Estimating the Costs of Adaptation to Climate Change

According to a new study prepared by the World Bank, the cost of adapting to climate change (to an approximately 2°C increase in temperature by 2050) will be in the range of $75 billion to $100 billion a year. The Economics of Adaptation to Climate Change (EACC) study, initiated by the World Bank in 2008, had as its objectives (i) to develop an estimate of adaptation costs for developing countries and (ii) to help decision makers in developing countries understand and assess the risks posed by climate change and design better strategies to adapt to it.

Study Methodology - The EACC’s approach to costing adaptation involved comparing a future world without climate change with a future world with climate change. The difference between these two worlds entails a series of actions to adapt to the new world conditions; the costs of these additional actions are the costs of adapting to climate change. The EACC chose 2050 for the timeframe for the study, developing baselines for the various sectors studied. The EACC employed two climate scenarios in order to capture as large as possible a range of model predictions. Model predictions do not diverge much in projected temperature increases by 2050, but precipitation changes vary substantially. For this reason, the study used two model scenarios that reflected extremes of dry and wet climate projections. The study then translated the impacts of changes in climate on the various economic activities (agriculture, fisheries), on people’s behaviour (consumption, health), on environmental conditions (water availability, oceans, forests), and on physical capital (infrastructure). Finally, the EACC estimated adaptation costs by major economic sector—infrastructure, coastal zones, water supply and flood management, agriculture, fisheries, human health, and forestry and ecosystem services.

Study Findings - The drier climate scenario requires lower total adaptation costs than does the wetter scenario, largely because of the sharply lower costs for infrastructure, which outweigh the higher costs for water and flood management. In both scenarios, infrastructure, coastal zones, and water supply and flood protection account for the bulk of the costs. Infrastructure adaptation costs are highest for the wetter scenario, and coastal zones costs are highest for the drier scenario.

On a regional basis, for both climate scenarios, the East Asia and Pacific Region bears the highest adaptation cost, whereas the Near East and North Africa Region bears the lowest. Latin America and the Caribbean and Sub-Saharan Africa follow East Asia and Pacific in both scenarios. On a sector breakdown, the highest costs for East Asia and the Pacific are in infrastructure and coastal zones; for Sub-Saharan Africa, water supply and flood protection and agriculture; for Latin America and the Caribbean, water supply and flood protection and coastal zones; and for South Asia, infrastructure and agriculture.

Not surprisingly, both climate scenarios show costs increasing over time, although falling as a percentage of GDP—suggesting that countries become less vulnerable to climate change as their economies grow. There are considerable regional variations, however. Adaptation costs as a percentage of GDP are considerably higher in Sub-Saharan Africa than in any other region, in large part because of the lower GDPs in this region.
**Agriculture.** Climate change affects agriculture by altering yields and changing areas where crops can be grown. The EACC study shows that changes in temperature and precipitation from both climate scenarios will significantly hurt crop yields and production—with irrigated and rainfed wheat and irrigated rice the hardest hit.

**Coastal zones.** Coastal zones are home to an ever growing concentration of people and economic activity, yet they are also subject to a number of climate risks, including sea-level rise and possible increased intensity of tropical storms and cyclones. These factors make adaptation to climate change critical. The EACC study shows that 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.

**Water supply.** Climate change has already affected the hydrological cycle, a process that is expected to intensify over the course of the 21st 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.

**Human health.** 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, injuries and deaths from flooding, and the prevalence of malnutrition. The EACC study, which focuses on malaria and diarrhea, finds adaptation costs falling in absolute terms over time to less than half the 2010 estimates of adaptation costs by 2050.

**Infrastructure.** The EACC found that this sector accounted for the largest share of adaptation costs. Urban infrastructure—urban drainage, public buildings and similar assets—accounts for about 54 percent of the infrastructure adaptation costs, followed by roads (mainly paved) at 23 percent. East Asia and the Pacific and South Asia face the highest costs, reflecting their relative populations.

**Conclusions:** The EACC reaches the following conclusions:

- **First, adaptation to a 2°C warmer world will be costly.** The study puts the cost of adapting between 2010 and 2050 to a warmer world by 2050 at **$75 billion to $100 billion** a year.
- **Second, the world cannot afford to neglect mitigation.** Adapting to an even warmer world than the 2°C assumed for the study—on the order of 4°C above pre-industrial levels by the end of the century—would be much more costly. Countries must take steps immediately to sharply reduce greenhouse gas emissions.
- **Third, development is imperative, but it must take a new form.** Development is the most powerful form of adaptation. It makes economies less reliant on climate-sensitive sectors, such as agriculture. Countries may have to shift patterns of development or manage resources in ways that take account of the potential impacts of climate change.
- **Fourth, uncertainties are large, so robust and flexible policies and more research are needed.** The imprecision of models projecting the future climate is the major source of uncertainty and risk for decision makers. Thus, it is crucial to undertake research, collect data, and disseminate information so that if climate change turns out to have worse impacts than anticipated in 20 or 30 years, countries can respond more quickly and effectively. In the meantime, countries should pursue low-cost policies and investments on the basis of the best or median forecast of climate change at the country level.

**For more information on the EACC:** worldbank.org/eacc