters and development. They stress the role of social structures in shaping vulnerability. Studies by Sen (1981) and Drèze and Sen (1989) are among the pioneering works in considering famine not just as a natural disaster, but also as an avoidable economic and political catastrophe. They show that the famines were caused not so much by lack of food as by lack of entitlement to resources based on access to economic, social, and political power. All these works have strongly influenced the concept of prevention and management of famines in the developing world and the idea that disasters are manmade or policy induced.

To pursue the analysis, it is crucial to understand that a natural disaster is not a completely exogenous event. What is often called a natural disaster is really a humanitarian disaster triggered by nature. Or, as Wisner stated in a more provocative manner, a natural disaster is a failure of human development (Wisner 2003). As we will see, natural disasters are the consequences of natural hazards, but they are also largely a reflection of development flaws.

Determinants of Vulnerability to Natural Hazards

Economic development typically reduces exposure to natural hazards. A reduction of the proportion of the population working in the agricultural sector increases the resilience of the country, because the overall level of production becomes less sensitive to hydrometeorological conditions. Intersectoral linkages are another determining factor of resilience: countries with a high degree of dualism, with a large capital-intensive extractive sector, are less sensitive to natural hazards. For example, droughts had a limited effect on the macroeconomies of Botswana, Namibia, and Zambia, all of which draw most of their resources from the mining industry.

The Financial System. Development is generally linked to a better financial system, which allows a wider diffusion of the impact of a disaster, especially when that system facilitates small-scale savings and transfers. In Zimbabwe, for example, after the 1991–92 drought, a well-developed financial system facilitated transfers from urban to rural regions. (Later we will discuss the role and importance of microcredit.)

Trade Openness. More open economies have fewer exchange constraints. As a consequence, any increase in imports for relief and reconstruction will not displace normal imports. Moreover, following a disaster, local inflation can be contained more easily in a more open economy. But, again, more study is needed on how openness to trade helps or hinders recovery from natural disasters.

Institutions. One of the most important factors in determining the resilience of a country is the willingness of the government to consider preparedness for natural hazards a priority. This includes a long-term commitment to mitigation and preparedness, even when no disaster has occurred during the preceding years. In addition, transparency, better reporting of relevant expenditures, and postdisaster reallocations are essential, as well as the enforcement of appropriate land-use and building codes.

At the same time, the coincidence of a natural disaster and political instability can have dramatic consequences. Such was the case during the violent struggle for independence in Bangladesh

during the mid-1970s or the war in Mozambique during the 1990s, which destabilized neighboring Malawi's transport system by provoking an influx of refugees.

A more recent example is the case of Zimbabwe in 2002. Angola, Lesotho, Malawi, Mozambique, Swaziland, Zambia, and Zimbabwe all suffered from food shortages after three years of drought combined with flooding in some areas. However, Zimbabwe, which was considered the "breadbasket" of southern Africa a few years ago, became the most vulnerable country of the Region. Political violence fueled by inflation, unemployment, racial tensions, land reform issues, and soaring rates of HIV/AIDS greatly weakened the country's capacity to provide effective relief. The government took control of the distribution of mealie meal (a basic food). Its objective was to ensure that mealie meal was supplied only to the supporters of the ZANU-PF ruling party (Oborne 2003). Sen (1981) was the first to observe that famines are the result of human behavior, stressing that they do not happen in democracies, where a free press and free speech create excellent early warning systems. Although Sen provided Zimbabwe as an example of a democracy that successfully prevented famines despite sharp declines in food output, he recognized that the country no longer qualified for the exemption he had given it before.

Public Awareness. Only a population informed of the risks related to natural hazards and concerned about them can create the appropriate incentives for the government to make sufficient investments in preparedness and mitigation. In Turkey, public awareness was very low despite frequent events. The Marmara earthquake in 1999 created a new level of public awareness, not only because of the unprecedented scale of the disaster, but also because it was mainly urban, making it difficult for the politicians, local municipalities, building contractors, and civil engineers to ignore their responsibility (Özyaprak 1999).

Sen has also compared the response to droughts in India and China. He argued that India avoided famines because of its free press, whereas China suffered a major famine in 1984 because the system was able to withhold information on the drought and was unwilling to admit problems or seek assistance.

An Example of Vulnerability Caused by Human Factors

In 1972–73, the Sahel experienced a catastrophic drought, during which thousands of people and millions of animals died (de Waal 1997; Mortimore 1998). This catastrophe was the result of both natural and human factors. The preceding droughts in the late 1960s and early 1970s increased people's vulnerability, especially in the rural areas, by depleting their stock of physical capital (savings, grains, animals) as well as their human capital through deterioration in health or migration to urban areas. Indeed, the rural communities were the most vulnerable because of a combination of socioeconomic factors: (i) isolation brought about by poor communication and transport links; (ii) an urban bias in policy making that was the result of poor rural representation; (iii) a focus on short-term stabilization rather than long-term economic development; and (iv) an emphasis on industrial investment and the conversion of agriculture to cash crops at the expense of the production of food for local consumption (Baker 1987; Shaw 1987; Rau 1991).

The relevance of those human factors is highlighted by the many droughts subsequently endured by the Sahel that were comparable to those of the early 1970s. None of them, however, led to such a massive famine (Mortimore 2000). If natural hazards have increased vulnerability in the short term, in the long term the population has developed many strategies to cope with drought, such as agricultural diversification and migration.

In this case, the emphasis on industrialization, cash crops, and export earnings in countries that are primarily rural—where most of the population cannot afford or lacks access to imported foodstuffs—increased the region's vulnerability. This example illustrates local-level adaptive capacity and the danger inherent in a "top-down"

approach to development, especially when the approach is based on global economic paradigms disconnected from the rural communities' reality (Pelling 2003).

The Complex Relationship Between Vulnerability and Development

Considerable development effort can be wasted when vulnerability is not taken into consideration. In Honduras, after Hurricane Mitch in 1998, President Carlos Flores stated that his country's development was set back 30–50 years. Indeed, from 70 to 80 percent of the transport infrastructure was destroyed, including almost all bridges and secondary roads. One-fifth of the population was left homeless; crops and animal losses led to food shortages; and lack of sanitation led to outbreaks of malaria, dengue fever, and cholera (U.S. National Climatic Center 2004).

Mohamed H.I. Dore and David Etkin (2003) point out the importance of adaptive capacity at an institutional level. They define the necessary conditions for adaptation by observing how developed countries respond to current climate risks. The authors observed six conditions:

- Developed countries have the technical know-how to understand climate.
- They have resources to devote to research on climate and its related risks.
- They have developed the necessary technology to cope with the effects of climate.
- They share risks through both government disaster-assistance programs and the insurance market.
- The insurance market mediates moral hazard problems through mechanisms such as deductibles, rebates for minimizing damages, or premium reductions for making no claims.
- Developed countries invest resources in emergency responses at all levels of government.

These six conditions are generally costly and require high-quality institutions and human capital. It can be deduced that a country needs to be relatively developed to meet the necessary conditions for a high resilience to natural hazards. At the same time, a vulnerable country is highly exposed to disasters that would be harmful to its development process. Consequently, there is a risk that poor countries will be locked in a vicious circle—vulnerable because of their low level of development, and brought back to their initial level of development through natural disasters because of that vulnerability.

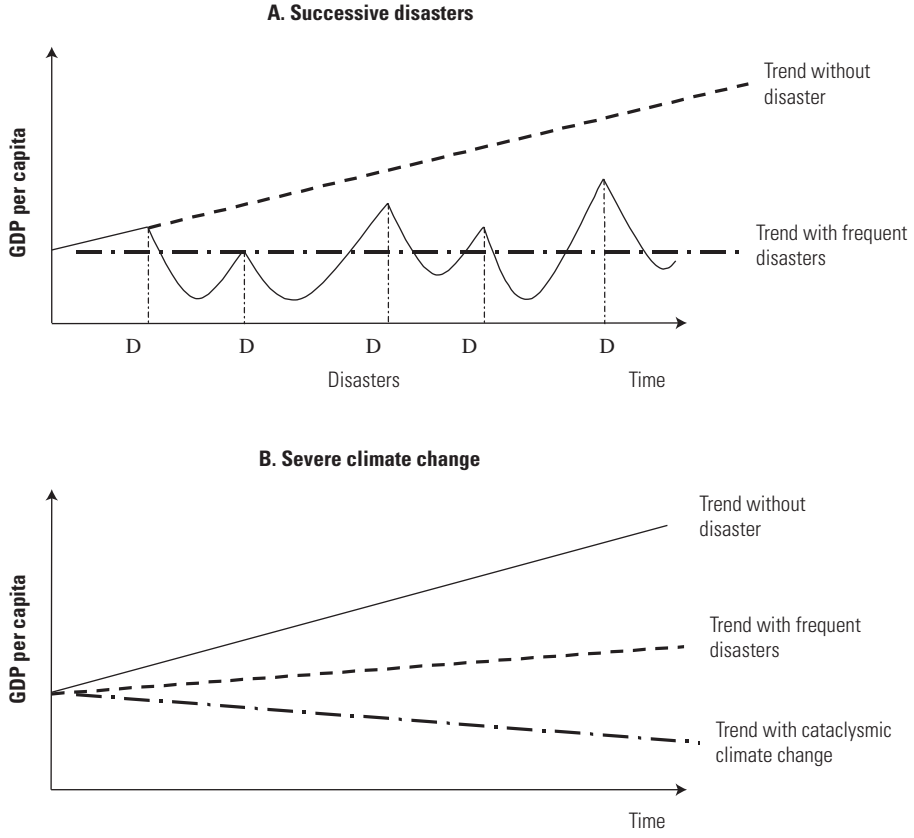
As represented in figure 3.1A, high vulnerability would result in frequent large-scale natural disasters. Even if one disaster would generally not have long-term effects (as represented in scenario A of figure 3.1, for example), a succession of disasters would prevent the country from reconstituting its capital or other productive capacities. The result is high instability and disconnection from the path of growth that would have been expected in the absence of disaster.

This could be the story of Ethiopia, for example. Ethiopia is particularly vulnerable because agriculture accounts for 41 percent of its GDP, 80 percent of the workforce, and 80 percent of exports.

Undoubtedly, vulnerability is only one of the numerous factors that can explain the stagnation of a least-developed country. The role of vulnerability should be addressed, including its indirect effects, such as discouraging private investments or increasing the risk of political instability. Although the establishment of a counterfactual would be difficult, further work on the link between vulnerability and development is necessary.

To progressively emerge from this situation, highly exposed countries need to incorporate how best to build resilience and reduce vulnerability into their development policy. Some authors, such as Katrina Allen (2003), go even further and argue that the distinction between resilience to natural hazard and development is mainly theoretical and has more meaning for government bodies than for local communities. At a local level, both hazards and development are strongly related to a lack of livelihood. Similarly, humanitarian crises are extensively

Figure 3.1: Possible Long-Term Impacts on Income



Source: Authors.

linked to a sociopolitical context. According to Allen, isolating vulnerability from the wider social background creates a risk of treating symptoms rather than the cause. The last case study of chapter 4 illustrates how vulnerability and poverty can be tackled jointly.

If Stern's projections (2007), which incorporate the impact of more severe climate change, are correct, then we must also include the possibility of a sharp drop in income and consumption. Figure 3.1B incorporates such a scenario without any prevention or coping action. This grim scenario would lead to a huge increase in poverty, malnutrition, and even mass famines, as well as serious disruption to development.

CHAPTER 4
Case Studies

The Landslide of La Josephina

In 1993, a huge landslide occurred in La Josefina, which is located in the mountainous southern region of Ecuador near the city of Cuenca. The landslide covered the entire valley and dammed the river, impounding it for 33 days. During this time 1,000 hectares were flooded. In all, about 200 persons were killed by the flood and 14,000 displaced. There was severe damage to land and buildings. The costs to agricultural lands, factories, and residential infrastructure reached several million dollars.

This case is a good example of a natural disaster caused by a combination of human and natural factors. The area had a permanent danger of landslide; below the 1993 landslide site, there are about 35 scars of past slides. But this should not mask the human responsibility. The area has a dense rural population. After land reforms, lands were divided into excessively small plots, worked by farmers with little experience using overly intensive agriculture. Monocultivation of maize in rows following the slope was a frequent practice, although this leads to heavy erosion.

After the disaster and during the 33 days of flood, 47 nongovernmental organizations were criticized for their lack of effective assistance, and the provincial government for its passivity. Codevilla (1993) argued that there was an excess of *asistencialismo* from the locals (that is, they were passively waiting to be helped). No structure in place at the time was able to handle the disaster.

A solution recommended by Morris (2003) is to promote a soft rather than a hard engineering approach—that is, making low-energy adaptations rather than trying to match the power of nature. This suggestion springs from Abramovitz's recommendations (2001), which advocate a greater control over land use, the limitation of intensive farming, and the development of forestry in critical zones. This strategy implies two things: (i) recognition of the significant risks linked to natural hazard, which cannot be totally controlled, and (ii) the acceptance of a tradeoff between the higher short-term productivity of intensive farming and the long-term benefits of maintaining a more resilient ecosystem.

A Successful Disaster Recovery in Mozambique

In a vulnerable country, one disaster can set back hard-won development efforts. Mozambique is one of the poorest countries in the world, with 69 percent of the population below the poverty line. In 1992, a peace agreement put an end to 17 years of civil war. From 1992 to 2000, the growth rate of GDP per capita averaged 6 percent. Then came the flood of 2000. It killed 700 people, displaced 650,000, and affected 4.5 million (a quarter of the population). It devastated 140,000 hectares of crops and their irrigation systems; 350,000 livestock were lost or seriously injured; 6,000 fishermen lost at least half of their boats and gear; and about 500 primary and 7 secondary schools were destroyed.

However, the long-term economic consequences of a disaster largely depend on the capacity of the country to handle the recovery program. Mozambique's recovery seems to have been generally effective. Recovery programs have provided opportunities for investments to upgrade services and infrastructure (Valid International and ANSA 2001). Many affected people have been assisted, and the rehabilitation and the rebuilding of schools and health facilities has encouraged the development of new social structures, such as associations and community committees.

This success can be explained by a number of factors, including the creation of the National Disaster Management Institute in 1999; development of a culture of prevention; provision of immediate and massive flows of aid; and, above all, the determination of the government to establish a recovery program aimed at strengthening national reconstruction and development policies. The government's objective was not simply to restore the previous level of development but to generate the social and economic improvements that would increase the country's resilience to future disasters. A clear sign of progress is that the United Nations Children's Fund (UNICEF 2002) noted significant improvements in responses to the flood in 2001. Preparedness measures had been taken, including the preplacement of food, boats, and other relief materials. Neighboring countries had been contacted to coordinate the displacement of affected populations.

One of the key elements to the success of the reconstruction was the extraordinarily high level of donor response—around $450 million by May 2000—and a commitment from the government to maintain macroeconomic stability. These aid flows dampened the negative impacts of the disasters, allowing a rapid return to high levels of growth. Therefore, the 2000 and 2001 floods were not considered to have had a lasting negative economic impact. A recent World Bank report (2005) on the case of Mozambique has outlined the following reasons for the successful recovery:

- Intensive labor-based infrastructure works for disaster mitigation
- Where possible, the use of local rather than international contractors
- Increased levels of accountability and transparency through the use of independent reviews and evaluations of recovery works
- Good practice guidelines to ensure that gender issues were addressed and that adequate attention was paid to land tenure issues, standards for housing, and recovery of complex livelihoods
- Emphasis on building capacity for disaster management at the district level and sharing information on budget and planning for disasters.

Combining Reduction of Both Vulnerability and Poverty

Instead of thinking of disaster response and development as two separate activities, can we think of programs and projects that combine them? An example of a successful project combining vulnerability and poverty reduction comes from Niger, one of the poorest countries in the world. The project was implemented by the Small Rural Operation in Niger. It took 11 years (1988–98) and targeted an area with a chronic food deficit. The project's aim was to reduce drought vulnerability by intensifying off-season crop production through widespread use of existing, simple, low-cost technologies. Approximately 35,000 farmers benefited from the strong increase in production resulting from higher cropping intensities, cultivation of higher-value crops, and diversification toward noncrop activities. In this case, the two objectives of poverty reduction and food security could not have been achieved separately, because they are both strongly linked to the livelihood of the rural population. More such combined approaches are needed to break the vicious cycle of disasters and low-level development.

CHAPTER 5
Climate Change, Disasters, and Development

Climate Change: A Growing Risk to Sub-Saharan Africa

The Intergovernmental Panel on Climate Change (IPCC) has provided some of the most reliable reports on the observation of actual climate changes and forecasts of future changes and their consequences. These predictions are unavoidably marked by uncertainty, but there are apprehensions that Sub-Saharan Africa and South Asia will be the most severely affected areas of the world. Because Africa is a very diverse continent, any statement on the impact of climate change can hardly be applicable to the entire continent. Unless specified, information provided in this section is extracted from IPCC reports (1996, 2001).

Despite its tiny contribution to climate change, Sub-Saharan Africa is one of the most adversely affected regions in the world. Indeed, the continent is highly exposed to climate change, and its structural weaknesses result in lower resilience. With 40 percent of its population living on arid, semi-arid, or dry subhumid areas (UNDP 1997), Africa is one of the areas of the world most exposed to global warming. It has experienced a warming of approximately 0.7°C during the past century, and the temperature is expected to increase by between 0.2°C and 0.5°C each decade. Moreover, Hulme and Kelly (1997) note that in the preceding 25 years, the decline in rainfall observed in the Sahel was the most substantial and sustained recorded anywhere in the world since instrumental measurement began.

A high proportion of Africans live in coastal areas: one-quarter of the population resides within 100 kilometers of a seacoast (Singh and others 1999). Because of the combination of increased climate variability and rising sea levels, this population will be increasingly exposed in the next decades. Nicholls, Hoozemans, and Marchand (1999) found that the sea level rise could increase the number of people in Africa affected by flooding from 1 million in 1990 to 70 million in 2080 (assuming the predicted a 38-centimeter global rise in sea level during this period).

Africa's Low Capacity to Cope with Climate Change

Not only is the African continent a highly exposed area, but it also faces structural difficulties that aggravate the consequences of climate change and limit its capacity to manage effective solutions. First, more than half of the African population is rural, which implies high vulnerability to natural hazard and a strong dependence on per capita food production. That production has been declining in Africa for the past two decades, contrary to the global trend. Population growth, which will put more pressure on the limited amount of land available for cultivation or cattle farming, is also a main concern. African countries are highly vulnerable not only to climate shocks, but also to economic (for example, terms of trade variability or aid volatility) and political shocks. The conjunction of different shocks has cumulative effects and undermines countries' ability to cope with crisis. To these weaknesses must be added the HIV/AIDS pandemic, which increases the burden on public resources and erodes human capital.

Nevertheless, Africa's high vulnerability to the existing prevalence of disasters and to the possibility that their frequency may increase must be addressed. This will require not only local initiative but also international help, because much of the continent will need to respond to effects induced by climate change created by actions taken largely in the developed

world. In other words, Africa suffers from development enjoyed elsewhere in the world, and Africa is a major recipient of the disastrous effects.

Main Concerns for the Future

Among the problems that will be exacerbated by climate change, particular attention should be paid to the highly interrelated issues of desertification, food security, and water supply. Any one of these can have dramatic consequences for the poor.

Desertification

Desertification contributed to the death of 250,000 people in the Sahel drought of 1968–73 (UNCOD 1977). By progressively reducing agricultural and livestock yields, drought reduces the land's capacity to support people, while the population keeps increasing rapidly. The total population of Africa has increased almost fivefold since 1950. During this period, desertification has reduced the productivity of one-quarter of the continent's land area by 25 percent, encouraging an exodus toward urban areas.

Desertification also has feedback effects that can create vicious cycles through, for example, the release of CO_2 or higher susceptibility to wind erosion, which may reduce the soil's water-retention capacity. Wind erosion (or loss of infiltration capacity caused by loss of vegetation or by soil compaction) intensifies the effects of climate variability on crop failure. Measures need to be taken to limit the extent of irreversible changes.

Food Security

There is a wide consensus that climate change will worsen food security in Africa through continuous climatic shifts, as well as an increase in extreme events. Hunger is not a sporadic episode in Africa: nearly 200 million of its people are undernourished, and 33 percent of African children are stunted, underweight, or wasted (FAO 1999). A combination of factors (noted previously) explains the reduction and uncertainty of crop, livestock, and fishery yields. These figures undeniably hide sizeable disparities. For example, although recurrent conflicts have shrunk food availability in Burundi, considerable progress in Ghana was triggered by higher agricultural productivity.

Water Supply

Except in the equatorial region and coastal areas of eastern and southern Africa, the continent is dry subhumid to arid. Global warming will result in a reduction in soil moisture in subhumid regions and a reduction in runoff, because high temperatures enhance evaporation. Africa has the lowest conversion factor of precipitation to runoff in the world (15 percent), and the situation is worsening rapidly. There has been a reduction in runoff of 17 percent in the past decade. Indeed, Arnell (1999) finds that the southern Africa region will experience the greatest reduction in runoff by the year 2050, increasing the number of countries included in the water stress category (using a per capita water-scarcity limit of 1,000 cubic meters per year).

Likewise, Sharma and others (1996) estimate that between 2000 and 2025, the number of African countries enduring water stress will rise from 8 to 18 and the population affected will double, reaching 600 million. This relative scarcity of water is also the consequence of rapid population growth. Poor people will be the most affected, because they have the most limited access to water resources, but the scarcity will have consequences for the whole economy—even industrial activity is threatened by the scarcity of water. In Ghana, the unprecedented drought of 1982–83 compelled electricity rationing until 1986, which stresses the need to develop alternative sources of energy.

Water-Related Conflicts

As an additional threat to African development, access to water is likely to be the source of an increasing number of conflicts in the future (Stern 2007). National as well as cross-border conflicts motivated by water access have been observed already. For example, in the 1970s and 1980s, droughts in Mali forced many seminomadic Tuareg to migrate; their troublesome return to their native lands was the basis for the Second Tuareg Rebellion in 1990. Along the

Senegal River the building of dams provoked a clash between Senegalese and Mauritanian populations during the late 1980s and early 1990s (Niasse 2005). Western Africa has already experienced a decline in its rainfall during the past three decades of between 10 and 30 percent. This raises many concerns for the forthcoming decades: cooperative mechanisms will be required to prevent the commencement of additional water-related contentions.

Adaptation to Climate Change

Issues raised in this section often progressively augment the vulnerability of a country, a situation that is often revealed only when an extreme event occurs. Increasing the resilience to natural hazard implies a permanent effort to tackle the diverse consequences of global warming. Desertification, food security, water supply, and other climate-related issues are strongly integrated, and efforts to provide solutions should be combined.

An essential first step is improved resource management. There is much room for improvement in this field. Low-cost technologies for control of wind erosion exist. Access to credit could stimulate the use of windbreaks, mulching, ridging, and rock embankments (Baidu-Forson and Napier 1998). Agricultural production can be enhanced by appropriate rainwater management, as in Morocco, where scarce rains are used very efficiently for farming. As another example, South Africa has started to develop strategies to optimize the use of water through pricing and demand management tools.

Given that access to water is an increasingly challenging issue and most of the major rivers of Africa flow through several countries, international river basin management protocols are now fundamental to precluding water-related conflicts. Such protocols have been fairly developed during the past decade and need to be encouraged by strengthening of their financial and human resources and establishing a legal framework that will ensure equity and efficiency in the management of water supply.

In the medium term, the development of better forecasting technologies would facilitate adaptation to climate change and preparedness for extreme hydrological events. For example, crop models could be used to make adjustments if they provided information about the probability of success of resource diversification or intensification. Development of data and local skills is necessary to enhance research and offer more practical solutions for dealing with such changes.

Finally, strong synergies can be identified between the reduction of vulnerability and global warming. Forest maintenance would mitigate both flooding and climate change. New opportunities in carbon trading are emerging that Africa could exploit (this section draws on World Bank 2006a). For example, in the European Union market, firms are willing to pay as much as US$20 per ton for sequestration. On the assumption that a hectare of dense tropical forest will emit some 500 tons of CO_2 when it burns or rots, its international market value could be as high as US$10,000. Conversion of tropical forest to farming gives high returns to the farmers, but these returns are often small compared with the international carbon trading options that are becoming available. For example, Tomich and others (2005) have shown that the net present value (using a discount rate of 10 percent) for one hectare cleared in Cameroon yields a return of about US$283–$623 for food crops, US$424–$1,409 for cocoa, and US$722–$1,458 for palm oil. Even if the carbon sequestration price were as low as US$3 per ton, it would give better returns to Cameroon than the farming options would. This does not include quantification of any other benefits of preserving tropical forests, such as biodiversity. Yohe, Andronova, and Schlesinger (2004) have argued that an international agreement on carbon sequestration would be viable even at US$2.70 per ton.

CHAPTER 6

Coping with and Preventing Natural Disasters

Financial Mechanisms

When governments do not resort to higher fiscal deficits to fund relief and reconstruction costs, they generally turn to international aid or reallocation of expenditures. However, other solutions are available for spreading risks. This section discusses the strengths and weaknesses of each solution.

Current Approach

Fiscal Deficits. When a government is submerged by a sudden overflow of emergency needs, higher expenditures, leading to larger fiscal deficits, are easy answers. Nonetheless, the long-term costs of indebtedness are well known, and make this choice the last resort for a government. Benson and Clay (1998; 2004) found no impact of natural disasters on the overall budget deficit except in drought-affected Sub-Saharan economies. In this Region, five of six case studies showed a noticeable increase in government borrowing following the drought.

Reallocation of Expenditures. One of the most common ways to cope with the urgent needs of a postdisaster situation is to reallocate budgetary resources. This solution provides a rapid source of funding while keeping domestic credit and money supply under control. However, it still diverts funds from planned investments, and thus hampers development. A main concern is that reallocation of funds after a disaster should follow a formal process rather than proceeding based on emergency decisions, so that funds would not be diverted from projects essential to the long-term development of the country. This is often not the case, and vital long-term development is affected.

International Aid. International agencies play a major role in helping countries that have limited resources to cope with the disaster. However, Benson and Clay (2004) suggest that postdisaster aid flows are not additional. In three case studies (Bangladesh, Dominica, and Malawi) they observed that disasters had little impact on the overall level of aid. Donors bring forward commitments, and thus reduce the availability of aid during the subsequent years. The IEG report on natural disasters (IEG 2006) confirms that despite the existence of an Emergency Recovery Loan, loan reallocations are the most frequent type of response to disasters in highly vulnerable countries; such reallocations often do not lead to good outcomes.

Another important issue in aid-based relief and reconstruction is that considerable flows of aid from different donors raise management difficulties for the receiving country. The country has to submit to different conditions from the donors, which can take time and limit its sovereignty. This diminishes the government's ability to determine the allocation of reconstruction funds and set its own priorities.

Increasingly, countries are taking greater ownership over donor coordination during the relief and recovery period. But where institutional capacities are limited, coordination can also be provided by one of the donors. After the 1989 drought in Sudan, the World Bank worked with other donors to organize the relief and avoid unnecessary overlaps in coverage. Special attention is required from the international community when a natural disaster occurs in a politically unstable country or in a country with weak institutions.

Benson and Clay (2004) denounce excessive reliance on international aid in cases of disasters. Natural disasters often substantially increase the gap between commitments and actual aid disbursements. In an emergency, small delays

can result in severe social and economic consequences. Moreover, as we look into the future, aid flows might not be able to cope with the rapid increase in the annual cost of disasters. There is a need to begin to look at other options. And if natural disaster management must be seen as part and parcel of economic development, then special funding mechanisms for disasters may actually lead to avoidance of the more fundamental choices countries must make to build disaster management into their development strategies.

Financial Risk Mechanisms

Insurance. In the world's poorest countries, currently less than 1 percent of the losses from natural disasters are formally insured (Freeman and others 2002). This financial risk mitigation mechanism could certainly be developed further to reduce aid dependency in managing disasters. The expansion of insurance, however, has been limited by its high cost: catastrophe insurance premiums can be several times higher than the actuarially determined expected losses (Froot 1999). Furthermore, to manage insurance schemes, strong institutions are required: regulation must ensure that insurance companies are sufficiently cautious and big enough to diversify the risk or be reinsured. Moreover, clear and agreed triggers are needed for insurance payouts, which are often difficult to agree on.

Because the risks are highly covariant and difficult to estimate, insurance industries always face considerable difficulties in providing insurance against natural hazard. When the risk is too low, agents have very few incentives to pay the insurance premiums. Conversely, in the most exposed regions, soaring risk discourages insurance companies from offering coverage. A closer look at the developed countries shows that, in most cases, the insurance market is not fully private and the government plays a major role, generally by providing catastrophe reinsurance to the companies. As a consequence, agents are encouraged to adopt risky behavior, knowing that they would not bear the full costs in case of a disaster. To limit the moral hazard, insurance can be provided conditionally—that is, on the implementation of loss-reduction measures and appropriate building and land-use zoning codes. In that way, insurance companies can contribute to the national effort for preparedness and mitigation by creating appropriate incentives.

A second drawback to the government serving as a backstop facility is that this does not eliminate the risk, but instead transfers the risk from the local to the national level. A rich country's government generally has the ability to absorb the costs, but a poor country would not have the same capacity. To handle the additional pressure on its budget, the poor country's government would need to resort to other sources of funding, such as international aid.

Determination of a Parametric Insurance Trigger. A possible solution would be to establish an insurance system in which payouts would be triggered by parametric observations such as extreme rainfall. Disbursing without following damage-assessment procedures can accelerate transfers and reduce transaction costs, but it is currently difficult to find simple instruments that are strongly related to economic costs. Both further agrometeorological research and good historical data are necessary for the insurance companies to be able to calculate accurate premium rates. Good institutions are also required—for example, the myriad difficulties related to landholding titles would surge if these were not well defined.

Because of the difficulties of implementation, there are currently few examples of insurance with a parametric trigger. Windward Islands Crop Insurance (WINCROP), which covers the export of bananas in Dominica, Grenada, St. Lucia, and St. Vincent and the Grenadines, has a verification system similar to a parametric trigger (Benson and Clay 2004). Evaluation of losses is easy because the insurance covers one crop against one hazard. When a disaster occurs, a 5 percent physical survey of affected growers reveals the proportion of damaged plants, which avoids lengthy damage assessment procedures. The benefit is calculated on the basis of the average deliveries during the preceding three years.

Premium payments are assured because the funds are directly deducted from export revenues. However, the scheme faces some difficulties, such as the high covariance risk, premiums that are too low but cannot be raised for political reasons, and the long-term decline in banana prices. So far, WINCROP has been unable to extend the insurance scheme to other crops because of legislative restrictions and extremely high reinsurance rates.

In January 2006 the World Bank initiated the preparatory studies for the establishment of the Caribbean Catastrophe Risk Insurance Facility (CCRIF). CCRIF will allow governments of the Caribbean Community and Common Market (CARICOM) to have access to insurance coverage at a lower rate than each state could have obtained on its own, for three main reasons:

1. Participating governments will pool, and thus diversify, their risk.
2. Donor partners will contribute to a reserve fund to reduce the need for international reinsurance.
3. The use of a predetermined parametric trigger will reduce transaction costs and moral hazard. Parametric triggers will allow immediate cash payment following a major earthquake or hurricane, which will help governments fund immediate postdisaster recovery while mobilizing additional resources (World Bank 2006b). A high exposure to natural hazard has encouraged Caribbean country governments to look for creative solutions. African countries need to pay particular attention to such initiatives and conceive their own solutions.

Instruments for Spreading Risks Directly to the Capital Market. Instruments such as "catastrophe bonds" could reduce postdisaster pressure on fiscal and external balances. The principle is very simple: the owner of the bond would receive regular payments. However, if the catastrophe occurs, an amount is taken from the principal or interest of the bond. This mechanism can provide immediate and timely availability of funds, but because of the high transaction costs, this solution is twice as expensive as insurance (Swiss Reinsurance Company 1999). Compared with postdisaster assistance, which is generally highly concessional, it is not surprising that the demand for risk transfer mechanisms in the private market is very low in developing countries. But in countries with repeated disasters, one could consider using part of the aid flows to invest in market-based risk-spreading options such as insurance, with part of the aid being used as a backstop facility. Turkey has developed such a scheme for earthquake insurance.

Microcredit Institutions. Microcredit institutions can help cushion the impact of the disaster for a part of the population that is highly vulnerable and not often reached by other institutions. Natural disasters have a profound impact on households, including human losses, but also loss of housing, livestock, food stores, and productive assets such as agricultural implements. The disaster-affected population has to replace homes and assets and meet basic needs until individuals are able to recommence income-generating activities. In the absence of microcredit institutions, poor households are forced to rely on moneylenders, who charge considerably higher rates of interest.

However, special attention needs to be paid to microcredit institutions, which are highly exposed. In Bangladesh, after the 1998 floods, considerable refinancing from the Bangladesh Bank prevented many microcredit institutions from falling into bankruptcy. The government backstop is essential because, once again, the high covariance risk would result in the microcredit agencies facing problems during a disaster. To avoid repercussions for the users of microcredit, a constant contingent liability from the governments or donors will be required. A risk-pooling arrangement with microcredit institutions from different parts of the world could be another prospect for diversifying risk.

Increasing the Flexibility of Aid Disbursements. The term "moral hazard" has often been used when accusing the governments of poor countries of not doing enough for disaster mitigation as part of their development strategy

because they expect to be able to count on external assistance for postdisaster recovery. However, the cost of insurance can be so high that it could have long-term economic effects by diverting capital from investment or any other spending with a high opportunity cost. In this case it is rational to rely on international aid, not only at a national level, but also at a collective level, because international assistance would be the solution that minimizes the long-term negative economic impact of natural disasters. It is likely that a country's capacity to handle the risks linked to natural hazard without international assistance will depend heavily on its stage of development. For this reason, insurance and instruments for spreading risk that are linked directly to the capital market—such as catastrophe bonds—might be accessible mainly to middle-income countries. However, in the least-developed countries, where the insurance industry is reticent because it is risk averse, the only solution might be intervention: aid flows must be adapted to address the urgent and massive needs following a disaster.

The limits of aid mentioned previously (such as the delays or the lack of coordination) are essentially caused by the tendency of the donor community to be reactive rather than proactive. Guillaumont (2006) suggests that aid could provide a guarantee to countries that agree to follow some predefined rules of shock management. This shift from ex post to ex ante conditionality could considerably reduce both delays and moral hazard. Disasters occur every year in the world, with increasing frequency. We know disasters will occur, we just do not know exactly when and where. One option would be to think of a regional or global disaster facility.

Based on recent recommendations from an evaluation (IEG 2006), the World Bank has taken the lead in establishing a pilot Global Disaster Facility with a fund of US$5 million to encourage mitigation activities. If the procedures for the use of the facility are agreed upon up front, such a facility (once scaled up) would also reduce the problems of donor coordination often seen in postdisaster reconstruction programs.

Another solution that deserves more attention, although it has already been implemented, is the use of debt relief to rapidly reduce financial pressure on the country where the disaster occurred. Debt relief circumvents regular delays related to fund release from the donors. This solution is particularly appropriate for highly indebted poor countries, where debt service can represent a serious burden, crowding out other important uses of scarce resources. For example, after the flood of 2000 in Mozambique, the World Bank approved accelerated debt relief worth US$10 million to the Mozambican government to cover 100 percent of International Development Association (IDA) debt interest over the next 12 months.

Can Disaster Preparedness Be Improved?

The Predictability of Natural Hazards

Most natural hazard risks are foreseeable, in the sense that it is possible to predict where events are more likely to occur in the near future, yet they are rarely included in country development strategies, even in highly vulnerable countries (IEG 2006).

Accurate prediction of exactly where and when a natural hazard might strike is difficult—but data covering past events can reveal which countries are more vulnerable to disasters. Some of the most advanced countries in Africa—such as South Africa—spend about US$5 million yearly for the economic cost of natural hazards, which are estimated to cost US$1 billion yearly. If forecasting research can make even a small contribution to better public decisions about mitigation of recovery costs, preparedness, and crisis management, it would justify sustaining the effort in research on climatic forecasting. Investments in early warning systems for flooding, tsunamis, and hurricanes can also help save thousands of lives, and even reduce the financial costs of disasters. There is much room for improvement in climate forecasting in Africa: the density of weather watch stations is eight times lower than the minimum level recommended by the World Meteorological Organization, and reporting rates there are the lowest in the world (Washington, Harrison, and Conway 2004).

Planning the Relief and Reconstruction

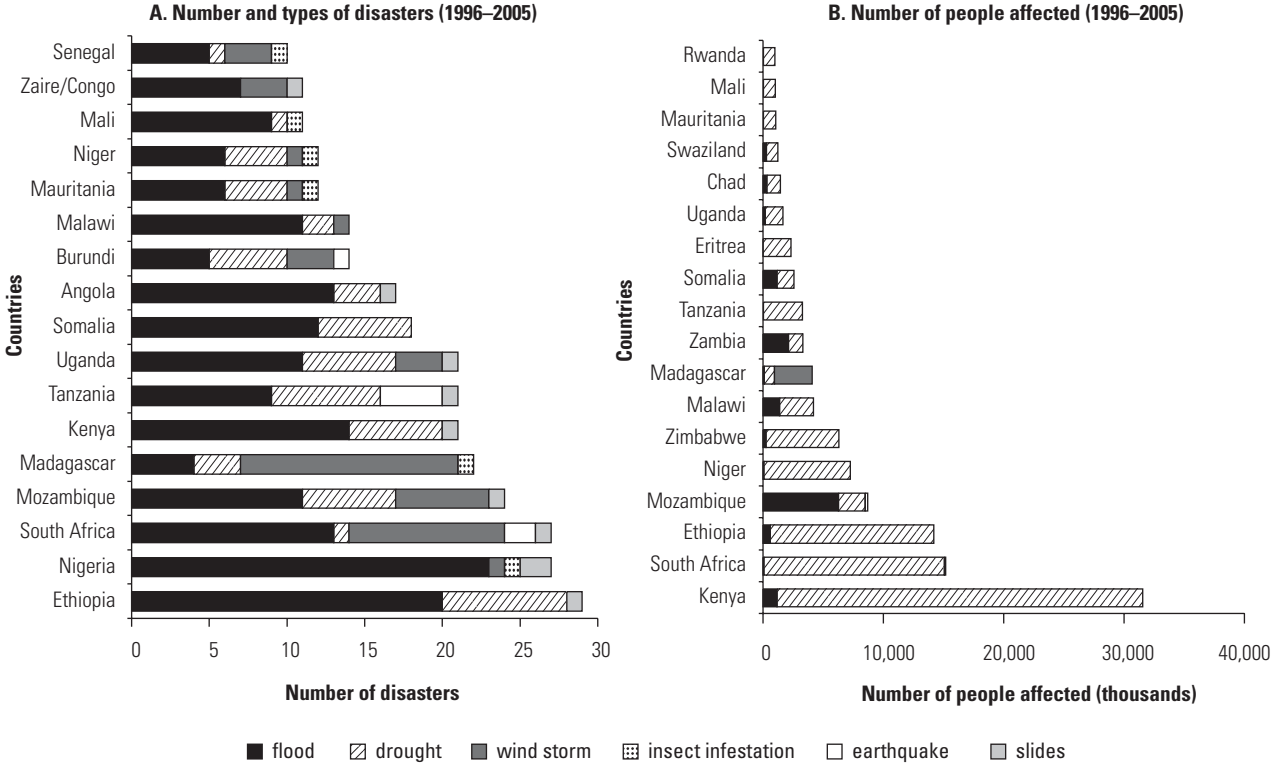
It is possible to identify a number of countries that are highly exposed to natural hazards. For example, figure 6.1 shows the countries of Sub-Saharan Africa where at least 10 disasters occurred between 1996 and 2005.

In figure 6.1B, the number of disasters and the number of people affected are represented for each kind of disaster for each country. Floods and droughts are the most frequent types of disasters in Sub-Saharan Africa, followed by wind storms. However, droughts tend to affect a much larger number of people. In countries with such a history, the probability that another disaster will occur during the next decade is very high.

Given the huge impact of disasters on poverty and economic outcomes, it would be expected that special attention would be paid to natural hazards in these countries' development strategies. However, among all the countries represented in the figure, only two have incorporated aspects of hazard risk management in their Poverty Reduction Strategy Papers (PRSPs).

A more ambitious agenda would involve prevention or reduction in the frequency of natural disasters through the design of development approaches and strategies that reduce people's vulnerability. Of course, development itself, by reducing exposure of the population to agroclimatic conditions, reduces vulnerability. But more specific actions can be taken as well, among them better water and land management, better infrastructure and housing, and more careful attention to actions that increase people's vulnerability to natural hazards.

Figure 6.1: Most Exposed Countries in Africa



Source: The Center for Research on the Epidemiology of Disasters.

Table 6.1: The Negligence of Natural Disasters in Development Strategies

Number of disasters (1966–2005)	Number of countries	Number of countries including a discussion of disasters in the PRSP
21–29	7	1 (Mozambique)
11–19	6	1 (Malawi)
1–9	18	1 (Ghana)
Total	31	3 (10%)

Note: Only Sub-Saharan countries that have a PRSP are included.

Disasters must be anticipated if rational choices are to be made, even in emergency situations. In highly exposed countries, governments should prepare a clearly defined policy framework to meet urgent needs as well as to minimize the long-term negative consequences of disasters. The policy should include a system of prioritization of individual development projects and programs to ensure that any budget reallocation would not harm those projects with the highest development impact for the country.

The Stern report (2007) also recognizes development as a key to long-term adaptation to climate change. Moreover, it points out some particular areas of development that are essential to fostering a country's adaptation to climate change:

- Income and food security
- Education and health systems
- Urban planning and provision of public services and infrastructure
- Gender equality.

The cost of adapting to climate change in the developing world is difficult to estimate, but it will be in the tens of billions of dollars. The costs of inaction, however, will be far greater. Firm measures to strengthen adaptation include the integration of climate change impact in all national, subnational, and sectoral planning processes and macroeconomic projections. Designating a core ministry, such as finance, economics, or planning, as accountable for mainstreaming adaptation would be an undeniable sign of government commitment (Sperling 2003).

CHAPTER 7

Conclusions and Directions for Future Research

The objective of this paper is to draw attention to the growing impact of natural hazards on long-term development, as well as the reciprocal effect of development on vulnerability. After a review of the existing literature, many areas have emerged that will need further investigation.

First, there is currently no consensus about the long-term economic impact of natural disasters. Some authors argue that although a subsequent negative impact is observed during the year of the shock, it is generally followed by an expansion, allowing a rapid return to the long-term equilibrium. Other authors object, noting that the reduction of human and physical capital can hinder the long-term development of the country, especially when the disasters are frequent. Because of technical difficulties, few previous studies have provided compelling empirical evidence to confirm either perspective. Both theoretical and better empirical work are needed.

Second, further theoretical and empirical studies of the long-term impact of natural disasters will have to go into greater detail in disaster analysis. It is very likely that the impact will differ according to the type of disaster, its frequency, the contribution of international aid, and the socioeconomic conditions of the country. Pooling all natural disasters together would fail to consider the vast range of possible effects, and could be misleading.

Third, the link between conflict and natural disasters and vulnerability needs more attention, especially in parts of Sub-Saharan Africa, where population pressure is being exacerbated and land degradation and desertification are increasing rapidly.

Fourth, management of Africa's forest resources and the potential for using carbon trading mechanisms to pay for their preservation open new areas for further research.

Fifth, the role of alternative funding mechanisms needs more research, whether they are market based, such as insurance and bonds; locally funded, such as microcredit schemes to reduce vulnerability; or globally or regionally prearranged funding mechanisms. Research should include a focus on how such funding mechanisms could be expanded and how the inherent moral hazard and covariance could be reduced.

Sixth, more work is also needed on adaptation to climate change. The focus has largely been on technical issues; much less attention has been given to the economic costs and benefits of different adaptation mechanisms.

Seventh, why do current development plans appear to ignore disaster risks? Is there a lack of incentives because of limited public awareness? Much more attention is needed on how economic development plans and strategies can build in disaster risk mitigation more visibly and centrally through PRSPs and national plans.

This paper has shown the importance of natural disasters to African development and the links between disaster management and economic development. The large costs of disasters, sometimes larger than aid inflows; the evidence that the intensity of disasters is determined by choices countries make on economic development; and the need to stop considering natural disasters as one-off events are highlighted in this paper. We find that despite the frequency of disasters in many African countries, the PRSPs of

only three countries discuss them. Finally, after showing that while Africa is a very small contributor to the factors causing global warming and climate change, it is likely to be the continent most adversely affected, and the paper offers some options for adaptation. We hope the paper will stimulate more discussion, more research, and better solutions to this issue.

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