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Climate Risks and Resilience in Infrastructure PPPs: Issues to be Considered

Satheesh Sundararajan (Senior Infrastructure Finance Specialist), Nuwan Suriyagoda (Climate & Energy Portfolio Coordinator)

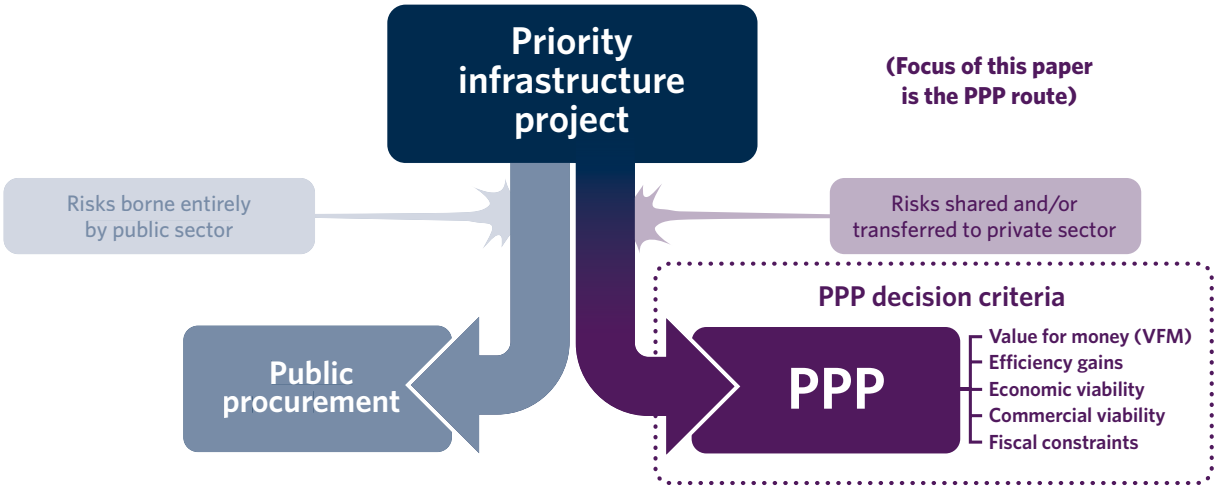
Photo by Asian Development Bank

1.0 INFRASTRUCTURE PPPs AND CLIMATE RISKS

Infrastructure assets are characterized by large irreversible investments with a long lifespan and limited alternative uses. In a typical infrastructure planning and public-investment-management context, governments first identify priority infrastructure projects through sector and spatial planning exercises, and then decide on the optimal delivery mode through conventional public procurements or public-private partnerships (PPPs). Figure 1 briefly illustrates this decision process:[1]

Climate change has contributed to a rise in extreme weather events - including typhoons. A young boy drags some possessions through the flooded streets of Metro Manila on 28 September 2009 after Typhoon Ketsana (Ondoy) hit the Philippines.

FIGURE 1: Selection Process for Intrastructure Delivery



The sector and spatial planning stage has the highest potential to identify and design climate adaptation and resilience strategies that are applicable to specific projects, regardless of the project delivery mode. In a conventional public procurement, the resilience strategies can be implemented through public investments, but in PPPs, the investment and operational decisions made by the private sector determine how climate resilience will be implemented over the lifetime of an infrastructure asset.

At the core of a PPP decision is the principle of risk allocation, whereby a specific risk is allocated to the party that is best able to manage it. It is interesting to note that, in a typical PPP risk allocation framework, climate risks are not explicitly considered or allocated to a specific party.

> Climate Risks are not explicitly allocated to either party in a PPP Contract!

Any event that is to be classified as a risk should be clearly defined with its likelihood and impact, and the public and private sectors should both understand and be in agreement with it. So, what is a climate risk within the context of infrastructure?

How do we define and interpret climate risks within the context of infrastructure? Climate risks are meteorological, hydrological and/or climatological events[2] that result in extreme weather, such as storms, floods, landslides, extreme temperatures, droughts and wildfires. Whereas climate risks in the past could be characterized using probability distributions, based on the availability of decades or even centuries of data, climate change has created new uncertainties, because weather patterns are changing in ways that are neither well understood nor predictable. Preparation for climate risks, therefore, poses new challenges with respect to numerous uncertainties, including the path of future emissions and the sensitivity of the climate system to increasing concentrations of atmospheric greenhouse gas (GHG) emissions.[3] This has created a new and deep uncertainty regarding the exposure of and impacts on socio-economic systems[4] that affect both supply and demand for infrastructure[5] and ultimately the optimal design of infrastructure. For example, higher temperatures may increase demand for water and electricity, while increased temperatures and drought may also affect the supply of water and electricity from thermal and hydropower sources.

A recent study[6] by the World Bank, the United Nations Economic Commission for Africa and the Agence Française de Développement that examined climate change impacts on hydropower infrastructure assets across Africa's seven main river basins showed that in wet-climate scenarios, there is potential for increased revenues of 20 to 140 percent. But these revenue increases can only be realized if investment and infrastructure planning in those basins are modified to factor in the possibility of excess water capacity. On the other hand, designing and building hydro infrastructure without adequate planning for climate uncertainty under the driest climate scenarios could result in possible revenue losses ranging from 5 to 60 percent.

Is management of climate risks important for infrastructure PPPs? In principle, the delivery route of infrastructure (through conventional public procurements or PPPs) is immaterial to climate-risk impacts on infrastructure. PPPs are a relatively small subset of overall infrastructure development. But PPPs are being considered as an important alternative in many developing countries, where climate uncertainties and vulnerabilities are also rapidly increasing. Moreover, the lock-in effect of PPP contracts over a long period and the effect of PPP investment decisions on the whole-life of the infrastructure asset makes the management of climate risks in infrastructure PPPs extremely important.

Do climate risks need a different type of management within PPPs? PPPs do manage a multitude of risks (commercial, technical, financial, market, political, legal, operational, etc.). They rely on these established approaches for the assessment and management of risks, albeit specifically configured for each project. Additionally, risk management is based on an understanding and appreciation of the impacts of risks by the public and private sectors. Because of the unpredictability of climate risks and the uncertainty it introduces, there is a strong need for a different approach—that is flexible and iterative—for risk management in PPPs.

What are the motivations for each party to manage climate risks in PPPs? Like any other risks in PPPs, the public and private sectors have different motivations for managing climate risks. The public sector's motivations are minimizing regret (of taking wrong action or inaction); avoiding economic losses; ensuring safety and security; preserving environmental sustainability; and ensuring availability and continuity of infrastructure services. It may be argued that the private sector may not be willing to absorb or share climate risks because such risks may not be within their best ability or scope to manage. However, the fact that climate risks affect both economic and physical performance over the life of the PPP contract may provide sufficient motivations for the private sector because retrofitting infrastructure is more expensive than than "building right" in the first place. Potential private sector motivations for managing climate risks include preventing investment

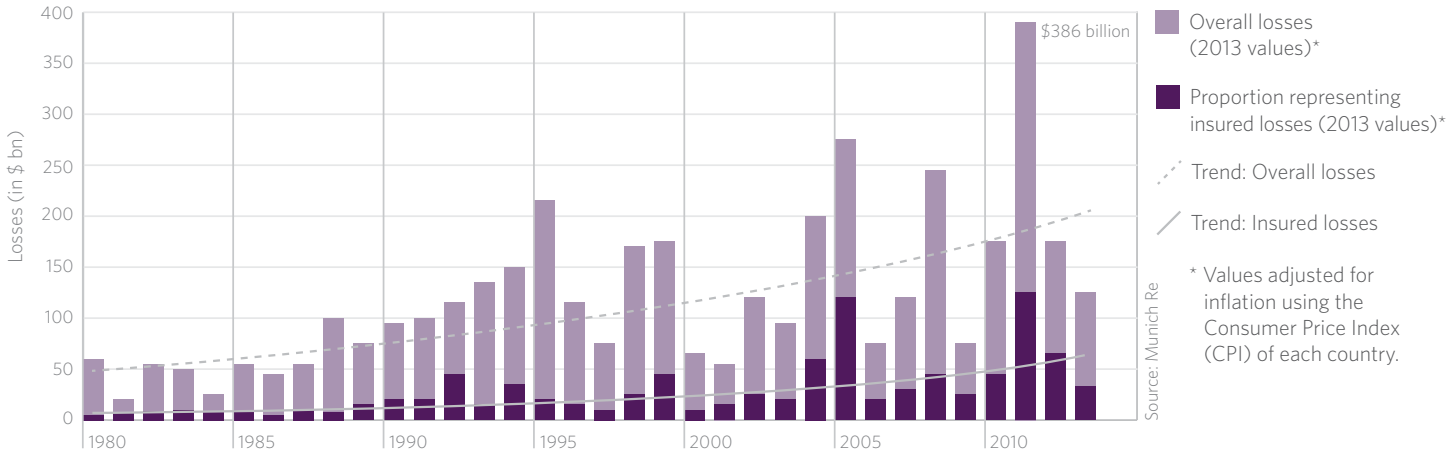
losses; regulatory provisions (e.g., gold-plating assets under a rate of return regulation); avoiding failure to meet contractual obligations; and reducing reputational risks. Additionally, the uncertainty associated with climate change can provide the private sector with more opportunities to develop innovative infrastructure PPP solutions. Nevertheless, it is important to note that users and taxpayers are the ones who ultimately end up absorbing a significant proportion of the losses arising from the impacts of climate risks on infrastructure. It is then appropriate to ask, how critical are climate risks for infrastructure?

2.0 EXPOSURE OF INFRASTRUCTURE ASSETS TO CLIMATE CHANGE

The exposure of infrastructure assets to climate risks is rising as extreme weather events such as storms, floods, landslides, heat waves, and droughts are increasing in frequency and intensity. The United Nations Environment Programme (UNEP) and the Bank for International Settlements (BIS) have found that natural catastrophes resulting in significant financial losses have become more frequent over the past three decades, with the year 2011 marking the highest-ever amount of catastrophe-related losses ($386 billion).[7] The insurance industry's experience similarly shows that natural disasters related to both climatic and geophysical events are becoming more frequent and severe, causing an increase in financial losses, as shown in Figure 2.a. This upward trend is also visible in developing countries that are highly vulnerable to climate risks, reflecting an increase in economic losses, as shown in Figure 2.b. This situation is exacerbated by rapid urbanization and population growth in climate-vulnerable regions, which affects infrastructure systems regardless of climate risks.

The *Global Climate Risk Index 2015* report states that nine out of the 10 most affected countries between 1994 and 2013 were low-income or lower-middle-income developing countries.[8] Direct economic losses[9]

FIGURE 2.a: Worldwide Losses Due to Major Natural Catastrophes from 1980 to 2013



* Values adjusted for inflation using the Consumer Price Index (CPI) of each country.

FIGURE 2.b: Loss Trends in 40 Low and Middle-Income Countries, 1981–2011

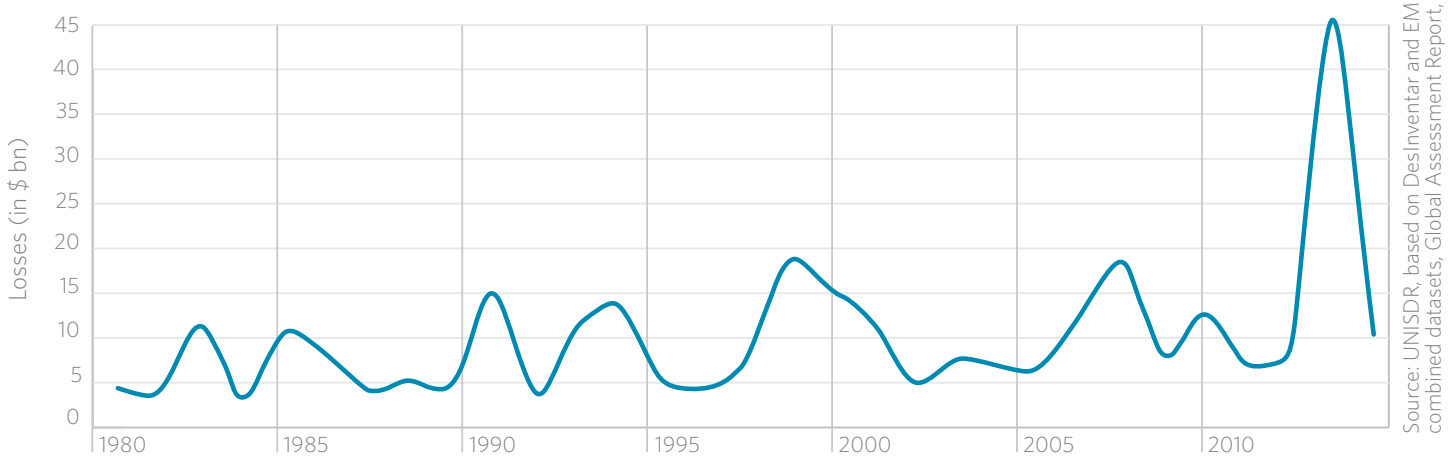
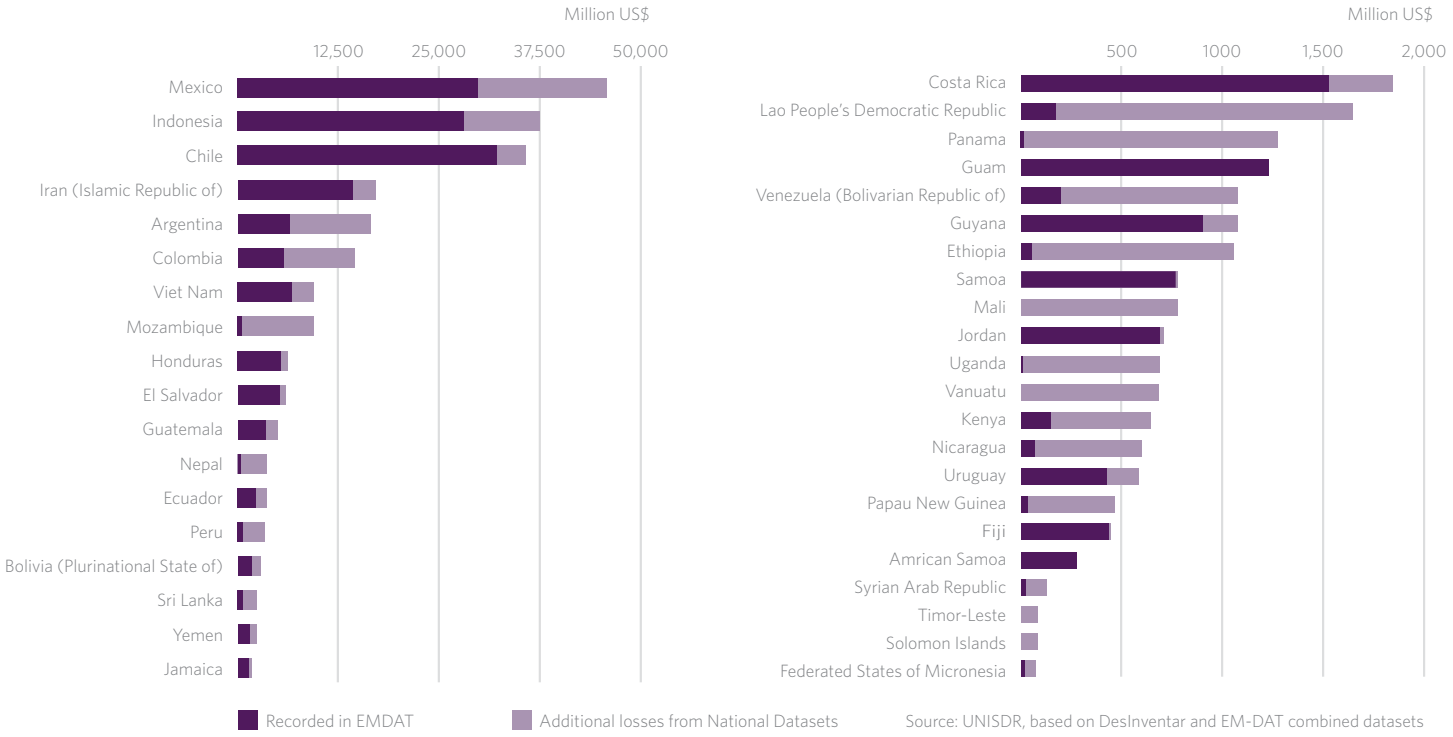


FIGURE 3: Direct Economic Losses in 40 Low- and Middle-Income Countries, 1981–2011



Source: UNISDR, based on DesInventar and EM-DAT combined datasets

in large capital-intensive infrastructure, housing, local infrastructure and agriculture in 40 low- and middle-income countries are shown in Figure 3.

For example, excessive rain and flooding caused the collapse of the WitKoppen Bridge in Johannesburg, South Africa. Conversely, the effects of drought on the Mtera Dam in Tanzania resulted in prolonged power outages. In Asia, a University of Singapore study found that 11 of the largest Asian cities' infrastructures are "critically unprepared" for floods.[10] Furthermore, the recent rain and flooding of Chennai, India disrupted electricity and transport networks for several days across the entire city.

Developing countries also face a massive infrastructure investment gap of more than $1 trillion per year.[11] This can be attributed to a combination of factors, such as fiscal constraints, inadequate cost recovery, poor technical capacity, and lack of deep financial markets, combined with urgent demands from rapid urbanization to develop new infrastructure at both the national and sub-national levels. To bridge this gap, the private sector has been playing an important role in investing and participating in infrastructure, in particular, through PPPs.[12]

In an increasing climate-risk scenario, incorporating climate change considerations into planning and design can reduce negative climate impacts on the physical and economic performance of infrastructure.[13] Even though PPPs are a subset of infrastructure development, they should also consider climate resilience to mitigate losses from future disasters. However, incorporating climate resilience in infrastructure PPPs is not without its challenges. This paper and the sections that follow discuss some of the challenges and the gaps that exist in PPP frameworks with respect to addressing climate risks, and highlights the need for a structural change in the development approach of PPPs in climate-vulnerable regions.

3.0 STANDARD FEATURES OF PPPs AND ISSUES IN MANAGEMENT OF CLIMATE RISKS

While there are many variations[14] within PPPs, they typically share common features, such as:

- Long-term contracts that lock-in infrastructure assets with irreversible investments;
- Long-term partnerships with pre-defined roles and responsibilities;
- Performance-based and output-driven payments;
- Payments linked to fixed or regulated tariffs; and
- Procurement of infrastructure with the most economical private-sector solutions.[15]

In a competitive environment, these features influence the private sector to be innovative in managing risks and improving efficiencies, reflecting the core principles of PPPs. Now, climate risks add a new type of investment risk to this existing equation, demanding further innovation in order to optimize the whole-life cost of infrastructure in tandem with other risks. However, there seems to be little evidence of many innovative solutions for managing climate risks in PPPs. This is partly attributable to limited expertise and the lack of explicit identification of climate risk or allocation of such risks to either public or private party. If

Hurricane Tomas destroys bridge in St. Lucia, 2010
via Caribbean Hurricane Network

we overlay standard PPP features with increased uncertainties of long-term climate risks, risk management becomes a significant challenge in PPPs. Some of these challenges include:

- **Incorrect Decision to Choose the PPP Route:** Does the additional risk created by climate risks make PPPs less attractive based on the expectation that the private sector will want additional compensation to manage climate risks?
- **Procurement Bias:** Innovative resilience measures proposed by the private sector for managing climate risks might require additional compensation (e.g., to meet additional adaptation costs). But in a "competitive bid" procurement scenario, highly weighted economic evaluation criteria might prevent the private sector from proposing innovative solutions that need additional compensation. Can the PPP procurement framework incentivize private-sector innovation to optimize whole-life cost and be competitive? Can tariff regulation in PPPs value and compensate for climate resilience measures more explicitly?
- **Split Incentives:** The whole-life costing approach to PPPs is mostly limited to the life of the contract[16] rather than the life of the infrastructure asset, although the irreversible nature of capital and maintenance cost decisions made during the PPP contract life affects the overall life of the asset. In this context, can the incentive structure allow the private sector to ensure an optimal balance between capital, operating and maintenance costs over the lifetime of the infrastructure asset, rather than only for the lifetime of the PPP contract, especially in instances where these two time periods differ?
- **Principal-Agent Problem:** Principal-agent problems such as "information asymmetry" and "moral hazards" related to PPPs are typically mitigated through contracts, regulation, and transparency and disclosure requirements. However, for undefined and unallocated risks such as climate risks, the principal-agent problem becomes more obvious. Can PPPs include mechanisms to mitigate the principal-agent problem in managing climate risks through increased transparency and disclosure? Can rent-seeking behavior to manage climate risks be avoided by enabling more open and balanced risk-management responsibilities between the public and private sector stakeholders?
- **Deterministic Contracts vs. Uncertain Events:** In principle, the deterministic features of PPP contracts are not conducive to managing uncertain events. For example, uncertain events such as political unrest, floods, etc., to an extent that are outside the contractual design and performance requirements of private sector, are expected to be rare and can be dealt through force majeure provisions. However as shown in fig 2a and 2b, the increasing trends and unpredictability of climate risks indicate such events to be more frequent and therefore the application of force majeure provisions becomes less appropriate. The deterministic nature of contracts also does not allow other provisions to manage uncertain events. Can PPP contracts allow a more flexible approach to deal with risks that have high uncertainties and unpredictability, such as climate risks?

Climate risks may be managed using an "active management" approach, wherein the public and private sectors work together proactively to continuously collect, analyze, identify and assess their likelihood and impacts in order to take appropriate action. Active management can help in the informed development and implementation of actions/responses through learning as climate change uncertainties unfold. Global experience shows that many countries do not have an enabling environment for active management of risks in PPPs.[17]

As explained before, strategies for adaptation and resilience are developed during the sector and spatial planning stage, although the project-level planning and design of such strategies depends on time preference, risk appetite, and the relative priority of physical and

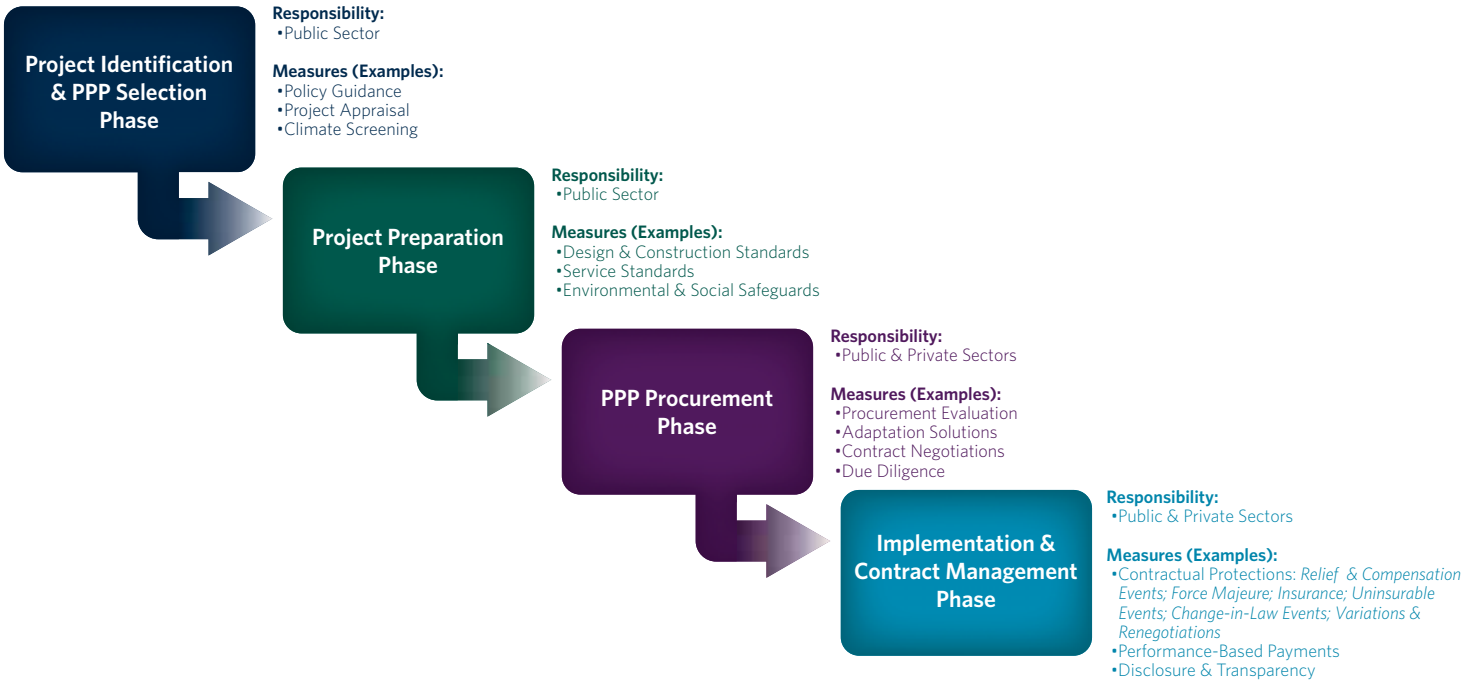
economic performance, within and across sectors[18]. But once the project delivery route is selected as a PPP, the adaptation and resilience strategies have to be translated into project requirements within the context of risk allocation and contractual performance. PPP structures are also not guided by principles of long-term resilience or concepts such as "build back better."[19] Additionally, the involvement of private investors and lenders requires adaptation responsibilities to be shared by some measures and incentive structures. This does not necessarily mean that PPPs do not manage climate risks at all; they always include some measures to address unforeseen, unpredictable and apparent risks.

4.0 TYPICAL MEASURES IN PPPs THAT INDIRECTLY ADDRESS CLIMATE RISKS

Figure 4 presents a linear view of the PPP phases and an overview of the measures and incentive structures available to factor in and manage climate risks in PPPs. In PPPs, the asset stewardship extends from the public sector to private sector investors and lenders. Whereas investors and lenders rely on their own due diligence for investment decision-making, they often require the public sector to provide sufficient contractual protections for investments. Such "protection measures" are normally agreed upon as part of the risk allocation process during the preparation and procurement stages and act as the primary vehicle for managing risks in PPPs.

- **Relief and Compensation Events:** Both relief and compensation events require private-sector investors to reinstate a PPP asset to its normal condition after a pre-identified risk event (e.g., flood or storm) has interrupted the contractual performance. Relief events offer "time only" relief, whereas compensation events offer "time and compensation" to private-sector investors.
- **Force Majeure (FM) Events:** FM covers both political and extreme-weather events, wherein both parties get equitable rights to terminate a PPP contract after a prolonged risk event, perhaps lasting 180 days or longer. In a typical FM termination, both parties share the financial impact; the public sector pays out debt obligations of lenders, paid-in equity including any breakage costs of investors (who forego future profits) in lieu of an affected infrastructure asset. Temporary FM events may be treated as relief or compensation events if such events have been pre-agreed to in the PPP contract.
- **Insurance:** Insurance transfers covered risks to third-party insurers. In PPPs, insurance provides significant value by way of third-party due diligence, while instilling disciplined risk-management practices to meet insurers' required standards. Additionally, innovative risk-management tools and products (e.g., weather index-based instruments) are also constantly being developed. In principle, the level of insurance coverage is a tradeoff between the expectations of the public sector (aligned with the lenders) for maximum asset protection and affordability, and the expectations of the private sector to optimize coverage with respect to availability and competitiveness.
- **Uninsurable Events:** Uninsurability arises from non-availability, unaffordability and/or the lack of a specific fit for a risk being considered. In such cases, the public sector remains by default the "insurer of last resort" or, in rare cases, the private sector retains the risk, with higher return expectations.

FIGURE 4: Measures and Incentives Included in PPP Frameworks



Coastal flooding of road infrastructure via Thinkstock

- **Change in Law:** The provision of change in law (for example, change in design and construction codes or regulatory limits on GHG emissions, etc.) protects private investors from the consequences of certain changes ex-post bid award, if they result in delays, additional costs and/or prevent the private sector from meeting contractual obligations.
- **Variations and Renegotiations:** PPP contracts also offer variation and renegotiation mechanisms that may be used to manage unforeseen risks. Variation mechanisms are often based on pre-agreed-upon cost levels or types of changes allowed to the contractual scope. Similarly, renegotiation of pre-agreed-upon contractual obligations may be allowed under specific circumstances, but requires extreme caution on how it is managed.

These contractual protections may appear comprehensive, but since climate risks are not explicitly allocated, and most climate uncertainties manifest during the contract implementation and management phases, these measures are ineffective over the life of PPPs. The next section highlights some weaknesses and gaps in these contractual protections and raises some of the challenges in managing climate risks in infrastructure PPPs.

5.0 WEAKNESSES IN PPP CONTRACT MEASURES TO ADDRESS CLIMATE RISKS

The table below, though not comprehensive, identifies some of the gaps and weaknesses in the way climate risks are managed in infrastructure PPPs.

TABLE 1: Gaps in PPP Measures to Address Climate Risks

MEASURE	GAP
Relief & Compensation	• Lack of a comprehensive list to capture all climate risks exposes the PPP asset to not being able to qualify certain events (e.g., storm, hail damage) as relief or compensation events
Force Majeure	• Non-standardized treatment of FM provisions across different jurisdictions creates investment uncertainty • Lack of standard catch-all provisions or itemized lists that fail to fully capture all climate risks under FM limits the extent of FM coverage • Due to increasing climate trends, rare climate events in the past may become normal events in the future, making current FM provisions inappropriate
Insurance	• Lack of access by developing countries to commercial insurance markets exposes PPP assets to long-term climate risks • Limited access and affordability of insurance increases risks in PPP projects and dissuades investors from investing in risky PPPs
Uninsurability	• Uninsurability provison can disincentivize the private sector from developing climate-resilient infrastructure and proactively managing climate risks • When the public sector assumes insurance risk under uninsurability provisions, it does not have the same ability and capacity of a commercial insurer to enforce a disciplined approach to risk management

Don Muang Airport in Bangkok, Thailand has been affected by one of the worst floodings in 50 years in 2011 via Neramit Sisa\Shutterstock

Additionally, the contractual protections discussed above only address climate risks as ex-post events (i.e., reacting after the climate event has happened), as opposed to managing them as ex-ante events (i.e., active management of climate event before it happens). Obvious exceptions are insurance; setting design and construction standards; and performance requirements (e.g., asset availability, reliability, condition, etc.), which are ex-ante measures. However, such exceptions become weak due to lack of knowledge and unclear allocation of climate risks in PPPs. As mentioned before, the use of and approach to force majeure to protect against climate risks needs modification in an increasing climate change scenario. In addition, the use of force majeure cannot be used as a proxy for lack of building resilience in design and meeting performance requirements of PPPs.

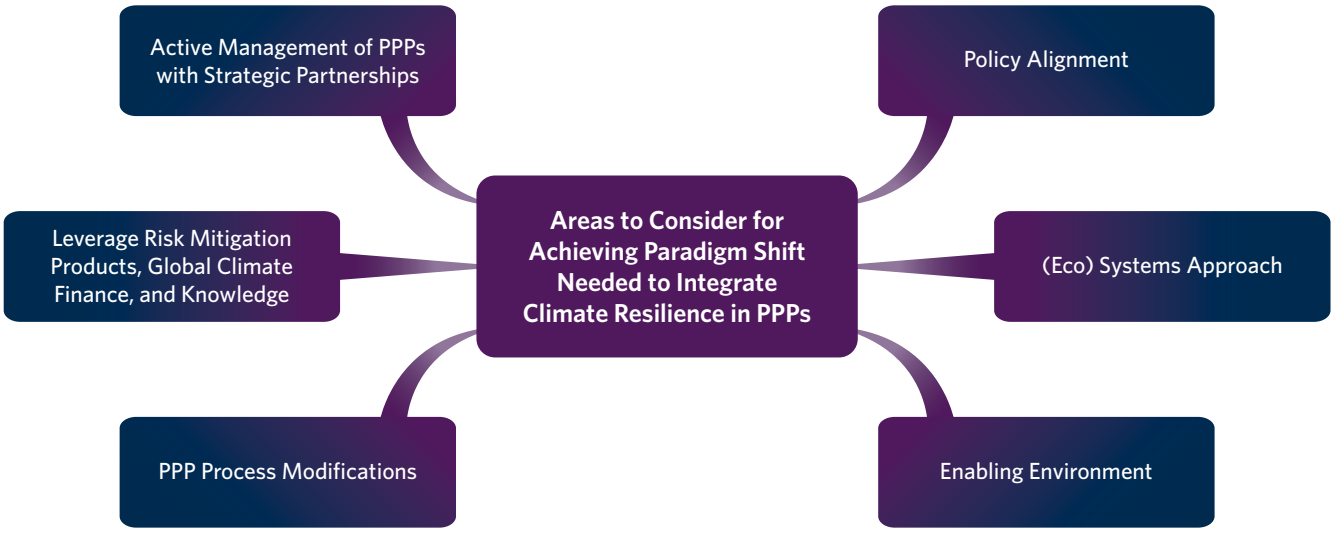
Of course, PPPs manage many risks, and a separate contractual provision to manage each risk is not optimal. Notwithstanding this, integrating climate resilience and actively managing climate risks is critical for the long-term sustainability of infrastructure assets and therefore, justifies this investment decision at the outset of a PPP project. The next section identifies at a high level the paradigm shifts needed in PPP processes to integrate climate risks.

6.0 PARADIGM SHIFT NEEDED FOR INTEGRATING CLIMATE RESILIENCE IN PPPs

The level of uncertainty associated with climate risks to infrastructure assets, and the deterministic nature of PPP contracts, require a paradigm shift in the way PPPs are developed, procured and implemented. Furthermore, mainstreaming adaptation and resilience requires an understanding of the policy and institutional landscape (identifying entry points where it is most optimal in the development cycle) including an appreciation of the regional, sectoral and project-specific issues. Such an approach will allow to make informed decisions based on options that are flexible and cost-effective. Some potential areas to achieve such a paradigm shift to integrate climate risks in infrastructure PPPs are outlined here (Figure 5) for detailed assessment and testing:

- **Policy Alignment:** A number of developing countries have developed climate-change policies (such as National Adaptation Plans), strategies and/or climate action plans. Similarly, many countries also have PPP policies or laws to enable private sector investments in infrastructure. Most of these PPP and climate-change policies are not aligned and therefore, require harmonization in order to develop robust, climate-resilient infrastructure. For example, a climate policy that reflects local or regional climate vulnerabilities, and/or a sector and spatial policy that addresses adaptation and resilience strategies for the sector[20] should also be reflected in a country's PPP policy. However, integration of such policies requires political will, strengthening institutional arrangements and applying appropriate economic tools.[21]
- **(Eco) Systems Approach:** Adaptation has great potential to reduce the negative impact of climate change,[22] but there is also a risk of unnecessarily adapting in the wrong way, which could be as significant as the risk of not adapting when needed. The public sector has the greatest incentive to plan for the balanced adaptive strategy to infrastructure at a country or regional level, using a "systems approach". But incentives for the private sector are designed to protect their investments at the project level. A solution to this issue

FIGURE 5: Actions Needed for Integrating Climate Resilience in PPPs



is to consider PPPs within a "multi-sector infrastructure resilience plan," starting at the regional or country level, and then identifying and specifying project-level resilience requirements. This approach avoids sub-optimal and expensive current practices that operate at a single project level, instead taking a systems/portfolio approach.[23] It is likely that the public sector will have better and more information on the overall optimized resilience strategy for the portfolio from which a project specific strategy can be adopted, following the process of active management.

- **Enabling Environment:** Education and awareness of climate risks are imperative to countries that are developing infrastructure in climate-vulnerable environments. With the help of multilaterals and other development institutions, national governments can create an enabling environment through an adequate policy and regulatory regime and the provision of tools and guidance. Key enabling factors influencing the role of the private sector in adaptation include consistent data and information, institutional arrangements including coordination between various stakeholders, policies, economic incentives, technology, and knowledge.[24]
- **PPP Process Modifications:** There are a number of areas where PPP processes can create the right incentive structures for active management of climate risks. Each helps to minimize investment risks while retaining the asset value over the life of a PPP. A few of these areas are as follows:
  - Integrate climate adaptation and resilience into infrastructure policy and the project appraisal framework.
  - Include clear and explicit allocation of specific climate-related risks in PPP contracts. Additionally, incorporate the concept of resilience to complement risk allocation.
  - Incorporate whole-asset-life-cost optimization approach instead of only PPP project life.
  - Include third-party reviews of climate risks for PPPs on a regional, country and project-level basis.
  - Form active partnerships with the insurance industry and engineering firms on wider infrastructure development and the use of climate screening tools[25] and risk-forecasting tools (such as climate vulnerability indexes, etc.) for project appraisal. There are various decision-support tools for adaptation that can be used for making decisions under uncertainty.[26]
  - Develop incentive structures through procurement policies (such as setting evaluation criteria for resilience, using asset life costing approach, etc.) that promote innovation while still operating within a competitive environment.
  - Establish regulatory incentives that are conducive to risk management, with an emphasis on integrating across overlapping regulatory regimes (e.g., regulation of water, energy and land use).[27]
  - Include pre-defined and costed risk mitigation plans for the active management of climate risks.
  - Utilize environmental impact assessment (EIA) procedures, environmental and social (E&S) standards and weather forecasting tools for enhancing the resilience as well as environmental sustainability of PPP projects, following international best practices.[28]
- **Leverage Risk Mitigation Products, Global Climate Finance, and Knowledge:** Studies also show that multilaterals can expand their risk mitigation products to more specifically target climate risks.[29] One similar example is a World Bank-structured weather derivative to help the Government of Uruguay to mitigate the impacts of

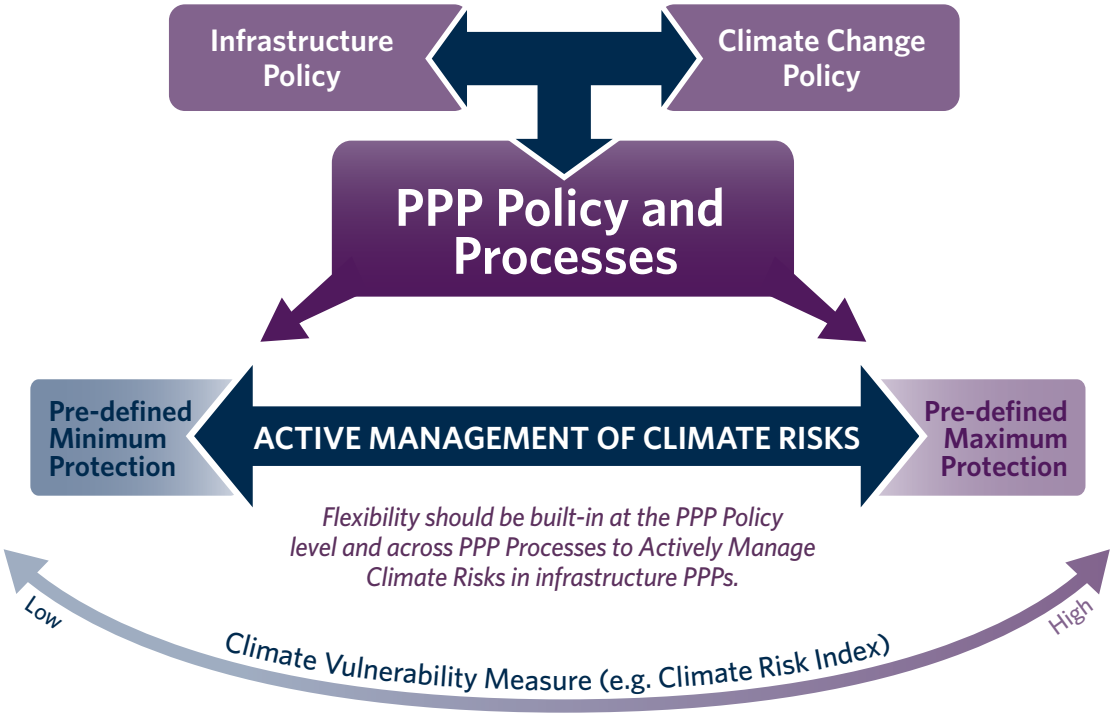
drought.[30] Various global sources of climate finance such as the Green Climate Fund, Climate Investment Funds, and Green Bonds, can also be mainstreamed as financing sources for climate-smart infrastructure. A recent example is the proposed establishment of the Africa Facility for Climate-Resilient Investment by the World Bank, the Africa Union Commission, and UNECA; this is an integral part of the World Bank's $16 billion Africa Climate Business Plan that was officially unveiled during the COP21 global climate conference in Paris.

- **Active Management of PPPs with Strategic Partnerships:** Actively managing long-term climate risks during the life of a PPP contract requires the expertise of both the public and private sectors in a joint decision-making forum. Flexibility should be built into PPP processes starting with the project selection, preparation, and procurement, through to implementation and contract management, while setting appropriate incentive structures for both parties. This active approach also requires strategic partnerships with stakeholders representing multiple disciplines (e.g., insurance industry, engineering and scientific climate communities), wherein openness, transparency and cost effectiveness would underpin the partnerships with solutions focusing on technical, financial, legal and institutional capacities.

For regions and countries that have high climate vulnerability, PPP policies should be modified with additional flexibility built in to allow for active management. Such flexibility can also be extended to countries whose climate risks are currently low but may increase in the future. Figure 6 shows a continuum approach to building flexibility into PPPs to actively manage climate risk over the project lifetime, wherein resilience measures (asset protection) are actively managed depending on the level of vulnerability. The pre-defined minimum protection can be related to a low-regret option that not only meets current adaptation deficits at low-cost but is flexible enough to respond to future changes.[31]

In essence, it is imperative to apply existing tools and build on methodologies for decision-making under climate uncertainty[32] through close collaboration and strategic partnerships between multilaterals, academia, engineering firms, the insurance industry, technology providers, and public-sector agencies.

FIGURE 6: Framework for Active Management of Climate Risks in PPPs



Typhoon Haiyan damage in Tacloban, Philippines 2013 via Thinkstock

CONCLUSION

Deep uncertainty regarding long-term climate risks reinforces the need for a paradigm shift in how PPPs incorporate long-term resilience in infrastructure investments. Various areas need attention, such as alignment of PPP and climate-change policies; partnering with the private sector and the insurance industry at a strategic level to find innovative and cost-effective solutions; using information technology and satellite imaging to collect and analyze climate data to assess potential risks; leveraging global climate finance sources; and taking an overall multi-sector, systems-wide approach to developing climate-smart infrastructure. Furthermore, mainstreaming resilience requires integration of various policy areas and consideration of flexibility and pragmatism.

To implement such changes, the capacity and knowledge of stakeholders should be improved through the use of information technology and capturing lessons from events after they unfold. Development institutions such as the World Bank Group, governments, and the private sector should continue to work together to create enabling environments for the active management of climate risks in PPPs. Climate screening tools should be mainstreamed for project selection and prioritization. Additionally, global climate finance and risk mitigation products should also be considered as a key source of financing to develop projects. The issues identified in this paper may provide motivation to various stakeholders for a coordinated and targeted engagement to develop climate resilient infrastructure PPPs.

ENDNOTES

[1] Further information about the process can be found in the PPP Reference Guide V2 (http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/09/08/000442464_20140908133431/Rendered/PDF/903840PPP0Refe0Box385311B000PUBLIC0.pdf)

[2] Excludes geophysical events such as earthquakes and tsunamis.

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[4] IPCC Fourth Assessment Report: Climate Change 2007, IPCC, 2007 (https://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch19s19-es.html)

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[7] "Natural catastrophes and global reinsurance – exploring the linkages" by Von Dahlen, Sebastian and von Peter, Goetz, BIS Quarterly Review, December 2012 (http://www.bis.org/publ/qtrpdf/r_qt1212.pdf)

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[10] The Urban Transition of Environmental Disaster Governance in Asia, Working Paper 210, National University of Singapore, October 2013 (http://www.ari.nus.edu.sg/publication/working-papers.html)

[11] The Global Infrastructure Facility (http://www.worldbank.org/en/programs/global-Infrastructure-facility)

[12] 2013 Global PPI Update, PPP Group, World Bank, 2014 (Figure 2; shows an increase from about $100 billion in 2005 to $200 billion in 2012 and then a drop below $150 billion after 2012) (http://www.scribd.com/doc/242091146/Private-Participation-in-Infrastructure-Global-Update-2013)

[13] Enhancing the Climate Resilience of Africa's Infrastructure: The Power and Water Sectors, Agence Française de Développement, 2015 (https://openknowledge.worldbank.org/handle/10986/21875)

[14] A spectrum of options reflecting simple management contracts to complex privatizations

[15] Even in jurisdictions where multi-criteria evaluation is applied, economic criteria is often given more weight

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ENABLING INFRASTRUCTURE INVESTMENT

PPIAF, a multi-donor trust fund housed in the World Bank Group, provides technical assistance to governments in developing countries. PPIAF's main goal is to create enabling environments through high-impact partnerships that facilitate private investment in infrastructure.