ADBI-ICRIER Working Paper Series

FACILITATING INTERNATIONAL ADAPTATION FINANCE FLOWS FROM PRIVATE SOURCES

Amrita Goldar, Somit Dasgupta,
Sajal Jain, Diya Dasgupta, and
Poulomi Bhattacharya

No. 1377
May 2023

Asian Development Bank Institute

Amrita Goldar is a senior fellow, Somit Dasgupta is a senior visiting fellow, Sajal Jain is a fellow, Diya Dasgupta is a research associate, and Poulomi Bhattacharya is a fellow, all at the Indian Council for Research on International Economic Relations, New Delhi, India.

The Working Paper series is a continuation of the formerly named Discussion Paper series; the numbering of the papers continued without interruption or change. ADBI's working papers reflect initial ideas on a topic and are posted online for discussion. Some working papers may develop into other forms of publication.

Suggested citation:

Goldar, A., S. Dasgupta, S. Jain, D. Dasgupta, and P. Bhattacharya. 2023. Facilitating International Adaptation Finance Flows from Private Sources. ADBI-ICRIER Working Paper 1377. Tokyo: Asian Development Bank Institute. Available: https://doi.org/10.56506/ZMOD9256

Please contact the authors for information about this paper.

Email: agoldar@icrier.res.in

Asian Development Bank Institute
Kasumigaseki Building, 8th Floor
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

Given its developmental underpinnings, adaptation finance has remained largely within the government purview of many developing countries. However, due to the exacerbation of climate impacts, there is a dire need to augment this source with private capital. This paper discusses the current landscape of adaptation financing, the role of the private sector, and the hurdles impinging on the finance flows from the said source. As a special case, it looks into the avenues available for climate risk adaptation, where the private sector contribution could be augmented through insurance and associated financial instruments for planned adaptation to climate risk. In addition, it makes a case for these financial instruments by looking at damage costs associated with unplanned impacts of climate-related natural calamities. Finally, analysis results from the investigation are then woven together as concrete suggestions for increasing private sector participation in adaptation financing in G20 countries.

Keywords: G20, adaptation, climate finance

JEL Classification: Q54, G150, G22

Contents

1. INTRODUCTION 1

1.1 The Need for Private Sector Investment in Adaptation 2

2. POLICY RELEVANCE AND RESEARCH OBJECTIVE 6

2.1 Policy Relevance 6
2.2 Research Objective 6

3. CLIMATE RISKS AND PLANNED CLIMATE IMPACTS: PRIVATE SECTOR AUGMENTATION 7

3.1 Barriers to Investment 7
3.2 Existing Channels to Make Private Investments into Adaptation Less Risky 8

4. CLIMATE RISKS AND UNPLANNED CLIMATE IMPACTS: PRIVATE INVESTMENTS IN INSURANCE 15

4.1 Insuring Against Disasters 15
4.2 The Business Case of Insurance Investments for the Private Sector 17

5. KEY TAKEAWAYS AND RECOMMENDATIONS FOR G20 19

5.1 Addressing the Impediments to Private Adaptation Finance 20
5.2 Encourage Greater Role of Insurance Companies and the Private Sector in Post-disaster Impact Reporting 21
5.3 G20 Knowledge Center for Research on Climate Impacts 21

6. CONCLUSION 22

REFERENCES 23

ANNEXURE 27

1. INTRODUCTION

It is widely acknowledged that climate funds from developed countries will have fallen far short of $100 billion per year for the period 2021 to 2025, as promised during COP 16 (2010) in Cancun.[1] According to the OECD, developed countries increased climate finance flows directed towards developing countries from an earlier $52.4 billion in 2013 to $83.3 billion in 2020 (OECD 2022). However, estimates reveal that the actual amount provided lay between $19 and $22.5 billion in 2017–18 (Oxfam 2020). The story, however, does not end there. It has increasingly been observed that within what was provided, a major part of the funds supported mitigation activities rather than adaptation. The world has seen more finance committed and mobilized for mitigation actions than the adaptation counterparts (Goldar, Dasgupta, and Jain 2022). Pure adaptation financing, at least for the years 2019–2020, made up only about 7.5% of the total climate finance (Climate Policy Initiative 2022).

Several other estimates regarding the actual fund requirements for tackling climate change exist.[2] The CPI (2021) has estimated a total need of $4.35 trillion, though the current level is only about $632 billion. Some estimates indicate that the total climate finance needs will increase by at least seven times by the end of this decade to attain the Paris targets (CPI 2022). This would then translate to the funding requirement growing at a compound annual growth rate (CAGR) of 21% until 2030! Ironically, while climate funds are difficult to come by, the total fossil fuel subsidies in 51 major countries alone are 40% higher than the total global investment in climate finance for 2011–20 (CPI 2022).

Box 1: The "Definitional Problem" of Adaptation

Levina and Tirpak (2006) note that there is a difference in the use of keywords for defining adaptation. While some describe it as a "process," there are others who allot words such as "adjustment" or simply "changes." Terms like "process" and "changes" can be interpreted as describing a broader and open-ended perspective, and do not include a particular time or subject references. These terms can be assumed to subsume any "adjustments." On the other hand, "adjustment" can be deciphered as a process with an end objective.

The contrasts in the definition of adaptation can also be attributed to the fundamental differences in the very definition of climate change, as provided by the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC makes a distinction between climate change that is attributable to human activities altering the atmospheric composition and climate variability that can be assigned to natural causes (UNFCCC Article 1 DEFINITIONS, n.d.). In contrast, the IPCC definition represents a broader view, attributing climate change to either natural variability or human activity. These definitions then have a considerable influence on the definition of adaptation, and hence their policy implications (IPCC 2018).

[1] The decision to provide $100 billion was taken during COP 15 at Copenhagen, but at that point in time it was not supported by all countries.

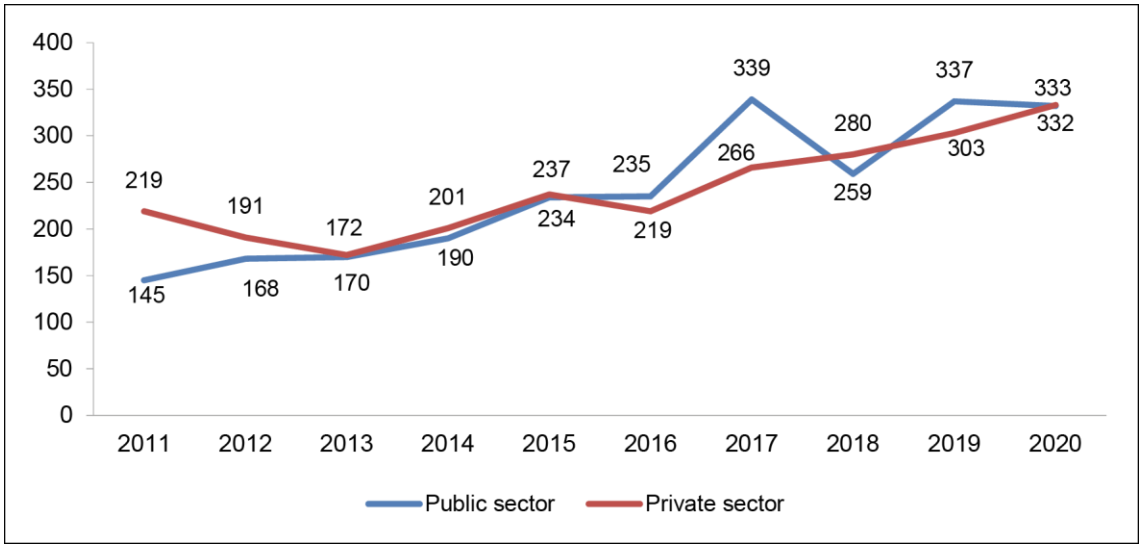
[2] The UNEP (2021) estimates that adaptation costs in developing countries alone are estimated to increase to $140–300 billion per year by 2030. By 2050, this figure will reach $500 billion.

Furthermore, it is important to note that there are difficulties in accounting for funds directed towards adaptation since the definition of adaptation activities itself needs to be clarified. The field of climate change is populated with multiple definitions of climate adaptation, not only making it difficult to estimate and track the global climate finance flows directed towards adaptation but also creating issues concerning the allotment of new finance. Table A.1 in the Annexure provides an overview of some of the existing definitions of climate change adaptation developed by a few leading entities in the climate change landscape.

1.1 The Need for Private Sector Investment in Adaptation

Forming a key stakeholder for raising finance, the current contribution of the private sector has been minimal, though it has three specific roles to play: the first is internal adaptation, i.e., climate-proofing their internal operations and supply chains; the second is financing adaptation as an investment option, i.e., providing finance for others to implement adaptation projects against a rate of return; and the third is providing adaptation goods and services (Stout 2022). However, if one considers the total climate finance quantum, inclusive of mitigation and adaptation measures, the private sector contribution is quite robust vis-à-vis the public sector (Figure 1).

Figure 1: Public and Private Spending in Total Climate Finance in US$ Billion

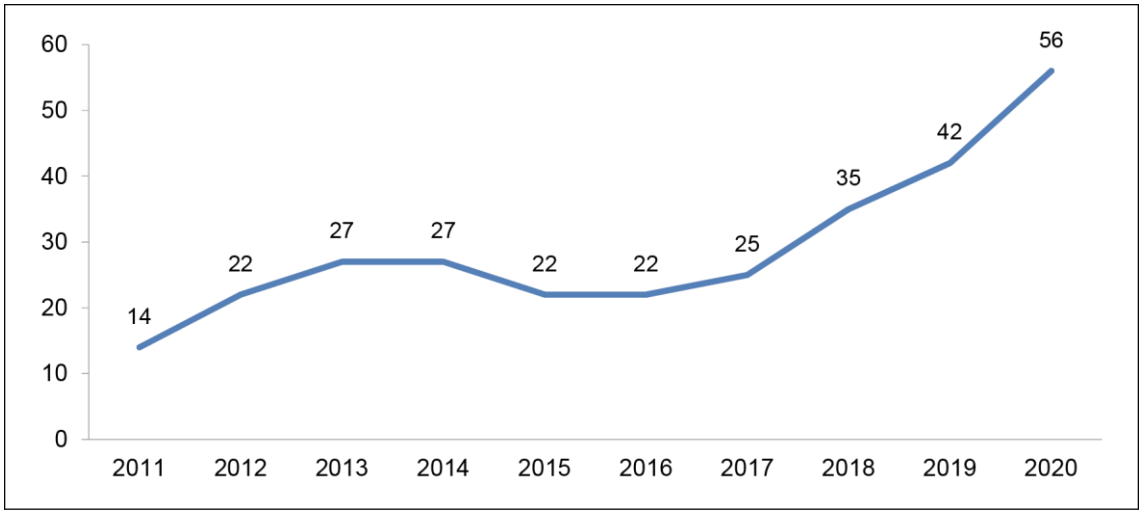


Source: CPI (2022).

It is therefore not without reason that we need to concentrate on the private sector. After all, the private sector provides 85% of the investments worldwide, 90% of the people living in developing countries depend on private sector-generated income, and the private sector represents 75% of global climate finance flows (Climate Action Network 2013). In fact, developing countries refer to “nonstate actors” in their Nationally Determined Contributions (NDCs) more frequently than higher-income countries (Hsu et al. 2020). Having said that, it is also true that private investment activity has been unevenly distributed amongst countries and economic sectors and often it does not match the most pressing needs of developing countries. However, Druceet al. (2016) and Averkhenkowa et al. (2016) have said that it is in the self-interest of the private sector to adapt its own operations and assets to climate change and invest in new business opportunities to achieve business stability.

Most of the funds made available for adaptation come from multilateral development banks (MDBs) in the form of loans.[3] Adaptation finance, incidentally, has been growing over the years and the Climate Policy Initiative (CPI) tracked $46 billion in adaptation finance in 2019–20, an increase of 53% from $30 billion in 2017–18. The CPI (2022) has also conducted its own assessment of adaptation finance, made available as shown in Figure 2. There is still a long way to go since the current financial flows are far short of the $180 billion needed between 2020 and 2030 (Atkins and Kowi 2021).

Figure 2: Adaptation Finance in US$ Billion



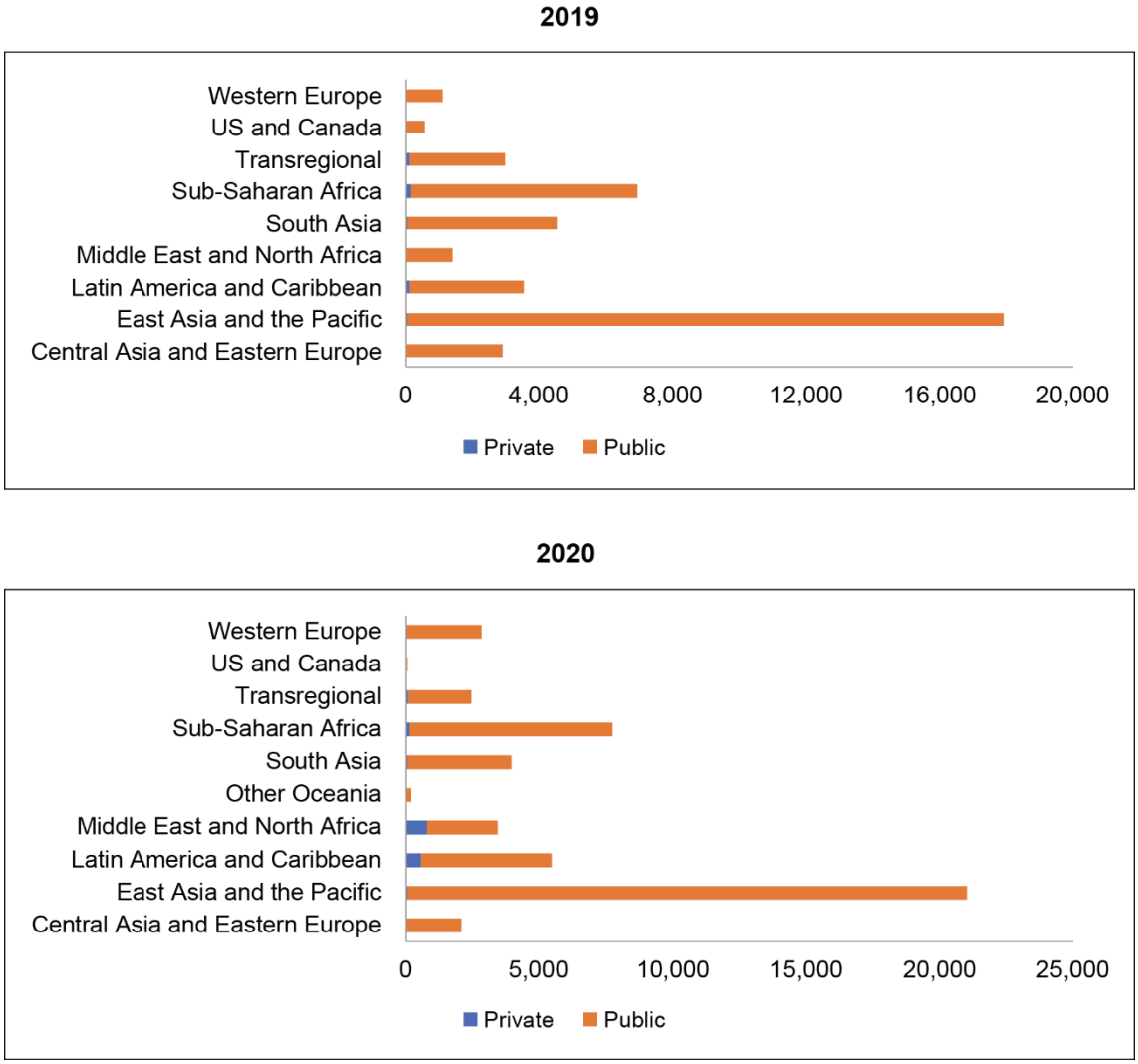
Source: CPI (2022).

In terms of public and private sources of funding, the current quantum of adaptation financing showcases disproportionate shares. According to the Global Landscape of Climate Finance report by the CPI, the adaptation sector recorded a total flow of $42,063 million for 2019, and $49,655 million for 2020 (CPI 2021). While the numbers have definitely increased over the years, the source-wise breakup of these numbers showcases the well-known stigma of the adaptation sector. As can be observed in Figure 3, for all specified regions,[4] adaptation finance is majorly supported through public sources of finance for both the years under consideration. While some absolute increase can be observed, the private sector's relative shares in climate change adaptation financing remains negligible.

[3] Most of the climate finance is debt and concessional finance and is limited to just 16%. Grant finance accounts for less than 5% (Climate Policy Initiative 2022).

[4] The CPI does not provide country-level data but a region-level analysis of different climate financing flows.

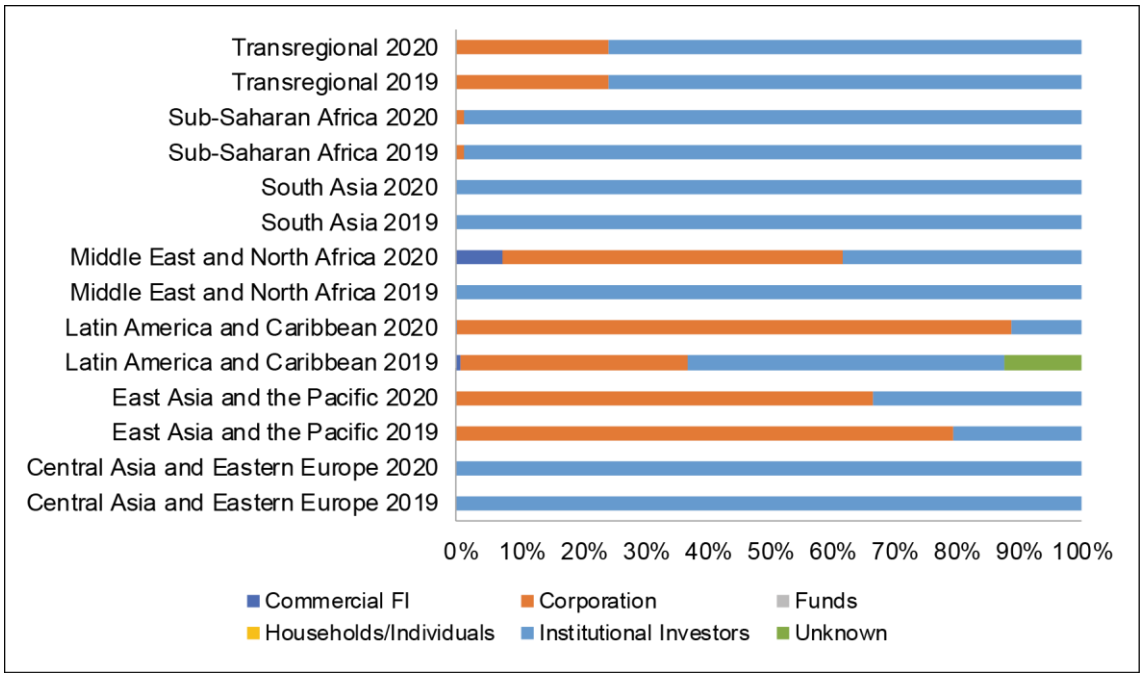
Figure 3: Private Vs. Public Adaptation Finance in 2019 and 2020 for Different Regions (US$ Million)



Source: Authors' compilation. Data: CPI Global Climate Finance Landscape 2021 database.

Further, a deeper dive into the different actors within the public and private sources of funding reveals that the route is confined to a limited set rather than a diversified group. The private sector in general operates through the corporations and institutional investors when financing adaptation in different regions, as can be seen in Figure 4.

Figure 4: Private Adaptation Finance Actors: Shares for Different Regions in 2019 and 2020



Source: Authors' compilation. Data: CPI Global Climate Finance Landscape 2021 database.

Encouraging greater private sector investments for the adaptation sector is not a new initiative. The need to augment private sector climate finance flows has been included as part of the G20 deliberations as well. For instance, the Green Finance Study Group (GFSG), launched under the Chinese G20 presidency (2016), was tasked with identifying market and institutional barriers to green finance and suggesting measures for improving private capital mobilization. The synthesis report prepared by the group highlighted voluntary options for improving the financial system's ability to mobilize private capital directed towards green investment (FM&CBG 2016). In the following round, the GFSG developed voluntary options for stimulating financial sector environmental risk analysis. Additionally, the G20 endorsed the recommendations put forth by the Task Force on Climate-related Financial Disclosures that called for voluntary disclosures by corporates with respect to climate-related financial risks (FM&CBG2017). In 2018, the scope of the GFSG was expanded to include sustainable development and was retermed the Sustainable Finance Study Group (SFSG). It put forth voluntary options for supporting the deployment of sustainable private capital (FM&CBG 2018; SFWG 2021). Under the Italian presidency, the SFSG was re-established and upgraded to form the Sustainable Finance Working Group (SFWG). The group was tasked with preparing a multi-year G20 Roadmap for Sustainable Finance, initially focusing on climate, with the primary aim of scaling up private and public sustainable finance, thereby accelerating the implementation of the Paris Agreement (FM&CBG 2021). Under the Indonesian presidency (2022), the group endorsed the findings of the G20 Sustainable Finance Report, which, amongst other things, called for improving the credibility of commitments of private sector financial institutions and augmenting sustainable finance instruments (G20 Bali Leaders' Declaration 2022; SFWG 2022).

2. POLICY RELEVANCE AND RESEARCH OBJECTIVE

2.1 Policy Relevance

Adaptation investments are important because they provide benefits, including avoiding losses, provide positive economic impact through risk reduction, and also ensure environmental and social benefits (Atkins and Kowi 2021). The World Bank has found that for every $1 invested in resilient infrastructure in low- and middle-income countries, it provides a benefit of $4. Multilateral development finance institutions (DFIs) are the main providers of global public finance for adaptation with a collective commitment of $14.9 billion in 2019, the majority of which was channeled through loans via the public sector. Grants only accounted for 5% of climate finance flows in 2017–18. The private sector contribution to total adaptation finance only reached 1.6%.

Across the developing world, investment in coastal protection (30%), infrastructure, energy and other built environments (24%), and water and waste management (24%) account for the largest shares of adaptation investment needs. The priority of adaptation is likely to be higher in sub-Saharan Africa as the adaptation investment need (as a share of GDP) is typically greater there and vulnerability to climate change is relatively high.

With apparent changes in climate and an increased frequency of climate change-induced disasters, there is an urgent need to channelize greater finance for meeting the adaptation needs of the world. While the private sector has traditionally played a much smaller role in adaptation financing, it is critical to understand the roadblocks and at the same time create new, more suitable avenues for them to increase their participation.

2.2 Research Objective

The present study discusses the current landscape of adaptation financing, the role of the private sector, and the hurdles in the way of increasing the finance flows from the said source. In doing so, the paper takes the route of adaptation to climate risk for planned and unplanned climate impacts. The analysis investigates the avenues through which the private sector could contribute to a greater extent towards meeting adaptation finance needs. It studies the role of the private sector as an investment source for specifically designed adaptation-related financial products or instruments catering to the planned alleviation of climate risks. In addition, an attempt has also been made to understand the repercussions of unplanned climate impacts like disasters, and to highlight the role of insurance as a finance-raising instrument for the private sector.

The rest of the paper is structured as follows: Section 3 elaborates on climate risk alleviation for planned climate impacts through greater private sector participation in formal adaptation financing; Section 4 delves into a special case for advocating investment into insurance-related instruments by focusing on the impacts of unplanned climate-induced disaster and its impacts; Section 5 provides key takeaways and policy recommendations for the G20; and Section 6 concludes the paper.

3. CLIMATE RISKS AND PLANNED CLIMATE IMPACTS: PRIVATE SECTOR AUGMENTATION

As discussed previously, efforts and initiatives have been put in place to encourage greater private sector participation in adaptation financing. However, to make any assessment of the formal ways and means to increase the same, there is a crucial need to comprehend and document the inhibitions of the private sector in entering the somewhat uncharted territory for them.

3.1 Barriers to Investment

The private sector faces a number of barriers to investment in adaptation-relevant sectors, making them more risk-averse, which may be financial or nonfinancial. Nonfinancial barriers would include technical and regulatory constraints as well. Costs affecting the rate of return, transaction costs, and information costs are some of the possible barriers affecting private actors' incentives (Torvanger et al. 2016).

The first barrier faced by the private sector is the nonavailability of climate risk data and tools (Atkins and Kowi 2021). The private sector has limited capacity to integrate physical climate risks into their decision-making. There is also limited understanding of how adaptation may provide a business opportunity for structuring and developing projects (Atkins and Kowi 2021). There exist information asymmetries and knowledge gaps with limited understanding about climate and uncertainty about where to invest. Private investors are unable to capture the environmental and social benefits that result from their investment (Stout 2022). An investor will not only need data/information about future climate change impacts but also about socioeconomic factors, population and migration trends, etc. Adaptation studies have significant "blind spots" not only in the assessment of the potential for climate-related impacts but also in the proposed approaches to managing such risks (Miller and Swann 2019). Moreover, there is usually a mismatch with respect to the time horizon viewed by the investor vis-à-vis climate change adaptation planning, with timelines viewed by an investor generally being much shorter (Stout 2022). Availability of information on long-term climate change adaptation will definitely improve the quality of investment.

The second barrier to private investment is the lack of institutional arrangements, policies, and planning for adaptation. In the absence of concrete policies, budgets, and investment programs, private financiers will not be interested in these types of investment (World Bank 2019). Very often it is seen in developing countries that public bodies do not have the requisite financial/technical knowledge for climate-related planning, and they often lack a single window clearance mechanism. Clear policy objectives and commitments are important to investors since they look to government strategies as important signals of intent. Along with the strategy, what is also required is a suitable legal, policy, and regulatory environment enabling investments in adaptation (Atkins and Kowi 2021). The absence of all this will definitely act as a dampener, and equally critical here is the presence of standards, metrics, and targets.

The third barrier to private investments in adaptation is the lack of financial incentives in the form of tax breaks/concessional finance, etc. Investment in adaptation is perceived to be risky with high upfront cost and low returns. Such incentives are thus necessary to lure private sector investments into adaptation where investments are front-loaded but returns may trickle in over many years besides being difficult to estimate. Adaptation projects rarely have monetized cash flows (Atkins and Kowi 2021). What might seem like a low-return adaptation project can get some relief by way

of grants, tax breaks, blended finance, etc. Moreover, instruments should not be just project based but rather should facilitate, for example, financial sector reform, fiscal policy changes, innovation, etc. (Atkins and Kowi 2021). Such a helping hand can only be extended by the government directly since one can't expect financial institutions like commercial banks to fund such projects or champion financial sector reform.

Multiple barriers suggest the need for an enabling investment environment for the private sector. These are a series of steps, albeit interrelated, that a government must initiate to invite private capital into adaptation activities. A detailed report prepared by the World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR) has outlined the steps that need to be taken to enable the private sector to come forward (World Bank and GFDRR 2021).[5] The first and foremost is to draw up an adaptation plan, so that private investments are in sync with the overall plan. Needless to say, the adaptation plan itself has to be in harmony with the NDC of the country. Preferably, the adaptation plan should follow a sectoral approach since not all sectors are on an equal footing when it comes to attaining net-zero emissions. Ideally, the adaptation plan should have a bottom-up approach as it should take care of the people who are going to be directly affected.

The second step would be to identify the projects, both from the public and private sector. For private sector investments to materialize, there has to be a revenue stream, which may not be possible in a variety of adaptation projects. In such cases, some innovative measures would be required that would act as a proxy to the revenue stream. One has to bear in mind that the private sector is usually risk-averse, and in the absence of a revenue stream, the enthusiasm to invest will be lacking. The private sector will have to be incentivized and their risk in adaptation projects will have to be lowered through the provision of grants or concessional loans. The formation of public-private partnerships could also be considered so that the risks could be divided depending upon the relative strengths and weaknesses.

The third step would be to finalize the project details and also identify the potential private sector investors. At this stage, the government will also have to identify bilateral donors for technical assistance and support project structuring and procurement. The last stage would involve the assessment of possible gaps and ensuring that the required policies, regulations, and other metrics are in place so as to de-risk the project to the greatest extent possible.

3.2 Existing Channels to Make Private Investments into Adaptation Less Risky

Overcoming the hurdles and barriers to private sector engagement requires the government to mobilize additional resources to raise revenue. This will increase investor confidence, thereby making private investments into adaptation less risky and reducing climate risks. There are a number of existing formal sector instruments that have the potential to achieve this objective. These include:

[5] Though this report speaks of a five-step approach, it is possible to collapse it into four steps since otherwise there seems to be a case of overlap. The four-step approach is detailed in the following paragraphs.

3.2.1 Access to Funds from Multilateral Climate Funds (MCFs) and Multilateral Development Banks (MDBs)

Altamirano (2021) states that in order to get access to climate finance, the developing economies can approach the existing MCFs or MDBs/DFIs.6 MCFs have supported climate mitigation and adaptation efforts mainly through grants and loans to governments. As of January 2022, the major contributors to MCFs, as monitored by Climate Funds Update (Heinrich-Böll-Stiftung and ODI 2022), were the UK ($7.3 billion), the US ($5.8 billion), Germany ($5.8 billion), Japan ($4.8 billion), France ($3.5 billion), and Norway ($3.4 billion).7 Support pledged to MCFs as of January 2022 amounted to about $11.9 billion for mitigation, $5.0 billion for adaptation, and $25.9 billion for projects that encompass both mitigation and adaptation. Most climate finance from developed to developing countries channeled through multilateral funds takes the form of grants and therefore will fall under the category of transfers.

MDBs (and also DFIs), on the other hand, provide concessional assistance including grants and soft loans. The simplest way in which MDBs could leverage a larger flow of private finance is by coinvesting with the private sector in the same project. The involvement of an MDB as a coinvestor in equity, or as a colender, can leverage additional flows if it gives comfort to private investors. For example, first loss guarantees8 could reduce risks for the private sector and encourage a larger flow of funds from the sector. MDBs can also engage in various forms of blending (Ahluwalia and Patel 2022). One of the main strengths of MDB grants is their simplicity as there are “no ongoing administration costs besides the monitoring of the project” (Lindenberg 2014). Dedicated adaptation finance can break down barriers to private investment by strengthening local capacities and institutions by taking on the larger risks with the lowest returns. Grants can be used to cover costs during the highest-risk development phase, thereby providing confidence to private investors (Lindenberg 2014). Similarly, blended finance helps induce private investment by leveraging public funds to de-risk and legitimize a given investment project (Lopez-Claros 2021).

To go a step further, MDBs can scale up their climate finance on their own balance sheet by shifting a larger share of their future lending commitments to climate-related projects, including adaptation. Masood (2021) has suggested that the World Bank could be repurposed to focus entirely on climate-related matters and other risks like the pandemic in developing countries. ADB, incidentally, has made the commitment that three quarters of its operation will be dedicated to programs that support climate change mitigation and adaptation and has also announced an ambitious expansion of climate finance through 2030. In 2015, they decided to increase climate financing from their own resources to $6 billion annually by 2020. In 2021, ADB announced that this amount would be increased to $100 billion by 2030. Details of the Climate Change Fund set up by ADB in 2008 to tackle climate change have been provided in Box 2.

---

[6] The distinction between MDBs and DFIs is nebulous. All MDBs are also DFIs but the reverse may not be true. Examples of MDBs are the World Bank, the Asian Development Bank, African Development Bank, European Bank for Reconstruction and Development, etc. DFIs are specialized development organizations that are usually majority owned by national governments. Examples of Indian DFIs would include NABARD, IDBI, EXIM Bank, National Housing Bank (NHB), etc.

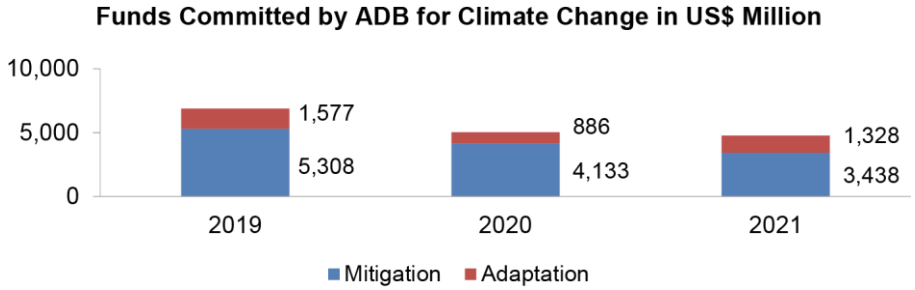
[7] From the website of Climate Funds Update (CFU) (https://climatefundsupdate.org/data-dashboard/, accessed 18 January 2023). CFU is a website that provides information on the growing number of dedicated multilateral climate finance initiatives designed to help developing countries.

[8] A mechanism whereby a third party compensates the lender if the borrower defaults.

Box 2: Climate Change Fund of ADB

The Climate Change Fund (CCF) was established in 2008 to provide assistance to developing countries to address issues arising out of climate change. The CCF provides money by way of grants, technical assistance, and direct charges. The CCF focuses on areas such as, adaptation, clean energy, sustainable transport, low-carbon urban development, and reduced emissions from deforestation and degradation.

Funds committed by ADB for climate change from 2019 to 2021 are given below:



Source: https://data.adb.org/dashboard/climate-change-financing-adb (accessed 31 January 2023).

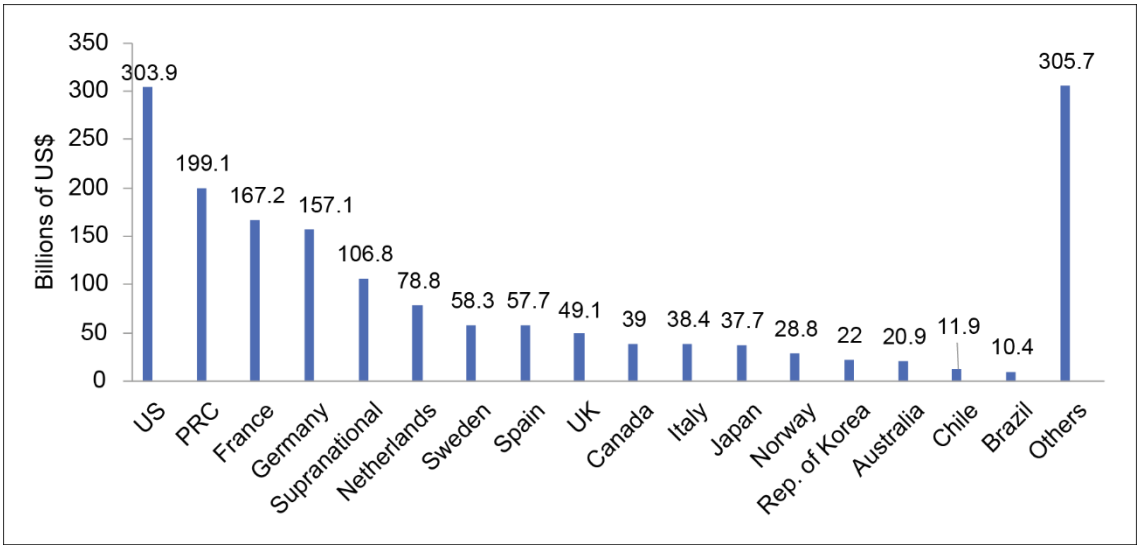
3.2.2 Green Bonds[9]

The World Bank defines green bonds as "fixed income," liquid financial instruments that are used to raise funds dedicated to climate mitigation, adaptation, and other environment-friendly projects. The green bond market grew from less than $40 billion in 2014 to over $250 billion in 2019. It is estimated that the value of the green bonds traded globally could reach $2.36 trillion by 2030 (Lopez-Claros 2021). Adaptation projects, per se, may not attract private capital, but if bonds are issued by reputed organizations, there is a good chance that private capital may be forthcoming.

One advantage of green bonds is that several projects can be grouped together (Lindenberg 2014). Green bonds are typically long-duration bonds, but for their successful operation, they need sophisticated financial markets and for the organization issuing the bonds to have high credit ratings (Lindenberg 2014; Torvanger and Pillay 2016). Not only that, but green bonds require an enabling environment including laws and regulations, transparency, and disclosure and reporting requirements (Pillay, Aakre, and Torvanger Asbjorn 2017). To incentivize green bond investments, public funds could be used to absorb risk to improve the risk profile of the bond. De-risking support can be provided by public entities using credit enhancement instruments, such as guarantees, subordinate debt, insurance cover policy, etc. Details of green bonds issued by some countries are provided in Figure 5.

[9] "Green bond" is a generic term and there are specific green bonds like water bonds, blue bonds (which support sustainable marine and fisheries), climate bonds, resilience bonds (which are a subset of green bonds, seeking to raise capital specifically for climate-resilient activities), etc.

Figure 5: Issue of Green Bonds by Various Countries in US$ Billion



Source: Statista 2022.

As of September 2022, 40 sovereign states have issued $308 billion in thematic bonds. Of these, 18 are emerging markets with a total issuance of $70 billion (Ramanathan 2023). Box 3 below gives the details of the Indian government's green bonds, which were auctioned recently.

Box 3: India's Sovereign Green Bonds

The government of India, in its budget for 2022–23, announced the issue of sovereign green bonds. The proceeds of the bonds will be deployed in public sector projects for reducing the carbon intensity of the economy. In its document, the government described a "green project" as one that encourages energy efficiency, reduces carbon emissions and greenhouse gases, and promotes climate resilience and/or adaptation, and also one that improves national ecosystems and biodiversity, especially with the Sustainable Development Goal (SDG) principles. Specifically, the proceeds will be used for renewable energy generation projects, the design and construction of government buildings/properties, to support public lighting through the installation of LEDs, to support the construction of low-carbon buildings, to promote public transportation and make infrastructure more resilient to the impacts of climate change, to invest in climate observation early warning systems, etc.

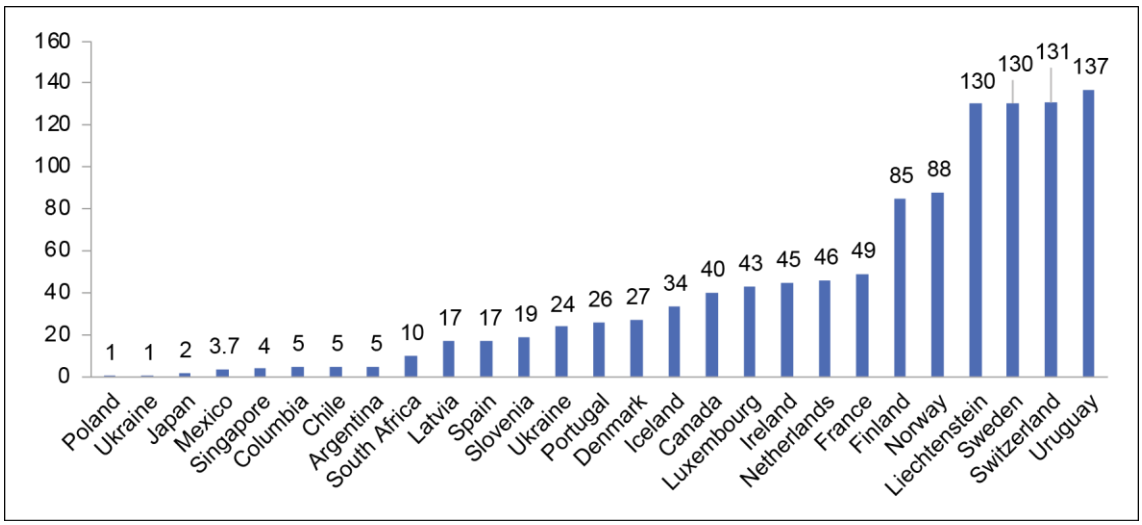
As a follow-up to this budget announcement, the government auctioned its maiden tranche of green bonds, estimated at ₹8,000 crore ($1 billion), on 25 January 2023. The yields of these bonds are below those of comparable bonds. The Reserve Bank of India, the Indian central bank, auctioned ₹4,000 crore of five-year bonds at a coupon rate of 7.1%, five basis points below the five-year sovereign yield. The remaining bonds of ₹4,000 crore had a tenure of ten years with a coupon rate of 7.29%, six basis points below other comparable government bonds. Another auction of bonds, again estimated at ₹8,000 crore, will be held subsequently.

(Source: Ramanathan 2023.)

3.2.3 Carbon Tax

Carbon tax is a very powerful instrument not only for discouraging the release of carbon into the atmosphere but also for raising revenue. The revenue thus raised can also be used for funding adaptation projects. The primary obstacle of carbon taxes is political and not technical, and it is said that four fifths of the carbon emissions remain unpriced (Lopez-Claros 2021). The IMF has estimated that limiting to the increase in temperature to 2 degrees would require a global carbon tax that would rise from the current global average of $2 to $3 per ton of CO_2 to $75 per ton of CO_2 by 2030. Only Finland, Norway, Liechtenstein, Sweden, Switzerland, and Uruguay have a carbon tax in excess of $75 (Figure 6). The IMF has also estimated that a uniform carbon price of $25, $50, and $75 per ton is required to reduce CO_2 emissions by 19%, 29%, and 35%, respectively, for the G20 countries by 2030.

Figure 6: Carbon Tax in US$ per Metric Ton of Carbon Dioxide in Various Countries



Source: Statista 2022.

3.2.4 Debt for Climate Swaps

In debt for climate (DFC) swaps, the debtor nation, instead of continuing to make external debt payments in foreign currency, makes payments in local currency to finance domestic climate projects on agreed-upon terms. In fact, this concept is not new, and debt for nature (DFN) swaps were introduced earlier in Bolivia, Ecuador, Indonesia, and the Seychelles, amongst others, and have been in operation since the 1980s. Debt swaps can be bilateral or tripartite or more. In bilateral swaps, a previously committed debt service is redirected to financing mutually agreed projects. Tripartite arrangements involve buyback of privately held debt financed by donors and/or new lenders, usually intermediated by an international nongovernmental organization (NGO). Usually, the NGO lends the money to the debtor country at concessional rates of interest on the condition that the debtor country buys back the debt at a discount (Chamon et al. 2022). The case of the Seychelles is presented in Box 4.

Box 4: Seychelles Debt for Climate Swap

In 2018, the Republic of Seychelles signed an agreement to protect a third of its marine and coastal areas in exchange for a reduction in sovereign debt. The deal was brokered between the Paris Club creditors and the government of Seychelles, which converted $21.6 million of the Seychelles' debt into investments in coastal protection. Apart from the creditors and the government of Seychelles, the other actors in the process were the Nature Conservancy's NatureVest (a US-based NGO) and a nationally based public-private trust fund set up through legislation, called the Seychelles' Conservation and Climate Adaptation Trust (SeyCCAT). NatureVest raised an impact loan of $15.2 million and also provided a $5 million grant to enable the government to purchase $21.6 million of its debt at a discount (93.5 cents in the dollar). The transaction was carried out by SeyCCAT, which was the new owner of the debt. The Seychelles government will issue two promissory notes to SeyCCAT, the first being $15.2 million at an interest rate of 3% over ten years, which would be used to pay the loan from NatureVest. The second promissory note would be for $6.5 million to fund conservation activities and capitalize future endowments. The financing will help the implementation of a Marine Spatial Plan for Seychelles exclusive economic zone, an area 3,000 times its landmass. Further, the deal will conserve 400,000 square kilometers of its marine area within the next five years.

Debt swaps have become important due to the rising debt of developing countries, especially since Covid-19, which has worsened the debt situation in middle- and low-income countries wherein economic activity has also gone down. Moreover, exchange rate fluctuations have made debt servicing more difficult. The IMF has estimated that debt service costs to government tax revenue will exceed 20% in the majority of low-income countries. More than 70% of the non-developed world debt service is owed by middle-income countries (Singh and Widge 2021). The average debt for low- and middle-income countries, excluding the People's Republic of China (PRC), reached 42% of their gross national income in 2020, up from 26% in 2011 (Oh 2022). For Latin American and Caribbean countries, the annual payment just to service debt averaged about 30% of their total exports.

It may, however, be added that the complex nature of debt swaps has limited their use and the amounts involved are very small, limited to the double-digit US million-dollar range. However, in terms of the number of swaps, more than 100 swaps have taken place since the late 1980s. Moreover, it is not certain whether these swaps are really an additional component that were not already planned (Essars, Cassimon, and Prowse 2021).

3.2.5 Climate Derivatives for Funding Climate Adaptation

The global derivatives market, with a value estimated to be greater than $100 trillion, provides huge potential for funding climate adaptation (Hull 2009). Derivatives are commonly used as a market-based instrument to transfer risk from one party that is exposed to risk to another that is concerned and able or willing to bear it. In simple terms, a derivative is a contract between two parties that have different perceptions regarding any parameter. One party (writer of the contract) makes a commitment to the other (investor) in relation to a predefined index. In return, the investor makes an upfront payment to the writer of the contract. According to Little et al. (2015), derivatives enable investors with different risk exposures and opinions on future climate impacts to transact.

3.2.6 Adaptation Benefit Mechanism (ABM)

This mechanism has been developed by the African Development Bank (AfDB) in association with a few African governments. It envisages the certification of social, economic, and environmental benefits of identified adaptation projects by reputed organizations. The value of the adaptation action captured in the certificates, including incremental costs of generating the benefits, will be presented before potential investors/lenders. Since adaptation projects generally have low rates of return, the donors will be expected to fill the gap and make the project financially viable. Once the donor(s) has been finalized the project developer will approach a commercial bank to seek a loan. An offtake agreement will be signed between the donor and the host country and such agreements will guarantee payments on delivery of adaptation benefits following a verified performance. Payment of adaptation benefits will enable financial institutions to consider ABM revenues as a new source of income and as extra security against loans and equity investments.

Primarily, this mechanism will de-risk and incentivize investments by facilitating payments for the delivery of adaptation benefits. Unlike "carbon credits," which can be used as emission rights, the certified adaptation benefits (CABs) created by the ABM represent verified and largely quantified information on progress towards resilience and climate finance. The ABM mechanism falls under Section 6.8 of the Paris Agreement, which speaks of nonmarket-based approaches. The first phase of the project began in 2019 and will go on until 2023.[10] About ten to 12 pilot projects will be set up during the first phase. During the pilot stage, small projects will be tested with the intention of replicating them or scaling them up subsequently. The objective of setting up the pilot projects is to develop sufficient infrastructure and awareness for project developers. This mechanism will assist in signing offtake agreements between the host countries and the climate financiers without having to set up demonstration projects. The identified pilot projects include, among others, solar-powered irrigation pumps to overcome unreliable rainfall, drip irrigation technology to make use of available irrigation water, the development of weather information systems to provide farmers with accurate forecasts, etc.

It is essential to highlight a key observation here. While the aforementioned financial instruments help in the planned adaptation of climate risks, the objective seems to be still embedded in the achievement of developmental goals. Raising finance for climate change adaptation in particular is not the primary objective of setting up or initiating the said sources. While addressing other developmental financing concerns like the need for infrastructure and ensuring energy security, the raising of adaptation finance seems to be a corollary objective and thus achievement. Raising climate finance solely for adaptation purposes seems to be a missing link in this route of escalating finance.

[10] The progress made so far includes the preparation of guidelines for project developers, initiating the work relating to methodology to be adopted for different projects, etc. The next step will be to get ready for validation. Registration of projects is yet to start. The only methodology that has been finalized to date is regarding "potato storage using green cooling technology" (ABM stakeholder consultation, held on 11 November 2022 during COP 27).

4. CLIMATE RISKS AND UNPLANNED CLIMATE IMPACTS: PRIVATE INVESTMENTS IN INSURANCE

4.1 Insuring Against Disasters

In the area of climate risk impacts, a crucial and perhaps more devastating component is formed by unplanned climate situations such as disasters. Climate change and the increase in extreme weather events have led to an increase in the number of disasters by a factor of five over a period of 50 years, from 1979 to 2019 (WMO 2021). In fact, the month of August 2022 was recorded as the world's sixth-warmest August in 143 years, according to scientists at the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NOAA 2022). Such climate-related disasters cause not just economic losses but also loss of livelihoods, human lives, infrastructure, etc., as well as having a significant impact on the industrial sectors.

As the previous section elaborates, one of the key financial instruments to address unplanned climate impacts like disasters is formed by insurance. It is said that the density of insurance penetration is critical to a society's ability to recover post disaster (Mellecky and Raddantz 2013); those with a higher penetration recover faster. Countries and communities with limited resources and low income usually have low insurance penetration. Insurance penetration in low-income countries usually falls below 1%. While this is astonishing, there are several reasons as to why insurance has not really been used as a shield against climate disasters. First, there is the cost of insurance, as it is considered to be high and mounting given the increasing number of cases of climate disasters. Second, there is limited understanding of insurance mechanisms amongst the general masses. Third, there are cultural barriers to insurance – for example, in countries where disaster is seen as a matter of "fate" (The Review 2008). Fourth, equally important is the fact that there is a lack of availability of insurance products and also a lack of a reinsurance facility (Grislain-Letremy, Lahidji, and Mongin 2015). Fifth, there is a mismatch in the time horizon of climate change (which is a long-term perspective) vis-à-vis insurance products, which are designed for short-term protection ranging usually from one to three years.

To enhance the role of the private sector in insurance protection, government intervention is again necessary, especially since there could be a supply problem if too many claims are made simultaneously. Further, in order to make insurance less expensive, risk pooling may be required so as to mitigate unaffordable insurance.[11] In addition, for smooth functioning of the insurance mechanism, the government has to ensure a proper legislative and regulatory framework, which ideally should be consistent across countries so as to allow cross-border use of risk financing and insurance instruments for climate adaptation (Jarzabkowski et al.2019). The government also needs to provide risk data and analysis of the impact of climate change for a better understanding of the risk profile of different countries, regions, assets, and populations.

[11] Government intervention in insurance has the problem of moral hazard, which needs to be borne in mind. Policy holders may engage in risky behavior knowing fully that the government will finally incur the cost.

Among the different types of insurances available, parametric insurance is one of the instruments available to combat climate change. It is an index-based insurance product in which a payment is triggered by a specific set of parameters or indices related to the severity of the disaster. Parameters include the wind speed in a cyclone, the volume of rainfall in floods, crop yields, power outages, etc. The advantage of parametric insurance is that its payouts are quick and that there is no need to assess the value of the loss. However, there could be challenges where the severity may be more than what is reflected in the model or vice versa, or the insured may lack the literacy to select a product.

As mentioned previously, the lack of reinsurance is one of the important reasons for the insurance industry not coming of age. One important source of reinsurance is catastrophe bonds, also known as "CAT bonds." CAT bonds were first used in the 1990s in the aftermath of Hurricane Andrew and the Northridge earthquake. Under this mechanism, an insurance company creates a special purpose vehicle (SPV), which issues the bonds that are purchased by investors and the money received can be invested in the government treasury market. In addition, the insurance company also pays a premium to the SPV, which is also invested in the treasury market. It is here where the role of the private sector becomes paramount and it can participate in a big way, providing funds for climate change. If there is a payout, the funds invested in the treasury market can be used. If no payouts are required, the investors are returned their money along with the interest earned. The advantages of CAT bonds are that they are 100% collateralized and structured to eliminate counterparty risk and are insulated from the general economic conditions prevailing in the economy. The Jamaican case of CAT bonds is shown in Box 5.

Box 5: CAT Bonds: A Case Study of Jamaica

The World Bank has issued CAT bonds that are also parametric in nature and will provide the government of Jamaica (GoJ) with $185 million in insurance cover for three hurricane seasons ending in December 2023. Natural disasters, incidentally, cost Jamaica about $2.1 billion from 2001 to 2010. The loss and damage from Hurricane Ivan in 2004 alone exceeded $350 million. The objectives of the project include increasing financial resilience against tropical cyclones without increasing sovereign debt, providing access to quick-disbursing and cost-effective insurance from the capital markets, etc. The premium for these bonds is being paid by the Global Risk Financing Facility (GRiF) and the United States Agency for International Development (USAID). The premium is fixed for the life of the bond. The types of events that will trigger a payout were predefined during the structuring of the transactions. The World Bank will transfer the payouts to the GoJ as soon as the calculation report is ready. The World Bank was able to secure donor grants for Jamaica from both the GRiF and USAID, which were used to finance CAT bond premium and transaction costs.

(Source: World Bank 2019.)

4.2 The Business Case of Insurance Investments for the Private Sector

The industrial or the private sector suffers both direct and indirect losses due to sudden disaster impacts. While the infrastructure damage translates to capital loss, the impact on the economy translates to losses in terms of a fall in production or output, among other parameters. However, a limited few within the private sector who are cognizant of the effect that climate-induced disasters can have do insure and to some extent bear the expenditure towards disaster management. However, there is still a significant informal segment of the private sector that remains unprepared, incurring huge losses due to such disasters. The lack of awareness of available insurance facilities and other factors, as discussed previously, thus limits the extent of climate risk mitigation.

Management of such unplanned climate disasters forms a key direct aspect of adaptation. Channelizing greater finance towards disaster management not only forms another measure of mitigating climate risks, but also represents an expenditure directed towards solely raising adaptation finance. In this section, an attempt has been made to build a business case for the private sector to invest in adaptation, not simply from the perspective of ensuring the greater good of the community, but also for the good of their own. The study makes use of the Emergency Events Database (EM-DAT) to highlight the increased frequency of climate disasters as well as the magnitude of damage that they induce, with a specific focus on the G20 developing countries. It is acknowledged that while the current focus of the study is limited to sudden-onset disaster impacts, a deeper dive into slow-onset climate impacts (surging temperature, sea level rise, etc.) would lend greater support to building the case for increased private sector adaptation action and investments.

4.2.1 EM-DAT Database Analysis

The EM-DAT database, developed by the Center for Research on the Epidemiology of Disasters (CRED), was used to gather data pertaining to natural disasters and associated damage costs for the period 1990–2022.[12] In particular, climatological, hydrological, and meteorological disasters have been considered as far as disaster types are concerned. The disaster subtypes included within the aforementioned subgroups are presented in Annexure Table A.2. As indicated earlier, this paper focuses on the G20 developing countries.

It is important to point out here that while the EM-DAT database specifies multiple instances of disaster occurrences, the damage costs, as indicated in Table 1, are underestimates arising out of a lack, or limited availability, of data regarding the same. Nevertheless, the available information has been suitably used to narrow down the disasters, countries, regions, and instances on which the present study focuses. For instance, in terms of the share of damage costs by disasters across the set of G20 developing countries, floods and storms stand out with a share of 57.22% and 28.03%, respectively. Likewise, in terms of frequency of occurrences, floods and storms feature as the top most recurrent disasters for the majority of these countries.

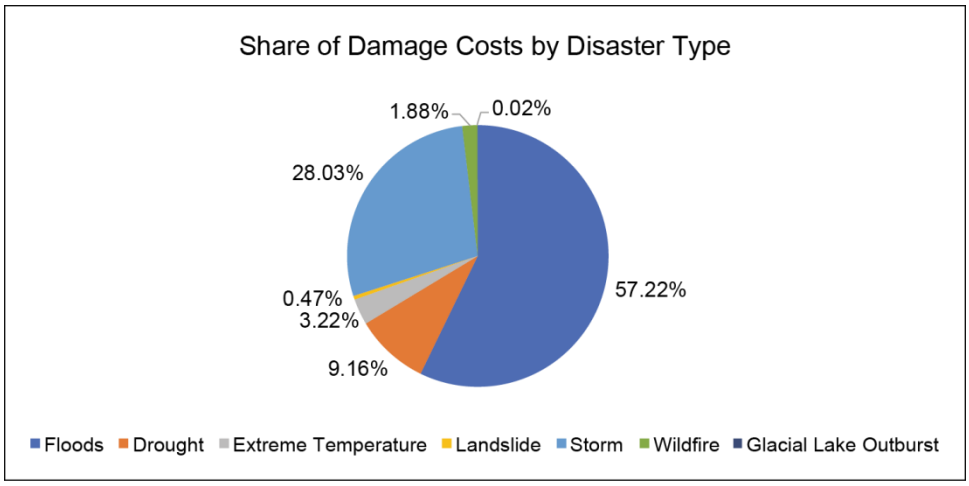
[12] Based on data as of 8 September 2022.

Table 1: Adjusted Damage Costs Due to Natural Disasters (in 000 USD)

Countries	Argentina	Brazil	PRC	India	Indonesia	Republic of Korea	Saudi Arabia	Mexico	South Africa	Türkiye	Totals by Disaster
Floods	10,773,212	7,625,915	404,525,274	102,392,665	9,950,643	4,726,917	1,500,418	6,044,069	1,636,846	3,987,188	553,163,147
Drought	3,845,705	16,156,948	53,981,383	7,851,001	150,027	0	0	2,729,929	3,829,330	0	88,544,323
Extreme Temperature (Cold/Heatwave)	0	868,346	28,773,184	589,198	0	143,384	0	759,698	0	1,574	31,135,384
Landslide	18,946	317,730	3,698,621	77,378	223,039	203,896	0	0	0	46,233	4,585,843
Storm	152,895	841,744	152,156,167	51,145,887	801,180	19,739,478	56,450	43,541,444	1,848,719	663,275	270,947,239
Wildfire	0	59,843	0	0	16,857,131	0	0	13,298	1,021,207	232,000	18,183,479
Glacial Lake Outburst	0	0	0	210,000	0	0	0	0	0	0	210,000
Totals by Country	14,790,758	25,870,526	643,134,629	162,266,129	27,982,020	24,813,675	1,556,868	53,088,438	8,336,102	4,930,270	966,769,415

Source: Authors' compilation using EM-DAT (2022).

Figure 7: Share of Damage Costs by Disaster Type



Source: Authors' construction using EM-DAT (2022).

When adopting a country-level focal lens, with respect to the total damage cost incurred on account of all natural disasters, it was found that the PRC and India bore the majority of the brunt with 66.52% and 16.78% shares, respectively. A closer inspection of the database also revealed that for countries such as Saudi Arabia and Türkiye, the data on damage costs were rather scarce, with only a handful of instances being accompanied by the relevant data. In fact, for Saudi Arabia, the only disasters reported were storms and floods. These countries have thus been dropped from the analysis. When cross-tabulating the frequency with which each disaster type has occurred in the case of the remaining countries, it was found that 32.96% and 22.26% were recorded in the PRC and India, respectively.

The EM-DAT analysis points to the stark reality that while the frequency of climate-induced disasters has increased, the magnitude of damages has also grown manifold. Insurance serves as a vital instrument to mitigate against this risk, while at the same time also serving as a critical avenue for the private sector to enter the adaptation sector. With different regions being vulnerable to a varied set of climate-induced disasters, this translates into different risks faced by each. This in turn warrants the need for a diverse set of financing requirements for each region, and it is well understood that this "impact chain" will require a substantial quantum of financing. As a critical player in the mobilization of climate finance, it is thus essential to expand the role of the private sector in adaptation financing.

5. KEY TAKEAWAYS AND RECOMMENDATIONS FOR G20

Risk mitigation forms a key aspect of augmenting private sector investment into climate adaptation. Planned climate impacts provide an opportunity to prepare and thus implement and act better. While the barriers faced by the private sector in this formal route need to be addressed, diverse financial instruments help in channelizing greater developmental finance and, in doing so, serve the adaptation purpose to some extent as well. The unplanned climate impacts, however, present a more difficult situation. There is an urgent need to make the sector aware of the availability of different types of insurance in order to be better prepared for unanticipated climate impacts like natural calamities.

Furthermore, the G20 can also help bolster the agenda. Time and again the forum has raised the agenda for effective mobilization of climate finance. With an increasing focus on adaptation financing in the global community, it is essential to initiate discussions on newer avenues and sources of raising finance as well as on the roadblocks that might emerge in the process. The G20 forum has always aimed at collective and sustainable growth, with all past presidencies assigning due importance to climate change concerns. It represents a powerful forum to find pragmatic solutions through focused dialogues and deliberations.

The analysis under the current study provides three main takeaways for the G20:

5.1 Addressing the Impediments to Private Adaptation Finance

The analysis highlights that adaptation financing from the private sector faces a few impediments that need to be addressed majorly by the public sector. Utilizing existing finance mobilization instruments, the public sector can achieve the twin benefit of raising additional finance and building up investor confidence for the private sector to enter the uncharted territory of adaptation finance.

The G20 can also play a crucial role in aiding this process. Adaptation finance has formed an important agenda item in the G20, from the early-stage discussions under the Turkish presidency in 2015 focusing on the development of resilience and reduction of disaster risks, to the Japanese presidency in 2019 standing in agreement with the "Action Agenda on Adaptation and Resilience." Supporting the initiatives required at the country or the government level, the G20 can help increase private sector investments in adaptation in several ways. First, setting up an institutional arrangement that serves as an intermediary and a facilitator between countries and private investors will help to smoothen the process by providing a platform in which both the interested parties can directly work together. The support of the G20 will provide the necessary confidence as sought by the private investors (Jain 2022).

Secondly, stringent policies for resources required for adaptation should be enforced by the institution. However, in order to prescribe effective adaptation policy, it is important to have a correct estimate of the total economic losses, consisting of the direct and indirect ones taking into account the spillover effects in the sector, region, and dynamic repercussions. This would necessitate establishing an institution that focuses on gathering data and facilitating impact-based assessments of the affected area or the adaptation-relevant sector, region, and time. In order to facilitate private sector investment, some form of incentives will be crucial, which may take the form of tax breaks and concessional finance. Rewriting insurance policies related to adaptation-relevant events could facilitate private sector investments. However, the data on insurance claims and the available insurance schemes would require proper monitoring.

5.2 Encourage Greater Role of Insurance Companies and the Private Sector in Post-disaster Impact Reporting

Based on an in-depth study of gray literature and other secondary sources, in a forthcoming policy brief[13] it was found that much of the reported damage numbers publicly available were restricted to a few sectors, including losses to government or public infrastructure. Furthermore, as the data were primarily provided by government sources, there was a large underestimation of the damages incurred. Two significant components where underreporting was noted were damages to physical capital in local industries, and damages to houses and other amenities for the residential sector. While this information can potentially be collated through claims made to insurance companies, the same is not easily available in the public domain.

It was also observed that the focus in reporting damages was more inclined towards the measurement of immediate direct impacts mostly pertaining to human suffering and damages to croplands, livestock, houses affected, and physical infrastructure. However, due to the long-term impact of losses in physical capital on incomes generated in subsequent periods, available estimates underreport impacts to a large extent. A comprehensive understanding and estimation of both direct and indirect impacts of disasters is vital to design better, prepare better, and therefore adapt and build back better.

5.3 G20 Knowledge Center for Research on Climate Impacts

Modeling can be an excellent tool for the comprehensive estimation of disaster impacts. As disaster impacts are largely local, usage of remote sensing and GIS can be extremely useful in disaster adaptation modeling by providing critical information about the characteristics of the area affected by a disaster, and how it can be adapted to reduce the risk of future disasters. There are some ways in which remote sensing and GIS can be used in disaster adaptation modeling, such as vulnerability assessment, hazard mapping, land-use mapping, and reconstruction and rehabilitation mapping. These, accompanied by an economic model, can provide significant insight into the spillover impacts of disasters, and optimal measures for reconstruction to reach pre-disaster levels of welfare.

As the G20 comprises some of the most powerful countries across the globe, they already possess cutting-edge scientific tools for hazard prediction and impact modeling. However, there still remain gains from synergizing knowledge across countries. It is thus proposed that a Knowledge Center for Research on Climate Impacts be established, along the lines of the existing Global Infrastructure Hub (GIH), to look into these areas. This Center could look into issues related to reducing vulnerability to climate hotspots, modeling the impact of adaptation efforts, and prioritizing options based on their impacts, investments needed, etc. It could also provide guidance for land-use planning decisions to reduce the risk of disasters.

[13] The policy brief, envisaged as a supplementary body of work to accompany this working paper, develops a business case for adaptation for the private sector. This is done by estimating and analyzing the economic losses and costs incurred in cases of unplanned climate impacts like storms and floods, through the utilization of modeling tools (MRIO tables), and the analysis of gray literature and secondary sources.

6. CONCLUSION

As with climate financing in general, the climate change adaptation landscape also faces a dearth of finance. While COP 26 and 27 brought the spotlight onto raising adaptation finance and also put in place international arrangements to channelize the same, the crucial question of a greater role of private sector participation in raising adaptation finance still remains.

The analysis of the formal route of raising private sector adaptation finance revealed that the need of the hour is to enhance spending on factors that lead to climate change, especially on adaptation vis-à-vis mitigation. Though the CAGR for the amounts spent on adaptation was 16.7% for the period 2011–2020 (as against 6% for mitigation) (Climate Policy Initiative 2022), this higher growth rate, in all likelihood, is due to the smaller base for adaptation activities. Looking at the figures for 2019–20, adaptation finance accounted for only 7.5% of the total amount spent on climate change, and the contribution of the private sector was only a fraction. Most of the adaptation spending has been directed towards water and waste water, whereas sectors such as building and infrastructure have been ignored. The main reasons for poor private sector participation were found to be asymmetry and the lack of data available to the private sector, the lack of a revenue stream for adaptation projects, the predominant nature of risk that is involved while dealing with adaptation projects, the lack of an overall adaptation plan and the required regulatory framework, etc. Of course, a part of the solution lies in the government extending concessional finance, blended finance, tax breaks, etc. All these measures will provide some form of risk guarantee. Additionally, an enabling environment in a country will determine the viability of specific financial instruments. Governments can also raise money through the imposition of carbon taxes or adopting debt for climate swaps. Separately, the private sector can directly resort to identified instruments, such as issuing green bonds, climate derivatives, or resorting to an adaptation benefit mechanism to raise resources for adaptation finance.

Furthermore, the increased frequency and damages of climate-induced disasters imply that the private sector in the past has not been untouched by climate disasters, and will not be in the future. There is, therefore, a strong case that could be built for the private sector to engage in adaptation-related activities that build resiliency, or invest in financial instruments that insure against the damage wreaked by natural calamities. Insurance can prove to play a critical role in this context of increasing private sector participation.

The G20 can play a pivotal role in this under researched area of loss and damage estimation. This paper highlights three salient areas where it could substantially contribute:

(a) Addressing the impediments to private adaptation finance

(b) Encouraging a greater role of insurance companies and the private sector in post-disaster impact reporting

(c) G20 Knowledge Center for Research on Climate Impacts

REFERENCES

Ahluwalia, M. S., and U. Patel. 2022. *Financing Climate Change Mitigation and Adaptation in Developing Countries*. New Delhi: Centre for Social and Economic Progress (CSEP).

Altamirano, M. A. 2021. *Leveraging Private Sector Investment in Adaptation.* Climate Market and Investment Association.

Atkins and Kowi. 2021. *Study on the Involvement of the Private Sector in Financing Adaptation Actions.* Bristol: WS Atkins International Limited.

Averkhenkowa, A., F. Krick, A. Kokernick-Mina, S. Surminski, and H.Leck. 2016. Multinationals and Large National Corporations and Climate Adaptations: Are We Asking the Right Questions? *Wiley Interdisciplinary Issues: Climate Change*, 7(4): 517–536.

Centre for Research on the Epidemiology of Disasters (CRED). 2022. *Emergency Events Database (EMDAT)*. https://www.emdat.be/ (accessed 10 September 2022).

Chamon, M., E. Klok, V. Thakoor, and J. Zettelmeyer. 2022. *Debt for Climate Swap: Analysis Implementation and Design*. IMF Working Paper 2022/162. Washington, DC: International Monetary Fund (IMF).

Climate Action Network. 2013. *Climate change adaptation and the role of the private sector: Creating effective tools for private sector engagement*. Brussels: CAN Europe.

Climate Policy Initiative (CPI). 2021. *Global Landscape of Climate Finance 2021. Methodology.* https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Methodology.pdf (accessed 29 September 2022).

———. 2022. *Global Landscape of Climate Finance-A decade of data: 2011-2020.* Climate Policy Initiative.

Druce, L., C. Gruening, U. Moslener, P. Pauw, and R. Connell. 2016. *Demystifying Private Adaptation Finance.* UNEP.

EEA. n.d. *What is the Difference between Adaptation and Mitigation?.* Helpcenter FAQ. https://www.eea.europa.eu/help/faq/what-is-the-difference-between (accessed 1 October 2022).

Essars, D., D. Cassimon, and M. Prowse. 2021. Debt for Climate Swaps: Killing Two Birds with One Stone? *Global Environmental Change*, 71: 102407.

Ramanathan, A. 2023. Green bonds debut at 5-6 bps below sovereign rates. Financial Express. https://www.financialexpress.com/market/green-bonds-debut-at-5-6-bps-below-sovereign-rates/2960396/ (accessed 8 February 2023).

FM&CBG. 2016. Communique: G20 Finance Ministers and Central Bank Governors Meeting. https://g20sfwg.org/wp-content/uploads/2021/07/Chengdu_Communique_G20_Finance_Ministers_and_Central_Bank_Governors_Meeting_23-24_July_2016.pdf (accessed 11 February 2023).

———. 2017. Chair's Summary: G20 Finance and Central Bank Governors Meeting. https://g20sfwg.org/wp-content/uploads/2021/07/Chairs_Summary_Washington_April_2017.pdf (accessed 11 February 2023).

———. 2018. Communique: G20 Finance Ministers & Central Bank Governors Meeting. http://www.g20.utoronto.ca/2018/2018-07-22-finance-en.pdf. (accessed 11 February 2023).

———. 2021. Communique: Second G20 Finance Ministers and Central Bank Governors meeting https://g20sfwg.org/wp-content/uploads/2021/08/2021-Communiqu%C2%AE-Second-G20-FMCBG-meeting-7-April.pdf (accessed 11 February 2023).

Goldar, A., D. Dasgupta, and S. Jain. 2022. *Financing Climate Targets: A Study of Select G20 Countries.* Asian Development Bank Institute. doi: https://doi.org/10.56506/

Grislain-Letremy, C., R. Lahidji, and P. Mongin. 2015. *Major Risks and Public initiative.* Analyses Economiques, XII-5.

G20 Bali Leaders' Declaration. 2022. https://g20sfwg.org/wp-content/uploads/2022/11/G20-Bali-Leaders-Declaration-2022.pdf (accessed 11 February 2023).

Heinrich-Böll-Stiftung and ODI. 2022. Climate Funds Update. https://climatefundsupdate.org/data-dashboard/ (accessed 18 January 2023).

Hsu, A., J. Brandt, O. Widerberg, S. Chan, and A. Weinfurter.(2020. *Exploring Links Between National Climate Strategies and Non-State Subnational Climate Action in NDCs.* Climate Policy, 443–457.

Hull, J. C. 2009. *Options, Futures and Other Derivatives.* New Jersey: Pearson Prentice Hall.

IPCC. (2018). Annex I: Glossary [Matthews, J.B.R. (ed.)]. In *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty,* edited by V. Masson-Delmotte et al. Cambridge: Cambridge University Press, UK and New York, NY, US, pp. 541–562. https://doi.org/10.1017/9781009157940.008/ https://www.ipcc.ch/site/assets/uploads/sites/2/2022/06/SR15_AnnexI.pdf

Jain, S. 2022. *Adaptation Finance: Scaling up for Better Preparedness.* Wordpress Blog. https://icrierclimatechange.wordpress.com/2022/07/05/adaptation-finance-scaling-up-for-better-preparedness/ (accessed 22 February 2023).

Jarzabkowski, P., K. Chalkias, D. Clarke, E. Iyahen, D. Stadweller, and A. Zwik. 2019. *Insurance for Climate Adaptation: Oppurtunities and Limitations. Global Commission on Adaptation.* Rotterdam and Washington, DC: Global Commission on Adaptation.

Levina, E., and D. Tirpak. 2006. *Adaptation to Climate Change.* Key terms. Organization for Economic Cooperation and Development and the International Energy Agency Washington, DC. https://www.oecd.org/env/cc/36736773.pdf (accessed 15 November 2022).

Lindenberg, N. 2014. *Public Instruments to Leverage Private Capital for Green Investments in Developing Countries.*Bonn: German Development Institute.

Little, R. L., A. J. Hobday, J. Parslow, C. Davies, and Q. R. Grafton.2015. *Funding Climate Adaptation Strategies with climate Derivatives.* Climate Risk Management, 9–15.

Lopez-Claros, A. 2021. *Financing Instruments for Climate Change Mitigation and Adaptation.* Climate Governance Commission. https://globalchallenges.org/wp-content/uploads/2021/11/Financing-Instruments-for-Climate-Change-Mitigation-and-Adaptation-2021-11-08.pdf (accessed 10 January 2023).

Masood, A. 2021. *The World Bank Must be Repurposed to Focus on Climate – or Net Zero is a Pipedream. The Independent.* https://www.independent.co.uk/climate-change/opinion/world-bank-climate-investment-net-zero-b1958514.html (accessed 5 January 2023).

Mellecky, M., and C. Raddantz. 2013. *How Do Governments Respond after Catastrophes? Natural Disaster-Shocks and the Fiscal Stance*. Washington, DC: World Bank.

Miller, A., and Swann, S. (2019). *Driving Finance Today for the Climate Resilient society of Tomorrow*. UNEPFI and Global Commission on Adaptation.

NOAA. 2022. In News & Features: *Earth Had its 6th-Warmest August on record*. Dated September 14, 2022. US Department of Commerce. https://www.noaa.gov/news/earth-had-its-6th-warmest-august-on-record (accessed 3 October 2022).

ODI. (n.d.) Notes and Methodology on *Climate Funds Update*. https://climatefundsupdate.org/about-us/notes-and-methodology/ (accessed 29 September 2022).

OECD. 2013. Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997. https://stats.oecd.org/glossary/detail.asp?ID=41 (accessed 26 October 2022).

———. 2016. *OECD DAC Rio Markers for Climate: Handbook. Paris, OECD*. https://www.oecd.org/dac/environmentdevelopment/Revised%20climate%20marker%20handbook_FINAL.pdf (accessed 22 December 2022).

———. 2022. *Aggregate trends of Climate Finance Provided and Mobilised by Developed Countries in 2013-2020.* OECD https://www.oecd.org/climate-change/finance-usd-100-billion-goal/aggregate-trends-of-climate-finance-provided-and-mobilised-by-developed-countries-in-2013-2020.pdf (accessed 23 September 2022).

Oxfam. 2020. *Climate Finance Shadow Report: Assessing Progress Towards the $100 billion Commitment.* Oxford: Oxfam International.

Pillay, K., S. Aakre, and A. Torvanger 2017. *Mobilising Aaptation Finance in Developing Countries.* Oslo: Centre for International Climate Research.

SFWG. 2021. *Terms of Reference: G20 Sustainable Finance Working Group.* from https://g20sfwg.org/wp-content/uploads/2022/12/ToR-SFWG-FINAL_June-2021.pdf (accessed 11 February 2023).

———. 2022. *G20 Sustainable Finance Report.* https://g20sfwg.org/wp-content/uploads/2022/10/2022-G20-Sustainable-Finance-Report-2.pdf (accessed 11 February 2023).

Singh, D., and V. Widge. 2021. Debt for Climate Swaps. Climate Policy Initiative https://www.climatepolicyinitiative.org/wp-content/uploads/2021/05/Debt-for-Climate-Swaps-Blueprint-May-2021.pdf (accessed 17 November 2022).

Statistica. 2022. *Carbon tax rates worldwide as of April 1, 2022, by country*. https://www.statista.com/statistics/483590/prices-of-implemented-carbon-pricing-instruments-worldwide-by-select-country/ (accessed 7 Jaunary 2023).

———. 2022. *Leading countries in terms of green bonds issued in 2021*. https://www.statista.com/statistics/1289016/green-bonds-issued-worldwide-by-country/ (accessed 7 January 2023).

Stout, S. 2022. *Unlocking Private Sector Adaptation Finance.* Climate Policy Initiative. https://www.climatepolicyinitiative.org/unlocking-private-sector-adaptation-finance/ (accessed 27 October 2022).

The Review. 2008. A Guide to Catastrophe Modelling. Informa UK Ltd.

Torvanger, A., and K. Pillay. 2016. *Norway's Role in Supporting Green Growth in Developing Countries.* Oslo: CICERO.

Torvanger, A., P. Narbel, K. Pillay, and C. Clapp. 2016. *Instruments to Incentivise Private Climate Finance for Developing Countries.* Oslo: CICERO.

Oh, S. 2022. *How Debt for Climate Swaps Can Help Low Income Countries' Crushing Debt and Environmental Challenges at the Same Time.* The Conversation. https://theconversation.com/how-debt-for-climate-swaps-can-help-solve-low-income-countries-crushing-debt-and-environmental-challenges-at-the-same-time-191161 (accessed 18 November 2022).

UK Climate Impacts Programme (CIP) 2007. *Identifying Adaptation Options*. https://www.ukcip.org.uk/wp-content/PDFs/ID_Adapt_options.pdf (accessed 18 October 2022).

United Nations Environment Programme (UNEP). 2021. *Adaptation Gap Report 2021: The Gathering Storm – Adapting to Climate Change in a Post-pandemic World.* Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

United Nations Framework Convention on Climate Change (UNFCCC). n.d. *What do Adaptation to Climate Change and Climate Resilience Mean?.* https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/what-do-adaptation-to-climate-change-and-climate-resilience-mean (accessed 3 October2022).

———. n.d. *ARTICLE 1 DEFINITIONS.* https://unfccc.int/resource/ccsites/zimbab/conven/text/art01.htm#:~:text=For%20the%20purposes%20of%20this%20Convention%3A&text=%22Climate%20change%22%20means%20a%20change,observed%20over%20comparable%20time%20periods (accessed 3 October 2022).

WMO. 2021*. WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019).* ISBN: 978-92-63-11267-5. https://library.wmo.int/doc_num.php?explnum_id=10989 (accessed 18 January 2023).

World Bank and GFDRR. 2021. *Enabling Private Investment in climate Adaptation & Resilience.* The World Bank Group.

World Bank. 2021. *World Bank Catastrophe Bond Provides Jamaica $185 Million in Storm Protection*. The World Bank. https://thedocs.worldbank.org/en/doc/43a111757d3b1ff1cabde80ee7eb0535-0340012021/original/Case-Study-Jamaica-Cat-Bond.pdf (accessed 25 January 2023).

———. 2019. *The World Bank Group Action Plan on Climate Change Adaptation and Resilience.* Washington, DC.

———. n.d. *Climate Change Knowledge Portal: Glossary.* https://climateknowledgeportal.worldbank.org/about (accessed 4 October 2022).

ANNEXURE

Table A.1: Definitions of Adaptation

S. N.	Entity	Definition of Adaptation	Source
1	Overseas Development Institute (ODI): Climate Funds Update (CFU)	CFU adopts the IPCC (2007) definition of adaptation.	ODI (n.d.). Notes and Methodology on Climate Funds Update.
2	European Environment Agency	Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause, or taking advantage of opportunities that may arise.	EEA (n.d.). What is the difference between adaptation and mitigation? Helpcenter FAQ.
3	Intergovernmental Panel on Climate Change (IPCC)	In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects. Incremental adaptation: adaptation that maintains the essence and integrity of a system or process at a given scale. In some cases, incremental adaptation can accrue to result in transformational adaptation. Transformational adaptation: adaptation that changes the fundamental attributes of a socioecological system in anticipation of climate change and its impacts.	IPCC (2018)
4	Organisation for Economic Co-operation and Development (OECD)	Adaptation refers to changes in an organism's structure or habits that help it adjust to its surroundings.	OECD (2013)
5	OECD DAC Rio Markers for Climate Handbook	An activity should be classified as adaptation-related (score Principal or Significant) if: it intends to reduce the vulnerability of human or natural systems to the current and expected impacts of climate change, including climate variability, by maintaining or increasing resilience, through increased ability to adapt to, or absorb, climate change stresses, shocks, and variability, and/or by helping reduce exposure to them. This encompasses a range of activities from information and knowledge generation to capacity development, planning, and the implementation of climate change adaptation actions.	OECD (2016)
6	UK Climate Impacts	An adjustment in natural or human systems in response to actual or expected climatic stimuli (variability, extremes, and changes) or their effects that moderates harm or exploits beneficial opportunities.	UK Climate Impacts Programme (CIP) (2007)
7	United Nations Framework Convention on Climate Change (UNFCCC)	Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. In simple terms, countries and communities need to develop adaptation solutions and implement action to respond to the impacts of climate change that are already happening, as well as prepare for future impacts.	UNFCCC (n.d.). What does adaptation to climate change and climate resilience mean?
8	World Bank Group	Adaptation: the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to the expected climate and its effects.	World Bank (n.d.) Climate Change Knowledge Portal: Glossary.

Source: Authors' compilation.

Table A.2: Disaster Subgroup, Type, and Subtype

Disaster Subgroup	Disaster Type	Disaster Subtype
Climatological	Droughts	Droughts
	Glacial-lake outbursts	Glacial-lake outbursts
	Wildfires	Forest fire and land fire (brush, bush, and pasture)
Hydrological	Floods	Coastal flood, flash flood, and riverine flood
	Landslides	Landslide, avalanche, mudslide and rockfall
Meteorological	Extreme Temperatures	Heatwave, cold wave, extreme weather conditions
	Storms	Convection storm, extra tropical storm, tropical cyclone

Source: Authors' construction.