

Allocation of Climate Funds and the Adaptation Infrastructure Gap

Mitali Das¹

¹ Research Department, International Monetary Fund, Washington DC 20431, United States

Correspondence: Mitali Das, Research Department, International Monetary Fund, Washington DC 20431, United States. E-mail: mdas@imf.org

Received: June 20, 2022

Accepted: June 29, 2022

Online Published: June 30, 2022

Abstract

Global climate adaptation financing schemes represent one of the most promising developments in climate finance for developing nations. Recently, there has been concern that the emergence of a competitive mechanism for the allocation of adaptation funds has un-leveled the playing field to qualify for funds because the most climate vulnerable countries also have the greatest capacity gaps to attract and leverage climate finance. However, without a comparable, consistent definition of vulnerability across countries, it has been difficult to verify this conjecture. In this paper, I take a quantifiable approach to assess the link between the allocation of finance and adaptation needs drawing on newly constructed adaptation costs in the Pacific SIDS. I find that adaptation funds do not adequately meet adaptation needs in several of these nations, opening up an *adaptation infrastructure gap* that global climate policies must address.

Keywords: climate finance, adaptation, infrastructure investment, resilience, climate change

1. Introduction

Small island developing states (SIDS) are among the most vulnerable to climate hazards. For some, such as those in the Pacific which lie only a few meters above sea level, climate change is an existential risk as it has contributed to rising ocean levels that may result in their submersion during this century (ADB, 2019). Even without this extreme scenario, the frequency and intensity of hurricanes, saltwater erosion of infrastructure, and the destruction of coastlines has drastically reduced arable land, led to ocean acidification, and put crippling pressure on public finances to cope with recurring need to rebuild infrastructure (Nunn 2012).

Building resilience to changing climatic conditions—*adaptation*—by implementing early warning systems and climate-proofing critical infrastructure (such as seawalls, water tanks, bridges) in these island nations is vital, but SIDS are among the least able to afford these efforts due to high public debt and limited access to global capital markets (Robinson 2018). It is estimated that average annual adaptation costs in the SIDS of the Pacific over the next decade are formidable, lying between 6.5 and 9 percent of GDP per year (Tiedemann et al. 2021, IMF 2021b).

1.1 Global Climate Adaptation Financing

Global climate adaptation financing vehicles represent one of the most promising developments in climate finance over the last decade. Modalities are wide-ranging in terms of institutions, arrangements, and instruments (Masullo et al. 2015). Pacific SIDS have accessed climate finance through bilateral donors as well as multilateral institutions such as development banks and Climate Funds. Arrangements have ranged from borrowing directly to borrowing via a system of accredited and implementing bodies, and instruments have been distributed between grants, concessional loans, equity and guarantees (Swiss Development Corporation 2021).

Bilateral funds are critical for rapid access as they typically respond to urgent needs and impose few access requirements. Pacific SIDS have historically been frequent recipients of such bilateral support from Australia, Japan, and New Zealand in the aftermath of natural disasters (OECD 2019). However, it is the multilateral arrangements such as those agreements secured with the multilateral development banks and the Climate Funds (discussed below) which are increasingly the key source of adaptation finance for three reasons: the large funding requirements of adaptation projects, the longer time-horizon envisaged for such projects, and as discussed below, the long lead times between conceptualization and execution of projects. Consequently, this paper will be focused predominantly on multilateral sources of climate adaptation financing.

1.2 Climate Funds

Among the multitude of climate adaptation financing vehicles, Climate Funds have risen to become the most prominent. These funds are financial facilities established by donors to help developing countries mitigate or adapt to climate change. The largest among these is the Green Climate Fund (GCF), established in 2010 as the financial vehicle of the UN Framework Convention on Climate Change (UNFCCC). According to the OECD climate finance database, as of 2020 the GCF had committed more funds to the Pacific SIDS than all other Climate Funds combined (Note 1).

Importantly, as a means to strengthen ownership of prospective climate projects, to ensure commitment to adaptation, and raise prospects of successful adaptation, the GCF as well as other Climate Funds require exposed countries to seek funding through a tiered process of application (Zamarioli et al. 2020). Countries therefore compete for GCF funds under assessment criteria that are still fluid, but include aspects of sustainability, feasibility, efficacy, and equity (Brown et al. 2017). This rich array of criteria results in many years between the conception and completion of an adaptation project, owing to strong fiduciary requirements, gender and social policy commitments, and environmental safeguards (IMF 2021a).

Emergence of a competitive allocation of adaptation finance has led to widespread concern about the immense technical, conceptual, financial, logistical and management burden it imposes on developing nations to qualify for funds (Masullo et al. 2015, OECD 2015, Amerasinghe et al. 2017, Wang et al. 2018, Robinson 2018, Tanner et al. 2019). In particular, institutional capacity has been cited as a key element in determining a country's ability to attract and leverage climate finance for adaptation (e.g., Doshi and Garschagen 2020, Doku et al. 2021), but some of the most vulnerable countries are also likely to have the greatest gaps in human and financial capacity for successful adaptation.

This has raised the question about the extent to which climate adaptation funds are allocated to those with the greatest vulnerabilities, but a clear answer has proved elusive thus far. A growing literature has considered whether disbursed climate funds take account of adaptation needs by linking adaptation funds with the vulnerability of recipients (see e.g., Klock 2015, Betzold and Weiler 2017, Weiler et al. 2018, Christiansen et al. 2018, Yeo 2019). Owing to lack of quantifiable measures of vulnerabilities, however, each of these studies has focused on indices of governance vulnerabilities (e.g., bureaucratic quality or government effectiveness indices from the World Bank) or physical vulnerabilities (e.g., indices of vulnerability to climate change such as those from the Notre Dame Global Adaptation Index (ND-GAIN)). Both scholars and practitioners are in broad agreement, however, that without a comparable, consistent definition of vulnerability across countries and over time, the findings of these studies cannot shed light on whether adaptation finance has or not been prioritized towards those with the greatest adaptation needs (Klein and Mohner 2011, Garschagen et al. 2021).

In this paper, in contrast to the existing literature, I take a quantifiable approach to assessing the link between the allocation of finance and adaptation needs. To do so, I draw on newly constructed data on actual annual adaptation costs in the Pacific SIDS described in IMF (2021b), and compare this with allocated adaptation funds to define an adaptation infrastructure gap. Using these quantitative measure of vulnerabilities and funds, based on publicly available data and transparent assumptions, I assess whether the allocation of climate funds tracks adaptation infrastructure gaps.

The remainder of the paper is organized as follows. In Section II, I discuss the adaptation costs in the Pacific SIDS and present the allocated adaptation funds. Section III defines an adaptation infrastructure gap, and analyzes how adaptation funds align with adaptation needs. Section IV concludes.

2. Adaptation Infrastructure Costs in the Pacific SIDS

Although the range of physical assets and processes (e.g., earning warning systems) that can buckle under climate stress is broad, I follow the literature by focusing on investment infrastructure since this is estimated to be the costliest (see GCA 2018, Hallegatte et al. 2019, Rozenberg and Fay 2019, IMF 2021b). Before turning to the computation of those costs, I briefly discuss the topography of the Pacific SIDS. Although these nations are similar in many geological and socio-economic respects, differences in physical geology are important to understand their adaptation needs. Table 1 puts adaptation costs in context by presenting key topographical differences that are relevant for differences in adaptation infrastructure needs (Table 1).

A first observation is that maximum elevation is extremely low everywhere, with the highest number at 4.5 km above sea level (Papua New Guinea), two countries (Kiribati and Nauru) at less than 100 meters above sea-level and Marshall Islands and Tuvalu at only 5-10 meters above sea level. Adaptation focused on coastal protection is thus critical to address the impact of climate change on rising ocean levels in these nations. Second, coastlines

vary dramatically from just 30 kilometers in Nauru to over 6000 kilometers in Micronesia. However, the presence of a significant number of atolls in the Pacific SIDS, many of them uninhabited, indicates that the length of the coastline per se may not adequately represent the length of coastal protection that is of policy interest as governments are likely to prioritize protection for the main islands and larger inhabited atolls.

Table 1. Topographical and socioeconomic characteristics of the Pacific SIDS

	Max. elevation (km)	Coastline (kms)	Geography	Coastline/area (km/km ²)	2022 GDP ((billion USD)	GDP per cap. (mill./1000)
			High islands, few			
Fiji	1.32	1129	minor atolls	8.3	5.17	6108
Kiribati	0.08	1143	Mainly atolls	40.1	0.22	1661
Marshall Islands	0.01	370	Atolls	27.5	0.27	4129
Micronesia	0.78	6112	High islands, atolls	231	0.43	4009
Nauru	0.07	30	Raised coral island	6.5	0.13	9119
Palau	0.24	1519	High islands, atolls	70.9	0.13	14759
			High islands, few			
Papua New Guinea	4.51	5152	minor atolls	7.6	29.9	2828
Samoa	1.86	403	High islands, atolls	7.7	0.82	4198
			High islands, few			
Solomon Islands	2.34	5313	minor atolls	31.8	1.67	2410
Tonga	1.03	419	High island	15.6	0.53	5116
Tuvalu	0.01	24	Atolls	4.71	0.07	4298
Vanuatu	1.88	2528	High islands, atolls	22.9	1.02	3099

Notes. Data are as of June 2022 for elevation, coastline, and coastline/area.

Sources: Author's compilation from U.S. Geological Survey (elevation, coastline, area), World Economic Outlook (GDP, population) and Asafu-Adjaye (2008) for geography.

Owing to their unique topographical characteristics, the Pacific SIDS have high exposure to floods and cyclones (UNESCAP 2019). Following the seminal work of Hallegatte et al. (2019), this has led to a strong focus on three categories of infrastructure adaptation in the Pacific islands: (1) strengthening the resilience of coastal protection infrastructure (e.g., construction of seawalls); (2) upgrades to new investment infrastructure (e.g., bridges with new technology for water drainage); and (3) retrofitting existing physical assets (e.g., refitting buildings with clean energy systems). I provide a high-level definition of these below to provide context for the measures of adaptation infrastructure gaps, and refer to IMF (2021a, 2021b) for details of the calculations and Hallegatte et al. 2019 and Rozenberg and Fay (2019) for details of the approaches.

2.1 Coastal Protection Infrastructure

Country-level estimates of coastal protection infrastructure correspond to the costs of building and upkeep of new infrastructure such as coastal seawalls, storm barriers and dikes and draw on global estimates calculated in Rozenberg and Fay (2019). The annual costs of adaptation used below draw on these global numbers to compute a country-specific estimate for a level of protection that tolerates losses no larger than 0.01 percent of GDP, using estimates of coastal protection construction costs from Nicholls et al. (2019) (Note 2).

2.2 Upgrades to New Investment

The two key inputs to costing adaptation for new investment are the share of the capital stock that is vulnerable to climate risks, which comes from Koks et al. (2019), and the added costs of climate-proofing which is based on World Bank (2019) and is assumed to be 15 percent of total investment costs. Using these inputs, the adaptation costs from upgrading new investments is calculated by multiplying the estimated share of vulnerable capital stock with estimates to the expected annual public and private investment over the medium term (defined as 5 years ahead), (Note 3) plus the additional unit costs of climate proofing.

2.3 Retrofitting Existing Physical Assets

Retrofitting involves the modification of existing capital stock that is vulnerable to climatic hazards with the aim of improving its resilience. It is generally more costly than upgrades to new investment, but often an efficient means to prolong the life of costly infrastructure. Using as input the share of capital exposed to climate risks from Koks et al. (2019) (as with the upgrade to new investment described above), and the assumption that every unit of capital's retrofit costs 50 percent of its current value spread over 10 years, the adaptation costs of retrofitting are calculated by multiplying the share of vulnerable capital with the unit retrofit cost, annualized by assuming a fixed investment over the next 10 years.

Using these transparent assumptions and publicly available data, the above inputs yield estimates of the combined infrastructure adaptation needs along with the breakdown of their shares of upgrade, retrofit and coastal protection needs (Figure 1).

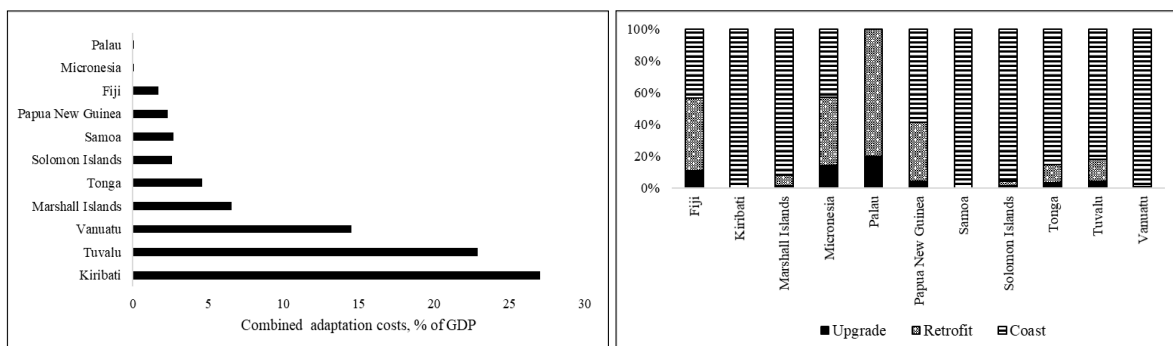


Figure 1. Annual combined adaptation (upgrade, retrofit, coastal infrastructure) costs and breakdown

Notes. Coastal protection costs assume losses are kept below 0.01 percent of GDP.

Sources. Upgrading and retrofit cost estimates draw on exposed capital share from Koks et al. (2019) and projections of the capital stock from World Economic Outlook database, Investment and Capital Stock, and author's calculations based on the perpetual inventory method; remaining adaptation costs from IMF (2021a) which draw on IMF (2021b), Rozenberg and Fay (2019), Nicholls et al. (2019) Hallegatte et al. (2019); Koks et al. (2019), Nicholls et al. (2019); World Bank (2019).

Two features stand out in Figure 1: the tremendous heterogeneity in the annual expected outlays for adaptation infrastructure, and the outsized share of coastal protection. Differences in physical location within the Pacific lead to varying vulnerabilities to cyclones and hurricanes, and differences in elevation result in different exposures to coastal erosion or sea-level rises. Vulnerable capital is affected by location, elevation, as well as the stock of existing capital. SIDS with recent large disasters, such as Vanuatu, have rebuilt or are in the process of rebuilding damaged infrastructure, leading to lower share of the exposed capital stock. Accordingly, its share of upgrades for adaptation are low while coastal protection (requiring new infrastructure using global estimates of coastal infrastructure adaptation drawn from Rozenberg and Fay (2019)) remains high.

2.4 Allocation of Adaptation Funds in the Pacific SIDS

Adaptation funds allocated to Pacific island nations vary significantly. Because the approval process for adaptation projects from multilateral institutions can take a significant amount of time, including due to the multi-tiered process of borrowing via a network of accredited and implementing bodies and strict evaluative criteria, the year-to-year variation of allocated funds can be volatile (OECD, 2019). To limit annual fluctuations, I present the total allocated adaptation funds between 2015 and 2020 (Figure 2).

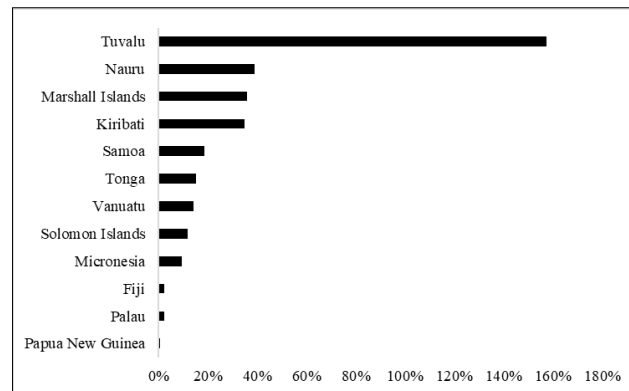


Figure 2. Multilateral Climate Financing for Adaptation in the Pacific SIDS, 2015-20

Notes. Data are shown for 2015-20 in percent of 2020 GDP, including all sources of multilateral adaptation finance. Multilateral institutions included are: Asia-Pacific Climate Finance Fund, World Bank, European Investment Bank, International Finance Corporation, Green Climate Fund, Climate Investment Fund, Global Climate Change, Global Environment Facility, Asia Development Fund, Abu Dhabi Fund for Development, and Global Green Growth Institute.

Sources. *OECD Climate-related Development Finance* (accessed June 2022: <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>) and *World Economic Outlook databases*.

Two features stand out from Figure 2. First, allocation of adaptation funds are large in relation to the size of the country and typically range from 20-40 percent of GDP. This reflects the confluence of three factors: the high cost of adaptation investment (Hallegatte et al 2019), the low size of economies in terms of their GDP, and significant adaptation needs in the Pacific SIDS. Second, there is significant variation across countries in multilateral allocated adaptation funds, ranging from nearly 0 to over 100 percent of GDP. However, only Tuvalu stands out as an outlier and this reflects the coastal protection project funded by the GCF, lying in excess of 100 percent of GDP (GCF 2016).

While informative about the total commitment to adaptation infrastructure, the magnitude of the allocated funds do not clearly convey whether they are commensurate with what is needed to adapt to climate change effects. In particular, without benchmarking the distribution of funds to vulnerability, they leave open the question of whether allocations are appropriately tracking needs rather than a country's ability to attract and leverage climate for adaptation. I turn to this question next.

3. Adaptation Infrastructure Gaps: Needs Versus Allocated Funding

I examine whether adaptation needs align with allocated adaptation funds. Unlike existing work, which uses indices of vulnerabilities that often result in inconsistent rankings across countries, my approach is a quantification of vulnerabilities using comparable inputs with transparent assumptions (described in Section 2). Using the adaptation costs underlying Figure 1 and the allocation of adaptation funds underlying Figure 2, I first define the adaptation infrastructure gap as the annual adaptation infrastructure needs less the average annual allocated adaptation funds.

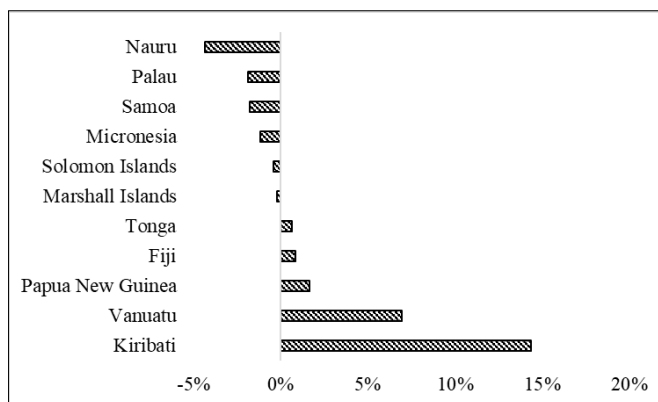


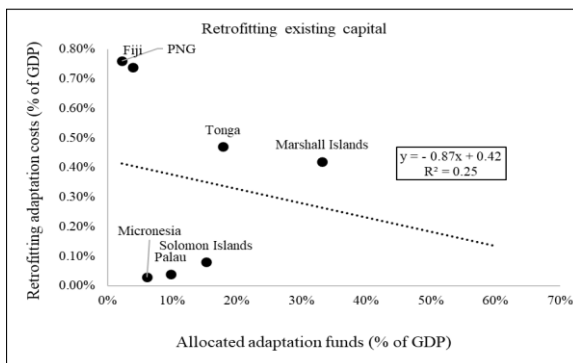
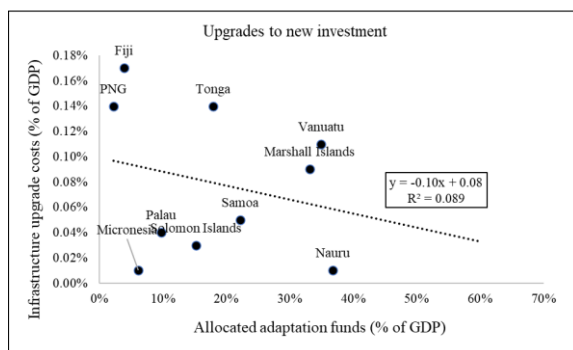
Figure 3. Adaptation Infrastructure Gap

Notes. The adaptation infrastructure gap is defined as the annual adaptation infrastructure need in percent of GDP from Fig.1 less the annual average of the 5-year allocated funds in 2015-20 which is derived using the reported numbers in Figure 2 each divided by five to obtain an annual estimate.

Sources. Author’s calculations using data from Figures 1 and 2.

Figure 3 delivers the stylized finding that in about half of the Pacific SIDS, adaptation infrastructure gaps are negative. In these countries, annual adaptation investment needs are as high as 5 percent of GDP more than average funds allocated to support such investment. Conversely, adaptation infrastructure gaps meet and even exceed the annual needs in some countries, most noticeably Kiribati.

Although Figure 3 picture gives reasons to be partially optimistic, it deserves further scrutiny. In particular, adaption needs derive from several sources as described in Section 2, and I next explore whether all components of adaptation infrastructure, as defined by the costs of coastal protection infrastructure, upgrades and retrofitting correspond with the allocated funds. I do so below, using the breakdown of adaptation costs underlying Figure 1 and the allocation of adaptation funds. The results are presented in Figure 4.



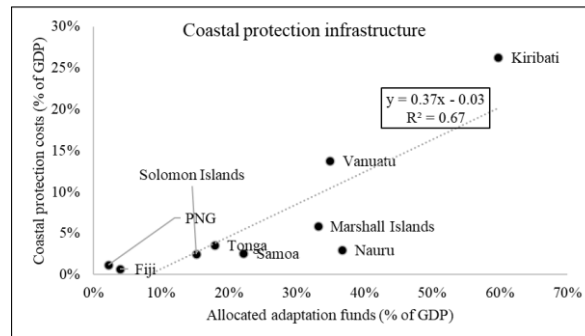


Figure 4. Allocated adaptation funds and adaptation needs in upgrades, retrofitting and coastal protection

Notes. Adaptation needs for upgrades to new investment, retrofitting and coastal protection are from Figure 1. Allocated adaptation funds are as in Figure 2. Underlying data to compute retrofitting is not available for Nauru, Samoa and Vanuatu; and for coastal protection in Tuvalu and Micronesia.

Sources. Author's calculations using data from Figures 1 and 2.

Two notable findings emerge from Figure 4. First, it is apparent that in terms of outlays, for both upgrading infrastructure and retrofitting existing physical assets, the larger are adaptation needs, the smaller is allocated adaptation funding. Since Climate Funds and multilateral development banks allocate on basis of sustainability, feasibility, efficacy, and equity, this suggests that the island nations are not sufficiently demonstrating the required policy commitments, the environmental safeguards or are being assessed as not ready to meet the strict fiduciary and other standards of Climate Funds. Furthermore, relatively richer countries in per capita terms, such as Nauru and Palau, appear to be benefiting with larger allocations, potentially reflecting greater capacity to prepare higher quality proposals and meet the standards of funding vehicles.

Second, where coastal protection infrastructure is concerned, larger adaptation requirements are met with higher allocated funds. The finding is robust to the exclusion of Kiribati, an outlier in terms of its coastal infrastructure adaptation needs. The evidence is consistent with two explanations. One is that Climate Funds and other multilateral development organizations are prioritizing coastal infrastructure as an adaptation project over upgrades to new investment or retrofitting existing capital in the Pacific SIDS, perhaps given their vulnerability to rising ocean levels, cyclonic storms, and hurricanes where coastal protection may well be the most urgent priority. The other is that the emerging competitive mechanisms for adaptation funds are allocatively efficient for this sub-category of adaptation investment, directing resources to countries with the greatest coastal protection needs.

4. Conclusions

Global climate adaptation financing vehicles represent a tremendous opportunity for developing countries to finance adaptation to adverse climate change. Recently, there has been some concern that the emergence of a competitive mechanism for the allocation of funds has un-leveled the playing field because the most climate vulnerable countries also have the greatest capacity gaps to attract climate finance for adaptation. Owing to a lack of quantifiable measures of vulnerabilities however, a clear answer to this conjecture has proved elusive.

In this paper, focusing on the Pacific SIDS, a group of countries highly vulnerable to climate change and in deep need of financial support, I re-examine this question. Using newly quantified measures of adaptation costs, I find that the picture is mixed. While adaptation funds meet adaptation investment needs in some, in many others there is an adaptation infrastructure gap. In particular, adaptation funds do not adequately track the needs for upgrades to new investment or retrofitting of existing capital, while they appear adequate for coastal protection. Future work should usefully expand this analysis to a greater number of countries in diverse regions.

Acknowledgments

I thank Vybhavi Balasundharam and Natalija Novta for generously sharing their expertise on climate change finance and climate adaptation costing data, Masahiro Nozaki and Mattheu Bellon for inputs into the adaptation costing literature, Hailey Ordal for assistance with updating the data from the OECD Climate-related Development Finance, US Geological Survey and capital stock database. The views expressed in this paper are those of the author and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

References

- ADB (2017). Impacts of Sea Level Rise on Economic Growth in Developing Asia. *Asian Development Bank*. <https://dx.doi.org/10.22617/WPS178618-2>
- Amerasinghe, N., Thwaites, J., Larnsen, G., & Ballesteros, A. (2017). *The Future of the Funds*. World Resources Institutes. Retrieved from <https://www.wri.org/research/future-funds-exploring-architecture-multilateral-climate-finance>
- Asafu-Adjaye, J. (2008). Environmental Quality and Economic Growth: The Case of Pacific Island Countries. *South Pacific Studies*, 29(1), 43-62.
- Betzold, C., & Weiler, F (2017). Allocation of aid for adaptation to climate change: Do vulnerable countries receive more support? *International Environmental Agreements*, 17, 17–36. <https://doi.org/10.1007/s10784-016-9343-8>
- Brown, L., Polycarp, C., & Spearman, M. (2013). *Within reach: strengthening country ownership and accountability in accessing climate finance*. World Resources Institute, United Nations Environmental Program. Retrieved from https://files.wri.org/d8/s3fs-public/ownership_and_accountability_final_paper.pdf
- Doku, I., Nwadi, R., & Phiri, A. (2021). Determinants of climate finance: analysis of recipient characteristics in Sub-Saharan Africa. *Cogent Economics and Finance*, 9, 1-17. <https://doi.org/10.1080/23322039.2021.1964212>
- Doshi, D., & Garschagen, M. (2020). Understanding adaptation finance allocation: which factors enable or constrain vulnerable countries to access funding? *Sustainability*, 12, 4308-20. <https://doi.org/10.3390/su12104308>
- Garschagen, M., Doshi, D., Reith, J., & Hagenlocher, M. (2021). Global patterns of disaster and climate risk—an analysis of the consistency of leading index-based assessments and their results. *Climatic Change*, 169, 1-19. <https://doi.org/10.1007/s10584-021-03209-7>
- GCF (2016). *Tuvalu Coastal Adaptation Project*. Green Climate Fund. Retrieved from <https://www.greenclimate.fund/sites/default/files/document/funding-proposal-fp015-undp-tuvalu.pdf>
- IMF (2021a). Unlocking Climate Finance Access for Pacific-Island Countries. IMF Departmental Paper, International Monetary Fund, Washington DC.
- IMF (2021b). Fiscal Policies to Address Climate Change in Asia and the Pacific. IMF Departmental Paper, International Monetary Fund, Washington DC.
- Kalaidjian, E., & Robinson S. A. (2022). Reviewing the Nature and Pitfalls of Multilateral Adaptation Finance for Small Island Developing States. *Climate Risk Management*, 36, 1-16. <https://doi.org/10.1016/j.crm.2022.100432>
- Klein, R. & Mohner, A. (2011). The political dimension of vulnerability: implications for the Green Climate Fund. *IDS bulletin*, 42(3), 15-22. <https://doi.org/10.1111/j.1759-5436.2011.00218.x>
- Klock, C (2015). Adapting to climate change in small island developing states. *Climate Change*, 133, 25-40. <https://doi.org/10.1007/s10584-015-1408-0>
- Koks, E., Rozenberg, J., Zorn, C., & Tariverdi, M. (2019). A Global Multi-hazard Risk Analysis of Road and Railway Infrastructure Assets. *Nature Communications*. <https://doi.org/10.1038/s41467-019-10442-3>
- Martinez, G., & Christiansen, L. (2018). *Adaptation metrics: perspectives on measuring, aggregating and comparing adaptation results*. Retrieved from <https://c2e2.unepdtu.org/wp-content/uploads/2018/03/udp-perspectives-adaptation-metrics-web-1.pdf>
- Masullo, I., Larsen, G., & Brown, L. (2015). “Direct Access” to Climate Finance: Lessons Learned by National Institutions. Retrieved from <https://www.wri.org/research/direct-access-climate-finance-lessons-learned-national-institutions>
- Nunn, P. (2012). *Climate Change and Pacific Island Countries*. Asia-Pacific Human Development Report. United Nations Development Program. Retrieved from <https://www.uncclearn.org/wp-content/uploads/library/undp303.pdf>
- OECD (2015). *Toolkit to Enhance Access to Adaptation Finance for Developing Countries*. Retrieved from <https://www.oecd.org/environment/cc/Toolkit%20to%20Enhance%20Access%20to%20Adaptation%20Finance.pdf>

- Robinson, S. A. (2018). Adapting to Climate Change at the National Level in Caribbean Small Islands Developing States. *Island Studies Journal*, 13, 79-100. <https://doi.org/10.24043/isj.59>
- Swiss Development Cooperation (2021). How to access the Green Climate Fund. Retrieved from <https://www.shareweb.ch/site/Climate-Change-and-Environment/Documents/How%20to%20access%20the%20Green%20Climate%20Fund-2021.pdf>
- Tanner, T., Bisht, H., Quevedo, A., Malik, M., Nadiruzzaman, M., & Biswas, S. (2019). Enabling access to the Green Climate Fund: Sharing country lessons from South Asia. <http://dx.doi.org/10.13140/rg.2.2.35409.79207>
- Tiedemann, J., Piatkov, V., Prihardini, D., Benitez J, & Zdzienicka A (2021). Meeting the Sustainable Development Goals in Small Developing States with Climate Vulnerabilities: Cost and Financing. IMF Working Paper 21/62, International Monetary Fund, Washington, DC. <https://doi.org/10.2139/ssrn.3852788>
- UNESCAP (2020). The Disaster Riskscape across the Pacific Small Island Developing States. United Nations Economic and Social Commission for Asia-Pacific. Retrieved from <https://www.unescap.org/sites/default/files/IDD-APDR-Subreport-Pacific-SIDS.pdf>
- Wang, F, Ford, J, Lesnikowski, A, Chen, C, Berrang-Ford, L, Biesbroek, G., & Huq, S. (2018). Assessing stakeholder needs for adaptation tracking. *Adaptation Metrics*, 1, 49-61. <https://doi.org/10.1016/j.worlddev.2017.11.001>
- Weiler, F., Klöck, C., & Dornan, M. (2018). Vulnerability, good governance, or donor interests? The allocation of aid for climate change adaptation. *World Development*, 104, 65-77.
- Yeo, S. (2019). Green Climate Fund attracts record US \$9.8 billion for developing nations. *Nature*. <https://doi.org/10.1038/d41586-019-03330-9>
- Zamarioli, L., Pauw, P., & Grüning, C. (2020). Country ownership as the means for paradigm shift: the case of the green climate fund. *Sustainability*, 12, 5714-22. <https://doi.org/10.3390/su12145714>

Notes

Note 1. Data are drawn from <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm> (accessed June 2022).

Note 2. An alternative is a cost based on a level of protection that limits the sum of protection and residual water damages (from flood or hurricanes) as described in IMF (2021a). This paper does not use such estimates

Note 3. Data on projected capital stocks are from the World Economic Outlook (indicator: NFI_R), the Investment and Capital Stock Database (<https://www.imf.org/external/np/fad/publicinvestment/data/data122216.xlsx>) and the Pacific Financial Technical Assistance Center (PFTAC). Where capital stock is not directly available, the perpetual inventory method is used to obtain the series starting at zero in 2000 and assuming an annual depreciation rate of 10 percent.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).