

Adapting to Consequences Due to Climate Change for Sustainability in Developing Countries

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Abstract

Adapting to consequences due to climate change to achieve sustainable development is a challenging job. Even with global emissions of greenhouse gases drastically reduced in the coming years, the global annual average temperature is expected to be 2°C above pre-industrial levels by 2050. A 2°C warmer world will experience more intense rainfall and more frequent and more intense droughts, floods, heat waves, and other extreme weather events. Unless the world begins immediately to reduce greenhouse gas emissions significantly, global annual average temperature will increase by about 2.5°C to 7°C above pre-industrial levels by the end of the century. It is important to develop an estimate of adaptation costs for developing countries and to help decision makers in developing countries understand and assess the risks posed by climate change and design better strategies to adapt to climate change.

Keywords: Adaptation; climate change; sustainability; developing countries.

1. Introduction

Households, communities, and planners need to put in place initiatives that “reduce the vulnerability of natural and human systems against actual and expected climate change effects” (IPCC 2007). Without such adaptation, development progress will be threatened—perhaps even reversed. While countries need to adapt to manage the unavoidable, they need to take decisive mitigation measures to avoid the unmanageable. Even with substantial public interventions, societies and ecosystems

will not be able to adapt to these impacts. Under the December 2007 Bali Action Plan adopted at the United Nations Climate Change Conference, developed countries agreed to allocate “adequate, predictable, and sustainable financial resources and [to provide] new and additional resources, including official and concessional funding for developing country parties” (UNFCCC 2008) to help them adapt to climate change. Yet, existing studies on adaptation costs provide only a wide range of estimates, from \$4 billion to \$109 billion a year, and have many gaps. Similarly, National Adaptation Programs of Action (prepared by Least Developed Countries under the United Nations Framework Convention on Climate Change, UNFCCC) identify and cost only urgent and immediate adaptation needs, and countries do not typically incorporate adaptation measures into long-term development plans [1-4]. To shed light on adaptation costs—and with the global climate change negotiations resuming in December 2009 in Copenhagen—the Economics of Adaptation to Climate Change (EACC) study was initiated by the World Bank in early 2008. The cost between 2010 and 2050 of adapting to an approximately 2°C warmer world by 2050 is in the range of \$75 billion to \$100 billion a year. The intuitive approach to costing adaptation involves comparing a future world without climate change with a future world with climate change [5-9]. The difference between these two worlds entails a series of actions to adapt to the new world conditions. And the costs of these additional actions are the costs of adapting to climate change.

2. Predicting Impacts

An analysis was done to predict what the world would look like under the new climate conditions. This meant translating the impacts of changes in climate on various economic activities (agriculture, fisheries), on people’s behavior (consumption, health), on environmental conditions (water availability, oceans, forests), and on physical capital (infrastructure). Adaptation costs were estimated by major economic sector—infrastructure, coastal zones, water supply and flood management, agriculture, fisheries, human health, and forestry and ecosystem services. Cost implications of changes in the frequency of extreme weather events were also considered. Cross-sectoral analysis of costs was not feasible. Many countries face a more general “development deficit,” of which the part related to climate events is termed the “adaptation deficit.” There are two ways to estimate the costs of adaptation: with the adaptation deficit or without it. This study chose to make the adaptation deficit a part of the development baseline, so that adaptation costs cover only the additional costs to cope with future climate change. Thus, the costs of measures that would have been undertaken even without climate change are not included in adaptation costs, but the costs of doing more, doing different things (policy and investment choices), and doing things differently are.

3. Adaptation Measures

These can be classified by the initiating economic sector—public or private. This study includes planned adaptation (adaptation that results from a deliberate public policy decision) but not autonomous or spontaneous adaptation (adaptation by households and communities acting on their own without public interventions but within an existing public policy framework). Since the objective is to help governments plan for risks, it is important to have an idea of what problems private markets will solve on their own, how public policies and investments can complement markets, and what measures are needed to protect public assets and vulnerable people—that is, planned adaptation. In all sectors, “hard” options involving engineering solutions were favored over “soft” options based on policy changes and social capital mobilization—except in the study of extreme weather events, where the emphasis is on investment in human resources, particularly those of women. Although hard adaptation options are feasible in nearly all settings, while soft options depend on social and institutional capital and thus may not be available in many settings, this focus on hard options was largely to ease computation of adaptation costs and not to suggest that these are always preferable. Countries have several options. They can try to fully adapt, so that society is at least as well off as it was before climate change. They can choose to do nothing—to suffer (or enjoy the benefits from) the full impact of climate change. Or they can decide to adapt to the level where the benefits from adaptation equal their costs, at the margin. The study assumes that countries will adapt up to the level at which they enjoy the same level of welfare in the (future) world as they would have without climate change. This is not necessarily the most economically rational decision, but it is a practical rule that greatly simplifies the exercise.

4. Adaptation Costs

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation costs as the costs of planning, preparing for, facilitating, and implementing adaptation measures, including transaction costs. Analysis indicates that the cost between 2010 and 2050 of adapting to an approximately 2°C warmer world by 2050 is in the range of \$75 billion to \$100 billion a year (table 1). This range is of the same order of magnitude as the foreign aid that developed countries now give developing countries each year, but it is still a very low percentage of the wealth of countries (measured by their GDP). Total adaptation costs average \$10 billion a year more calculated by the gross sum method than by the other two methods (the insignificant difference between the X-sum and net sum figures is largely a coincidence). The difference is driven by countries that appear to benefit from climate change in the water supply and flood protection sector, especially in East Asia and Pacific and South Asia. Coastal adaptation costs are significant and vary with the magnitude of sea-level rise, making it essential for policymakers to plan while accounting for the uncertainty. Climate change has already affected the hydrologic cycle, a process that is expected to intensify over the century. In some parts of the world, water availability has increased and will continue to increase, but in other parts, it has decreased and will continue to do so.

Moreover, the frequency and magnitude of floods are expected to rise. Changes in temperature and precipitation from both climate scenarios will significantly hurt crop yields and production—with irrigated and rain-fed wheat and irrigated rice the hardest hit. South Asia shoulders the biggest losses in production, but developing countries fare worse for almost all crops compared with developed countries. The key human health impacts of climate change include increases in the incidence of vector-borne disease (malaria), water-borne diseases (diarrhea), heat- and cold-related deaths, and injuries and deaths from flooding and in the prevalence of malnutrition. By 2050, neutralizing the impact of extreme weather events requires educating an additional 18 million to 23 million young women at a cost of \$12 billion to \$15 billion a year.

Table 1: Estimates of adaptation costs for infrastructure from previous studies (billions).

Study	New investment flows (\$ billions)	Percent of new investment sensitive to climate	Additional costs to reduce risk from climate change (percent)	Costs (\$ billions)
World Bank (2006)	1,760a	2–40	10–20	9–41
Stern (2007)	1,760a	2–20	5–20	4–37
UNDP (2007)	3,112b	2–33	5–20	5–67
UNFCCC (2007)	5,417c	1–3	5–20	2–41

Source: Economics of Adaptation to Climate Change study team analysis of listed sources.

a In 2000; b In 2005; c In 2030, backed out as mean of upper and lower bounds..

5. Conclusion

Temperature increases higher than 2°C say on the order of 4°C are predicted to significantly increase the likelihood of irreversible and potentially catastrophic impacts such as the extinction of half of species worldwide, inundation of 30 percent of coastal wetlands, and substantial increases in malnutrition and diarrheal and cardio-respiratory diseases. Climate change affects agriculture through changes in yields and in areas planted. Farmers respond by changing their management practices. The resulting production effects work their way through agricultural markets, affecting prices. Consumers respond by changing consumption patterns. When prices rise, consumption falls and the number of malnourished children rises. Adaptation expenditures on productivity-enhancing investments can offset these impacts of climate change. Costs of adaptation are measured against the human well-being measure of malnutrition in preschool children, a highly vulnerable group. The number of malnourished children is determined in part by per capita calorie availability but also by access to clean drinking water and maternal education. Investments in agricultural research, roads, and irrigation increase agricultural productivity under climate change, increasing calorie

availability and reducing child malnutrition estimates. The costs of adaptation for agriculture are calculated solely from the perspective of the agriculture sector, so the starting point is investment and asset stocks in the base year (2000). Thus, the estimates of investments in research, irrigation, and rural roads do not take account of overlaps in spending on these activities or assets with the baseline growth or of adaptation costs for other sectors, such as infrastructure and water resources management. This is an unavoidable consequence of estimating the cost of adaptation for each sector separately and in parallel. For rural roads, an attempt was made to eliminate overlapping expenditures in compiling the consolidated estimates of the costs of adaptation for developing countries shown later in the report in table 24. The baseline provision of rural roads up to 2050 used to estimate costs of adaptation is adjusted to take account of the additional length of rural roads consistent with the baseline projections for road investment. This adjustment reduces the investment in rural roads included in the cost of adaptation for agriculture by about 80–85 percent for the two climate scenarios. The adjustment for these overlaps amounts to \$2.0–\$2.2 billion a year averaged over the full period.

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