Get adept at adaptation

As daunting as the risks and uncertainties of destructive weather may be, some basic tools can help countries make smart choices about how to prepare.

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Over the past 50 years, great weather disasters, including drought, floods, heat waves, and tropical storms, have caused more than 780,000 deaths and over $1 trillion in economic loss. In the past decade, the insured losses alone caused by such disasters have reached record levels, ranging between $10 billion and $50 billion per year. The risks to lives and assets—farms, roads, buildings, and so on—based on historical weather patterns have always been substantial, but they continue to grow as populations and development do.

As society continues to put more people and assets in the path of destructive weather, it must proceed with development intelligently. Well-targeted, early investment to adapt to climate hazards is likely to be cheaper and more effective than complex disaster relief efforts after the event. Not surprisingly, however, less-developed countries have not adapted to the climate as well as their more highly developed counterparts, leaving them at heightened risk of devastating loss.[1] Ironically, some of these countries boast fast-growing economies, and so are developing most busily in risky places. We have estimated the losses by 2030 in some of these countries to be as high as 12 percent of annual GDP, based on existing climate patterns. And if scientists' projections about climate change come to pass, causing more frequent and severe weather events during this period, the amount of annual GDP we estimate to be at risk in these areas rises to 19 percent. It is

[1] There is a well-documented "adaptation deficit" in developing countries. See, for example, A. Bowen, B. Chatterjee, and S. Fankhauser, "Adaptation and economic growth" (paper prepared for the UK Department of International Development, Grantham Research Institute, London School of Economics, 2009).

vital, then, that these countries incorporate adaptation measures into their economic development strategies.

The good news is that many effective adaptation measures already exist. Among much other work, reliable research on eight climate-sensitive regions (most of them in developing countries) suggests that existing, proven measures could avert at least 40 percent of climate-related losses, even if scientists' worst fears about climate change materialize.[2] Why, then, have developing countries' governments not routinely incorporated these measures into their development plans? For many governments, it boils down to two challenges. The first has to do with data. Some governments lack the data on weather patterns for their region or regions necessary to understand which existing measures would be most applicable to the risks they face. Others may have good data but aren't sure how those patterns will be altered by climate change, similarly calling into question which adaptation measures would be relevant. The second challenge has to do with the volume of available adaptation measures. How should decision makers choose among the admittedly many options? In the face of uncertainty, they succumb to the inclination not to act.

[2] The Economics of Climate Adaptation (ECA) Working Group, which included members of the public, private, and social sectors, developed a methodology for quantifying the risks associated with climate change. The group then tested and refined its methodology by applying it in eight countries or regions, including China, Guyana, India (Maharashtra), Mali, Samoa, Tanzania, the United Kingdom (Hull), and the United States (Florida). The group published a study based on this work, "Shaping climate-resilient development: A framework for decision-making," which outlines the framework and describes the case studies. Since then, the approach has been applied in additional countries and regions, including eight islands in the Caribbean—Anguilla, Antigua and Barbuda, Barbados, Bermuda, the Cayman Islands, Dominica, Jamaica, and St. Lucia.

Some basic decision-making tools can help governments conduct the analysis necessary to allow them to take action. It is possible to identify and quantify specific, local climate risks and then design a portfolio of cost-effective adaptation measures that often largely pay for themselves and, in some cases, even aid economic growth. The government of a developing country can then integrate these measures into a comprehensive economic development plan. Once the national government has developed a high-level plan for addressing the significant climate risks, it can begin to involve the many stakeholders at the country, regional, and local levels who will be needed to execute it.

Too little data, too much uncertainty, too many solutions

Countries face several challenges in assessing climate risk. Some have a severe shortage of data on historical weather patterns and economic activity. Without knowing the frequency and severity of past weather events, as well as the value at stake, governments will have difficulty projecting where and when future events will occur, and how much damage such events might inflict.

For countries that have good historical data and know how to interpret the data, the wild card is climate change. How far will it go? And, however near or far that is, how much of a problem will it be in any given area of the world? For example, general circulation models incorporating climate change pointed to an overall increase in average rainfall in Tanzania through 2030. This appeared to contradict other projections that the country's central region would experience more drought. Digging deeper revealed there was no contradiction: Tanzania is forecasted to face increased rainfall on the coasts and greater drought in the central region. But the tendency not to dig deeply enough is precisely what leaves people paralyzed. In Guyana, the situation was even more difficult. The limited available data on global warming suggested two possible—and contradictory—changes in rainfall patterns through 2030: a 5 percent decrease, which would lessen flooding, and a 10 percent increase, which would worsen it significantly. Many decision makers believe it is impossible to plan adaptation measures based on diverging predictions such as these.

Even if climate risk were easy to assess, the sheer range of adaptation measures on offer makes it difficult to choose those best capable of protecting life and property in the most cost-efficient manner for a given risk. Decision makers can draw on a wealth of existing research developed in recent years by governmental, intergovernmental, private, nonprofit, and academic organizations.[3] Until now, however, there has been no systematic approach to calculate and compare the costs and benefits of these measures.

Decision makers who do not make the effort to determine what the risks are and how to best mitigate them in a coordinated way are likelier to make decisions that are less than optimal and in some cases may even counteract each other. For example, the government in Samoa funded two adaptation measures simultaneously: the building of roads inland to encourage people to move away from the coasts and the building of seawalls to prevent coastal flooding. Not only was the seawall project relatively expensive for the benefits it would offer, but it also negated the benefits of building roads. Because the seawalls made people feel safer in coastal areas, residents were less inclined to move inland. In other cases, expensive adaptation decisions made hastily in response to immediate perceived threats may not be the best investments, at least in the short term. For example, in response to a drought that began in 1987, the city of Santa Barbara, California, decided in 1991 to fund a $35 million seawater desalination plant. By the time the plant was completed the following year, the drought had ended, and the plant has not yet been used. Likewise, a series of reactive adaptation measures adopted in an uncoordinated way by private actors may protect individual households or assets but probably will not address an economy's overall vulnerability. Also, marginal populations already poorly adapted to climate are likely to be neglected.

Furthermore, societies that fail to take any climate adaptation measures, falling back on aid in the wake of disasters, could put much higher economic value and many more lives at risk.

Assessing and addressing the risks

What is to be done? Even for locations where climate and economic data are sparse (as is often the case in least-developed countries) or where the potential effects of climate change are not understood, there is a way to estimate potential climate-related losses and quantify the economic costs and benefits of a wide range of adaptation measures. This new approach applies across hugely diverse locations, climate risks, and economic impacts, enabling decision makers to make better development decisions.

The first step is to identify the most relevant hazards. This is, of course, easier in some cases than in others but possible everywhere. For example, in many small Caribbean countries, hurricane-related hazards such as wind damage, inland flooding, coastal flooding, and storm surge pose the most severe risks to populations and economies. However, in larger countries, the threats can vary from region to region, as noted in the earlier example of Tanzania. Where good data are available,

[3] The UN Framework Convention on Climate Change has done extensive work to identify effective adaptation measures through the National Adaptation Programs of Action conducted in more than 40 least-developed countries. Several other groups have conducted adaptation studies as well, including the US Country Studies Program, the UN Development Program's Adaptation Policy Frameworks, and the World Resources Institute. The ECA Working Group evaluated more than 600 different adaptation measures for its report.

analysis can focus on historical rainfall patterns and the effects of weather in terms of fatalities, disease, and damage to buildings, livestock, and crops. Where data are limited or conflicting, local officials and academic experts can help fill in the gaps. In Tanzania, local health and precipitation data allowed calculations for initial correlations between disease incidence and prevalence. Local health care expertise was critical to understanding these correlations—and contradicted some of the beliefs of external researchers.

After identifying the relevant hazards, decision makers need to estimate "total climate risk." This figure will include expected losses to lives and existing assets from current climate patterns, as well as projections of what else will be at risk due to economic growth and climate change. The first of these variables can be calculated by assigning values to the people, assets, and income that lie in the path of the hazards identified in the first step. In Samoa, for example, we assessed the damage caused by coastal flooding by using very detailed geographical data and simulating events of different intensities.

The second variable is what else will be at risk. Determining this involves making projections about how much value will be at stake in the future through an analysis of current growth trends.

The third variable, climate change, is perhaps where many governments encounter the most trouble. How to plan for something over which there is so much debate? But the fact is that the scientific community knows enough about the possible range of outcomes to build plausible scenarios of what might happen, even where data are limited. We suggest that decision makers use scenario-planning techniques to assess a range of possible futures, usually three: no climate change, moderate change, and high climate change. The scenario-planning exercise establishes the outer limits of the risks a location might face, not for the purpose of determining which are most likely to happen, but to help governments make the no-regrets moves that will be economically attractive under all three scenarios.

The next question seems inevitable: "What can we do to minimize these risks?" But because decision makers should tackle climate adaptation as part of an economic-development strategy, we suggest reframing the question as "How can we reach our development targets while accounting for current and future risks?" As noted earlier, most of the solutions already exist, and they can be grouped into four main categories:

1. Infrastructure-based responses—physical changes to existing assets or the building of new assets, such as planting mangrove-tree buffers and building houses on stilts in Samoa to protect against floods

2. New technologies or processes—such as, in India, better fertilizer application to improve crop yields and wider use of electronic timers for irrigation systems to lower the consequences of drought

3. Behavioral change—incentives to increase adaptation (for example, better enforcement of building codes or zoning regulations) or steps that will encourage the population to undertake a coordinated systematic response (such as awareness campaigns and improved emergency response training)

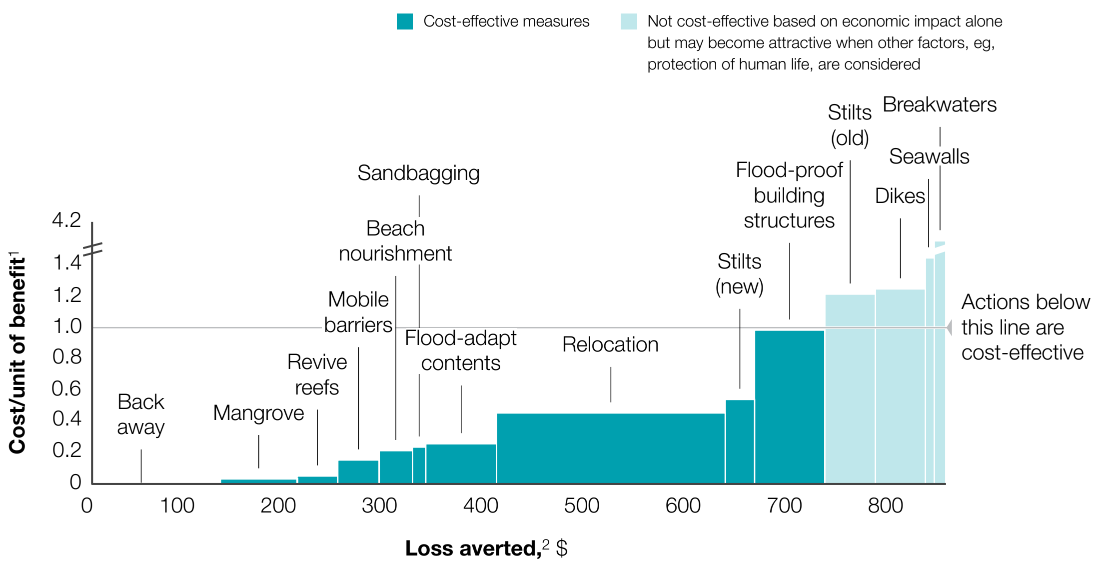
4. Insurance and other financial means of risk transfer—available for low-frequency, high-severity events

Many potential adaptation measures are available in each of these four categories—indeed, too many to list here. Decision makers should work with local nongovernmental organizations, leaders in the public and private sectors, and experts (climate scientists, private- and public-sector engineers, etc.) to identify the measures that are most applicable to local hazards and most feasible to implement. For example, the group developing a list of possible measures to consider in Mali held workshops with leaders, administrators, and experts involved in the National Adaptation Programs of Action process, as well as local farmers.

Next, decision makers need to apply a thorough cost/benefit analysis to the measures identified. Exhibit 1 shows how this type of analysis was applied to flood-related threats facing Samoa. For example, the costs of planting mangrove-tree buffers and building houses on stilts were calculated and weighed against the financial benefits of averting floods (that is, assets protected). The resulting ratios are then placed along a cost curve, ranging from the most cost-effective measures on the left to the least cost-effective on the right. The x-axis shows the total loss averted by each measure, and the y-axis shows the ratio of the measure's cost per unit of benefit. In a situation where adaptation measures could also improve revenue—for example, the enhanced agricultural production that would result if areas in India were to make better use of fertilizer and irrigation control—the curve would

Exhibit 1

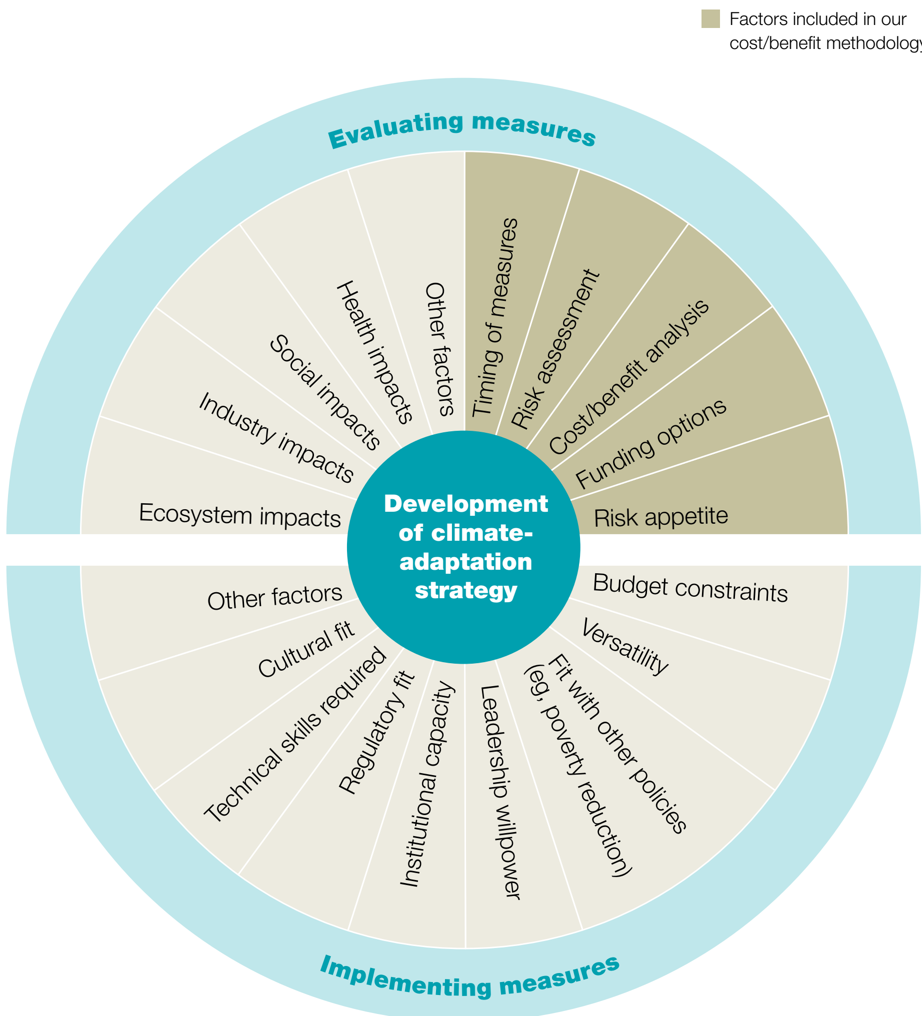
Adaptation cost curve identifies cost-effective actions.



[1] Ratio of all costs to all benefits of given measure. Costs and benefits calculated using existing practices and costs. This ratio is a net present value calculation discounted at local rates.
[2] Reduction of expected loss by implementing given measure.

Exhibit 2

Considerations go beyond costs/benefits.



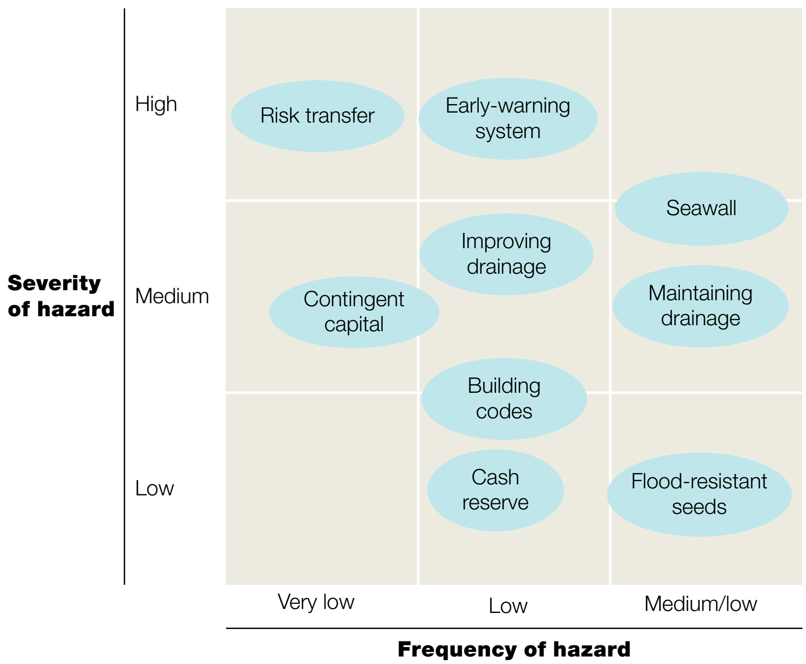
show their lifetime benefits to outweigh their costs, placing them below the zero line on the y-axis. In addition, of course, governments also need to consider the value of human life beyond what is shown by the cost curve.

As with all cost/benefit analysis, the results of the cost curve do not alone provide an explicit answer on what adaptation measures would be most effective for a particular location. Decision makers need to create a prioritized portfolio based not only on costs and benefits but also on a range of other considerations, such as the ease of implementing measures from a political perspective (Exhibit 2).

Also, of course, the portfolio should address hazards of differing frequency and severity

Exhibit 3

Balance portfolio of measures across range of hazards.



(Exhibit 3). Prioritizing the portfolio according to these factors can result in some different strategies, even for locations that appear to face similar risks. For example, it so happens that Jamaica has a higher likelihood of being struck by a major hurricane than its Caribbean neighbor, Dominica. As a result, Jamaica would likely recover the costs of adaptation measures relatively quickly because such measures could avert damage to buildings from multiple events in a short period. In contrast, because Dominica is less likely to face a direct hurricane strike, that country is less likely to find that extensive adaptation measures aimed at that risk would be cost-effective. However, because a potential hurricane strike could be truly devastating, some of the less expensive adaptation measures will make sense for both countries (as will, of course, measures aimed at protecting human life). For example, enforcing or modifying zoning laws to prevent new development in high-risk areas is almost always cost-beneficial. Preserving existing, and often threatened, natural defense systems such as mangroves and coral reefs is another very low-cost measure. The experiences of areas hit by the 2004 Pacific tsunami showed that these two natural barrier systems can avert significant amounts of wave damage. Moreover, coral reefs promote tourism, which can create substantial economic value.

This point leads to another consideration: in many cases, a balanced portfolio of adaptation measures can also strengthen economic development. In Mali, for example, the Mopti region faces the threat of a gradual southward shift of the Sahara Desert. Greater cultivation of cash crops in this region could help generate around $2 billion per

year in new revenue—enough to cover a large part, if not all, of the expected loss for the entire country. Implementing these measures would be challenging, requiring substantial efforts by the government, nongovernmental organizations, and development organizations. The ability to demonstrate that these measures would provide such a large net economic benefit, therefore, is crucial to building the support necessary to underpin complex action, as well as to attracting private investment and triggering valuable new innovations and partnerships.

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Governments can benefit from beginning to develop a comprehensive approach to adaptation and involving decision makers at the country, regional, and local levels. Ideally, the effort would be led by a senior government decision maker, with significant support from the private sector, the social sector, and academic experts. The ultimate goal would typically be a plan that requires action by a range of parties: The central government would integrate risk-management policies into economic-development plans. Government agencies would regulate, incentivize, and implement relevant preventive strategies. Local government would implement protective zoning regulations. NGOs would expand the knowledge base on possible adaptation measures, spread best practices, and encourage the funding and implementation of measures particular to their areas of focus. The private sector would provide products and services that help manage climate risk. And individuals would enhance their own and their community's disaster preparedness capabilities.

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