Plugging The Climate Adaptation Gap With High Resilience Benefit Investments

December 7, 2018

Key Takeaways

- Adaptation financing needs to substantially increase to address the higher impact of extreme weather to society due to climate change.
- Adaptation projects are typically cost effective and bring wide range of resilience benefits.
- To demonstrate the value of resilience benefits to various stakeholders we consider that it is important to quantify those benefits based on a robust modeling framework.
- We expect that due to the large size of the adaptation gap and constrained public finances, private investment would need to make a considerable contribution to adaptation financing.

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We believe the recent surge in economic damage from extreme climatic events may focus the attention of public authorities about the need for adaptation investments and accelerate investment in this area. The United Nations Environment Program (UNEP) forecasts adaptation costs in developing countries at between $140 billion and $300 billion by 2030, and $280 billion and $500 billion by 2050. That is approximately 6x-13x above the amount of international public-sector finance available today--just to meet 2030 costs.

Over the last two years, the world has seen a flurry of extreme weather, which has exposed the vulnerability of many countries to these events. Climate change may make matters worse, irrespective of whether we manage to keep global warming to 2 degrees Celsius or not. Attention to climate change adaptation is therefore increasing, especially about how to finance it, given the need to raise enough public and private investment to fortify exposed countries and communities against the potentially devastating effects of physical climate risk.

Investment in adaptation can offer cost-effective protection against extreme weather damage, what we refer to as a "resilience benefit." In particular, demonstrating a strong resilience benefit should attract private investors interested in investments with significant resilience in addition to an attractive risk-return profile. The successful adoption of new financial instruments that introduce a strong link between investment returns and resilience benefits could further help uptake in adaptation investments. There are various ways to assess resilience benefits, including one developed by S&P Global Ratings as part of its Green Evaluation methodology.

What We Consider To Be An Adaptation Project

Adaptation projects aim to strengthen the resilience of buildings, critical infrastructure, and communities against the risk of extreme weather or longer-term shifts and variability in weather patterns caused by climate change. The world is going to need to adapt to greater heat and water stress, more severe droughts, floods, storms, and forest fires that climate change is expected to bring. Strengthening flood defenses is probably the most common adaptation investment, in particular in coastal areas to protect against the impact of increased storm surges due to rising sea levels.

An adaptation project could involve hard engineering infrastructure, for example, a flood wall; a nature-based solution such as wetland restoration; or soft infrastructure, like development of an early-warning system. The project size could range from a very large and complex to small and local. The sole purpose of a project could be improvements in community resilience, for example, flood defense. Or, a project could be an add-on to another project to ensure that it is climate resilient, for example, investing an additional amount to ensure that a new building is resilient to extreme weather events.

The Resilience Benefits

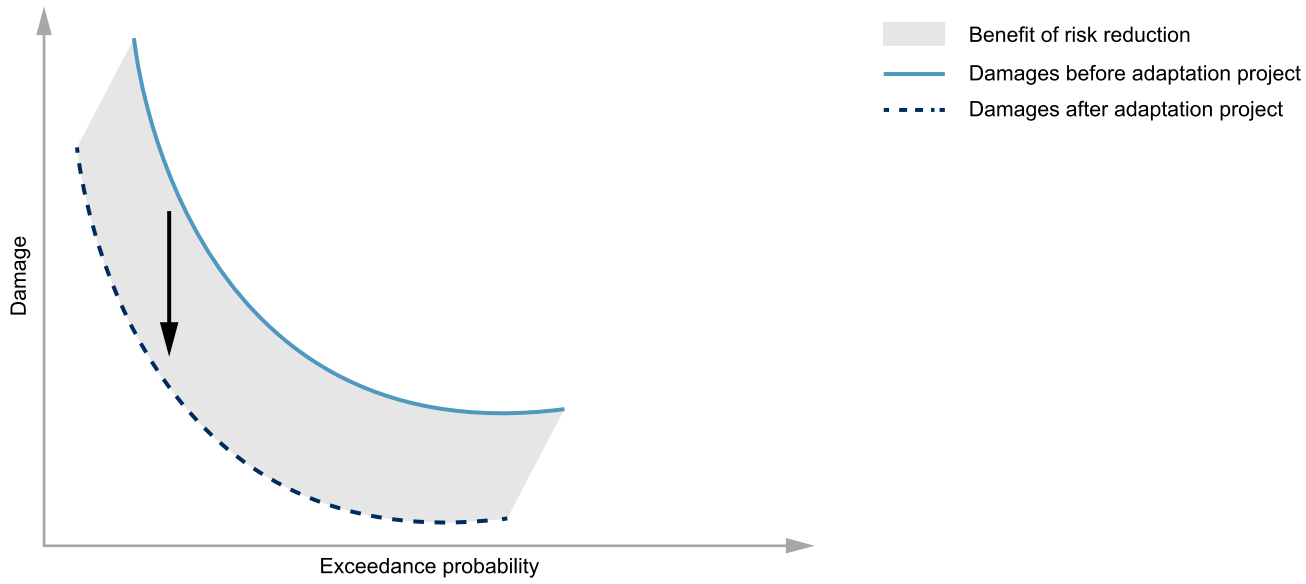
Adaptation in many cases is cost effective, that is, the benefits substantially exceed the investment. The most obvious benefit is reducing the possibility and extent of physical damage from extreme weather events. For example, had the levees in New Orleans been effective as intended, the major flood caused by Hurricane Katrina in 2005 and subsequent property damage would have been avoided. Another important benefit arises from minimizing the economic disruption following the event. Reducing damage and disruption is likely to lead to further social and ecological benefits.

Extreme weather events may disrupt economic activity, which is also likely to affect peoples' livelihoods. Businesses may be forced to close until damage is cleared or in case of a disruption to water and electricity services. Extreme weather events may cause higher operating costs. For example, businesses may use generators to supply electricity if there is a power failure or incur higher travel costs if there are transport disruptions. The economic disruption could extend beyond the affected region through global supply chains. For example, the floods in Thailand in 2011 had a global impact on computer and car production because the production of key parts was concentrated in the flooded area. What's more, extreme weather events could weigh on public finances if spending is increased to help affected communities and if they dampen economic activity.

Social benefits arise from reducing the risk of major disruption to the livelihoods of the people living in the affected area. Residents may incur health costs associated with treating sickness and injury, for example, due to water-borne diseases following floods. There could be an extra cost to obtaining drinking water and electricity if supplies are disrupted. Also, extreme weather events may cause psychological stress from injury or death to family members, lost income, or damaged possessions. For example, Hurricane Matthew, which hit Haiti in 2016, led to significant upheaval to the local population; agricultural losses reduced income and contributed to food shortage and malnutrition, while damage to the water supply led to cholera outbreaks.

Chart 1

Impact Of Adaptation On Expected Damages



Source: S&P Global Ratings.

There are likely to be ecological benefits as well because adaptation may also protect the natural environment. For example, the huge flooding triggered by Hurricane Florence this year caused raw sewage, swine waste, and coal ash ponds to spill over and enter the water system. If adaptation projects include nature-based solutions, they may also help restore the natural habitat. For example, the restoration of sand dunes helps coastal ecosystems thrive. From an environmental standpoint, nature-based solutions may be an attractive option because of their low carbon footprint relative to hard infrastructure. Nevertheless, their effectiveness and expected resilience benefit in case of very extreme weather events needs to be considered.

There could be considerable secondary financial benefits from improvements in resilience. They may promote economic development in an area adequately protected against extreme weather events that formerly wasn't. For example, flood protection of low-lying areas against storm surges in the Netherlands helped economic development of those areas. Another financial benefit may come if insurance costs drop in the protected area, reflecting reduced natural catastrophe risk. Insurance costs could decrease if an area, previously prone to frequent flooding, adds protection against major flood damage.

It's not just about protecting property

It is important to recognize that if the main driver for an adaptation project is to avoid property damage, adaptation investment may be diverted to high-end real estate areas. Arguably, wealthy communities may be the most able to recover even after a major natural catastrophe. Typically, such areas recover very quickly following a natural catastrophe. For example, as a whole, economic activity in Houston, which experienced very severe flooding following Hurricane Harvey, recovered quickly, but the poorest parts of the city are still suffering the consequences of the

damage. In contrast, given the low asset values in poorer areas, the value of the adaptation may be significantly understated if only physical damage is taken into account. For them, the much larger benefit is likely to be the avoidance of critical disruption to the livelihood of those vulnerable communities that may lack the safety net of richer communities. Following Hurricane Maria, many poor communities were completely destroyed, leading to significant hardship, with many of the residents choosing to emigrate to mainland U.S. Capturing and quantifying social benefits are therefore key to recognizing the high value of adaptation to such communities.

Quantifying The Benefit

While the existence of different types of benefits of adaptation is often well appreciated, quantifying the expected benefits is usually difficult. This requires models to capture the variety of benefits across weather events of different magnitude and over a long projection period, for which detailed historical damage and exposure data are needed. In addition, such models need to take into account long-term climate scenarios, incorporating projections of how climate might develop and how exposure to the resulting risks might change because of growth in assets and population.

Climate change is expected to increase the overall severity and frequency of extreme weather events. However, there is no scientific agreement on the precise change, which is likely to vary significantly among different types of weather events and geographies. For example, some areas may become wetter, increasing the risk of floods, while other areas may become dryer, which could reduce the overall risk of floods but will likely increase drought risk.

There is also uncertainty about growth of exposure in high-risk areas, in particular regarding asset values and population. Exposure in those areas could grow because of overall economic development and their general attractiveness, for example, near coastlines. Recently, because the biggest economic centers are typically found on coasts, asset value and population growth there has considerably outpaced that of inland areas. Alternatively, exposure could decline if the increased risk discourages people from living in those areas or regulations constrain developments in high-risk areas. Some low-laying islands in the U.S. have been abandoned because of frequent flooding at high tide caused by the rise in sea levels. Even if exposure grows, new developments and infrastructure could be built in a more resilient way, which could reduce overall risk exposure.

When quantifying the benefit, it is important to consider all costs and potential negative impacts as well. In particular, any increased damages to other areas as a result of the project need to be taken into account. For example, a flood defense project in one area may increase flood likelihood in a neighboring area as the flood water is diverted. In 2014, the magnitude of the floods experienced in some towns on the Thames River was blamed on the artificial river diversion channel built to protect the areas around Maidenhead. It should also be noted that all adaptation infrastructure requires regular maintenance to operate as intended. The associated costs, which in some cases may be enormous, also need to be reflected in the quantification to determine the total overall net benefit. Lack of adequate maintenance was a factor why the levees in New Orleans were breached.

Difficulties in the quantification

While there are well-established methods and models to calculate avoided property damage, economic and social benefits are harder to evaluate because of their wider systemic impact, which requires understanding of how the different elements of the system are affected and interact with each other. While academics and businesses are developing tools to address these

modeling gaps, quantifying these aspects may remain challenging for a while. Nevertheless, we consider that even if it is not possible for them to be fully quantified, they should be sufficiently highlighted to communicate the wider benefit of the adaptation project.

Overall, we recognize that calculating the benefit of adaptation projects often takes place amid considerable data, assumptions, and modeling challenges. These challenges may introduce a material level of model uncertainty, which could overestimate or underestimate the overall level of the benefit. This is why disclosing the sensitivities of the value of the benefits to key assumptions is important in understanding the degree of uncertainty. Also, flexible investments may be a useful way to deal with uncertainties regarding the precise impact of climate change, but they often increase the overall cost of the project.

Value of quantification

Despite these considerable modeling challenges, we consider that quantification of all of the various impacts of adaptation is important to demonstrate the value of the investment and avoid suboptimal adaptation. Given the difficulties and modeling uncertainties in calculating the resilience benefit, we consider it important to adopt a sufficiently robust modeling framework. That framework and key assumptions--exposure growth rates, assumed global warming, and discount rates, for example--should be disclosed along with the results. This should be complemented by a discussion of inherent modeling uncertainties illustrated through, for example, sensitivities.

Demonstrating the value of the adaptation benefit should be important for all stakeholders: sponsors, the public, and investors. In particular, demonstrating a strong resilience benefit is likely to attract more private investors. This is because there are climate-minded investors, which in addition to risk-return characteristics, will also consider the environmental benefit of investment opportunities.

It is true that the return of those investments is not directly linked to the expected resilience benefit of the investment. However, in many cases adaptation investments may indirectly help returns. For example, if a local authority issues a green bond to invest in an adaptation project, the project should help the local economy and community to be more resilient to natural catastrophes. So, when one occurs, the finances of the local community should suffer a smaller shock than without the adaptation project. Everything else being equal, this could lead to better credit quality for the issuer and potentially a better investment return on all bond issues by the local authority, including the green bond used to finance the adaptation project.

To link the investment return of the financing instrument and the achieved resilience of the financed project, a number of new financial instruments are being proposed, for example by Lloyd's in partnership with the U.K. government's Centre for Global Disaster Protection (see their recent report, "Innovative finance for resilient infrastructure"). While their adoption in practice will take time, such instruments should increase adaptation with good resilience benefit due to the direct link between the investment return to investors.

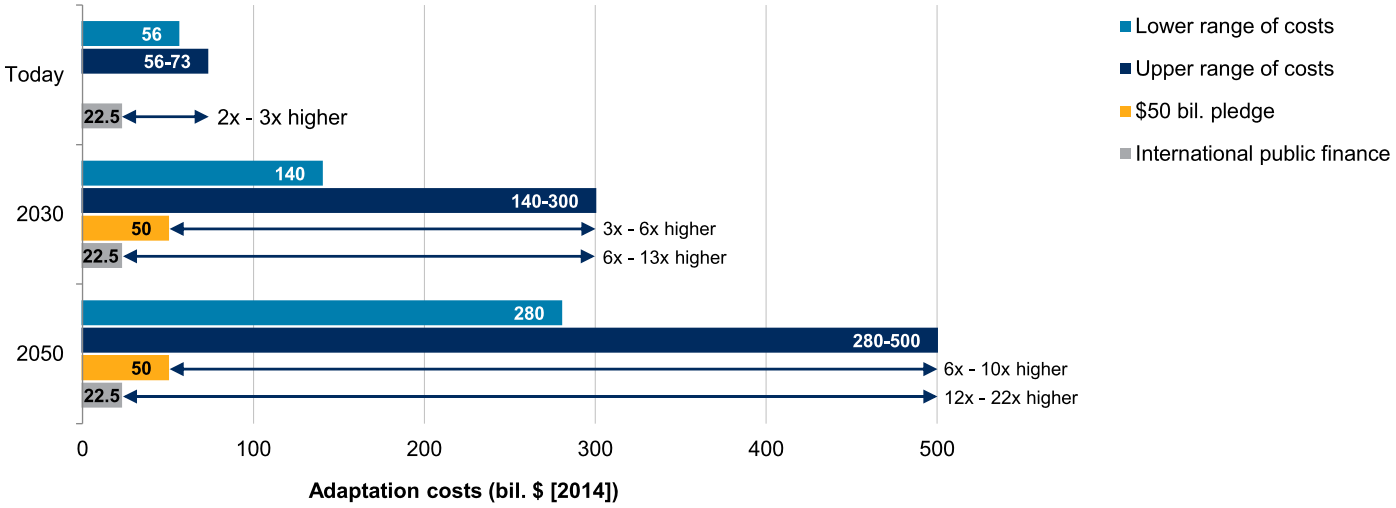
Adaptation Gap

It is very difficult to accurately estimate global adaptation needs. Any reliable estimate needs to explicitly take into account exposure growth and the impact of climate change on extreme weather. Nevertheless, there have been several attempts to estimate adaptation investment needs, with the UNEP estimate being the most referenced. For its 2016 Adaptation Gap Report, UNEP aggregated various national and sectorial studies to come up with an estimate for

developing countries of between $140 billion and $300 billion by 2030, and $280 billion and $500 billion by 2050. In other words, financing for adaptation in 2030 would need to increase by approximately 6x to 13x above all international public finance available today (see chart 2). While the latest 2018 Adaptation Gap Report UNEP didn't update the figures, it stated that, overall, various studies of the global cost of adaptation indicate higher financial needs compare to earlier ones. We expect that a significant amount of this will need to be directed to the most vulnerable countries, that is, the least developed economies (see chart 3 for the geographical distribution of international adaptation financing).

Chart 2

Conceptualizing The Adaptation Finance Gap

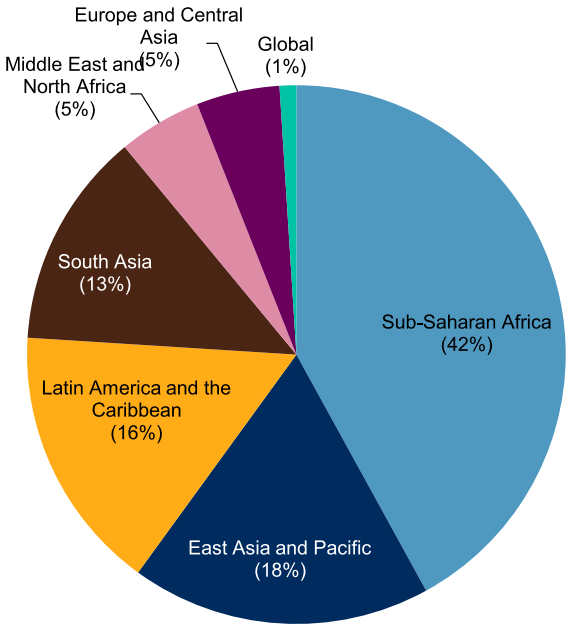


Source: UNEP 2016. The Adaptation Finance Gap Report 2016. United Nations Environment Programme (UNEP), Nairobi.

The adaptation gap is not just an issue for developing countries. Even though developed countries are more resilient to extreme weather events, many of them will need significant adaptation investments to prepare them for the potential impact of climate change. One important aspect is adapting to rising sea levels, one of the biggest threats of climate change. The impact of the sea level rise is relatively more certain compared with other threats, and it therefore should be easier to see the need for adaptation investments.

Chart 3

Geographical Distribution Of Approved Adaptation Finance (2003-2017)



Source: "Climate Finance Thematic Briefing: Adaptation Finance," Neil Bird and Charlene Watson, Overseas Development Institute, and Liane Schalatek and Katharina Keil, Heinrich Böll Stiftung, December 2017.

The economics of adaptation to a sea level rise

Given its importance, there have been a number of estimates regarding future adaptation needs related specifically to the rise in sea levels. Some of those estimates are based on global models that reflect the expected impact of climate change, the current level of adaptation, and exposure growth. A recent academic study ("Economically robust protection against 21st century sea-level rise," Lincke and Hinkel, 2018) estimates global protection costs of $2.8 trillion-$7.8 trillion based on a range of global warming and social development pathways. Given their global scope, these estimates do not capture local engineering challenges that could raise or lower local adaptation costs. Nevertheless, such estimates provide useful indications of the magnitude of the global adaptation challenge.

This study also provides insights into which areas could be protected in a cost-effective way, where benefits exceed the cost. So, despite the large amounts of investment required, the good news is that this modeling indicates that it could be economically beneficial to protect the vast majority (more than 90%) of population and assets exposed to the sea level rise. Bearing in mind the uncertainties of the estimates at the local level, we expect that the majority of the world's assets and population exposed to the sea level rise can be protected with infrastructure, whose resilience benefit could exceed the cost by more than 4x (which is the highest level on the resilience scale of our "Green Evaluation Analytical Approach," published on April 26, 2017). On

the other hand, based on the projections in the academic study mentioned above, we estimate it may not be economically justifiable to protect parts of the global coastline that constitute more than 80% of the global length, but these are typically areas with low population and asset density.

Barriers To Adaptation

We believe that there are many potential adaptation projects with high resilience benefits that are not seeing the light of day. The need for adaptation in densely populated areas in the U.S. (for example, around New York and Boston), Bangladesh, Indonesia, and the Philippines are well known and solutions are actively being considered even though their implementation will take time due to the complexity of the projects and the size of investment required. However, there are many other lesser-known small areas with adaptation needs that can be protected in a cost-effective way.

Given the high needs and benefits for adaptation, the obvious question is why the level of investment is so low. We consider the main factors to be the large sums involved and difficulties in demonstrating the value of adaptation to stakeholders. This makes it difficult to convince decision-makers to prioritize such projects relative to other development needs. Or, it may be difficult to allocate significant amounts of financing to projects whose benefits may emerge only during an extreme weather event that may happen many years in the future.

Another important barrier for adaptation investments, in contrast to mitigation projects, is the difficulty of monetizing the benefits in the form of clear cash flow streams. Most of the benefits are to make society and business more resilient to unfavorable weather events, that is, to avoid costs. It is hard to estimate the specific benefit to every individual family or business in the area that would allow the project to explicitly charge to them for the benefits. As a result, public resources or development banks finance most adaptation projects. However, in times of strained public finances, such projects are unlikely to be seen as high priority, especially when the expected benefit may not become evident in the short term.

Adaptation Projects Face Many Other Roadblocks

The large scale of adaptation projects requires significant amounts of finance and a complex approval process, which drains resources and leads to delays. They often require difficult decisions and trade-offs among different benefits and costs affecting various groups and communities, which typically leads to legal disputes and challenges. For example, an adaptation project may protect one area from flooding at the expense of increasing flood risk downstream.

Another important obstacle is social acceptance. Adaptation projects may bring changes to the daily lives of local communities. For example, a new seawall may restrict sea views and access to the beach or it may affect the natural environment. Such inconveniences may make it difficult for local communities to support such projects if they are seen as disrupting daily life or lowering the attractiveness of an area. As a consequence, the project could depress property prices or tourist activities, while the benefit of the increased resilience may not be sufficiently appreciated or understood to compensate for that.

Sometimes it may be difficult to undertake adaptation projects because of the lack of scientific certainty of the precise impact of climate change on extreme weather events, which complicates decisions about the design of the infrastructure. One way to deal with that is to undertake a gradual process in implementing adaptation as the certainty of climate projections improves over time, which is the approach of the Thames Estuary 2100 project. For example, the height of flood

defenses could be gradually reviewed and upgraded (for example, every 10 years) in response to the expected sea level rise, instead of deciding at outset the height of the necessary flood defense that would be expected to last 100 years or so. The downside of this approach is that it is likely to add additional operational complexity and cost.

The challenges for effective adaptation design, together with the potential negative impact to some communities, could increase the risk of legal action, which could be another factor deterring adaptation. On the other hand, authorities may face legal action if they don't build the necessary adaptation infrastructure, and communities suffer significant damage and disruption caused by climate change. However, they may also be under scrutiny if the measures undertaken do not deliver the expected resilience benefits. Any potential legal or corrective actions could increase costs to sponsors and potentially reduce the attractiveness to investors because of the reputational risk of being associated with failed adaptation infrastructure.

The Need For Private Financing

We expect that due to the large size of the adaptation gap and constrained public finances, other sources would need to make considerable contributions to adaptation financing. Therefore, we see the need to attract private finance in this area, especially given the number of investors interested in opportunities in climate finance. We believe that the ability to demonstrate the resilience benefit of such projects through robust modeling will be an important catalyst. In a companion piece to this report, "Determining The Resilience Benefit Of Climate Adaptation Financing," published Dec. 6, 2018, we discuss how we assess the resilience benefit of adaptation projects in our Green Evaluation.

Related Research

- Plugging The Climate Adaptation Gap With High Resilience Benefit Investments, Dec. 7, 2018
- Climate Finance & Sustainability: Key Research By S&P Global Ratings, 2018, Nov. 21, 2018
- Green Evaluation Analytical Approach, on April 26, 2017