Strengthening the Investment Case for Climate Adaptation

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By World Resources Institute[1]

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EXECUTIVE SUMMARY

Highlights

- The substantial adaptation finance gap is compounded by a lack of standardized, transparent data on the projected and realized benefits of adaptation and resilience investments. Economic appraisal tools are effective because they put the cost of anticipated damages directly alongside the estimated benefits of adaptation investments.
- AdapTDR is a first-of-its-kind database that details 320 projects across 12 countries and four economic sectors, totaling US$133 billion in investment and generating roughly $1.4 trillion in returns over 10 years. The database enables governments, donors, and researchers to understand the projects' returns on investment (ROIs) and the composition of their economic and climate benefits, grouped according to the triple dividend of resilience (TDR) approach.
- Adaptation investments have very high internal rates of return (IRRs), averaging 26.9 percent across countries and sectors. They are considerably higher than those considered sufficient for development bank lending. Health, forestry/landscapes, and disaster risk management projects have the highest IRRs on average, followed by agriculture and infrastructure projects.
- High-return investments in adaptation and resilience are largely driven by induced development (the second dividend of resilience) and environmental and social benefits (the third dividend of resilience), which are, on average, more than double the value of avoided loss benefits (the first dividend of resilience). This shows that good adaptation is also good development.
- The TDR approach helps to further focus project benefits on different classes of beneficiaries, such as rural farmers, urban middle classes, or nature. It also shows that projects with high returns have cross-sectoral benefits, such as offering both water and health benefits, or both infrastructure and biodiversity benefits.
- Adaptation investments have significant climate mitigation co-benefits, supporting the case for adaptation and pointing to additional financial opportunities through, for example, carbon finance.
- This paper asks what types of projects are adaptation "best buys," and more importantly, "best buys for whom?" By both understanding the source of high IRRs and mapping interventions and their benefits to beneficiaries, the IRR analysis informs the "best buy" question, and the triple dividend analysis informs the "for whom" question.
- DFIs, international funds, and governments can take several steps to improve economic appraisal and impact evaluation methods, including by broadening and standardizing the use of the TDR methodology and ex-post benefit assessments.

Background

The global need for adaptation finance far exceeds current flows, leaving people and assets increasingly vulnerable to the worsening impacts of climate change. One of the key reasons for this financial gap is the lack of full information on the costs and benefits of addressing climate risks. Without such information, neither risks nor returns can be accurately priced and calculated, impeding the mobilization and allocation of both public and private sector resources. Further, adaptation is often misunderstood as consisting of only avoiding losses rather than also delivering economic returns.

Drawing on evidence from hundreds of investment projects contained in the Adaptation Triple Dividend of Resilience (AdapTDR) database, this paper supports development finance institutions (DFIs), international funds, governments, private investors, and other stakeholders in considering the full range of benefits that adaptation and resilience-building investments can yield. Findings show that benefits fall across three dividends—avoided losses (first dividend), induced economic development (second dividend), and social and environmental benefits (third dividend)—with the second and third dividends often exceeding the first and driving high returns on investment (ROIs). The data shows that far from simply being an additional co-benefit, benefits such as induced investment or climate mitigation are key features of good adaptation interventions. Further, through a careful, systematic review of costs and benefits, the AdapTDR database enables the identification of economically and environmentally sensible investments, showing their value for money and making the case for closing the adaptation finance gap.

Key Takeaways and Recommendations

Key Takeaway 1: Climate adaptation projects average returns on investment (RoI's) are 27 percent, which is extremely high. Since many diverse benefits are not monetized, even these high RoIs are under-estimates. Health and disaster risk management sub-sectors show high returns based on reducing mortality and morbidity. Sustainable agriculture and forestry/landscape projects show high returns based on high poverty reduction benefits as well as low-carbon benefits. Infrastructure-related adaptation projects, such as in energy, transport, and cities, show benefits across all three types of dividends.

- **Recommendation**: **Work with DFIs and governments to increase awareness of these high returns on investment from adaptation and teach them to calculate their own going forward.** The AdapTDR database shows the many different types of benefits accruing to these projects. Lessons specific to high-return projects in different sectors and regions can be used to inform project design in other countries and geographies. But the data can also be used to focus on priority beneficiaries. Several projects in the AdapTDR database show a combination of high economic returns ("best buys") and benefits for priority socio-economic groups, sectors, or regions ("best buys for whom"), suggesting that well-designed investments do not just present value for money but can also support the broader movement toward empowering local communities to ensure that interventions are appropriate for their local contexts.

Key Takeaway 2: Adaptation projects are good development. Rather than being considered stand-alone projects, adaptation investments should be thought of as adding resilience to good development projects. (In private sector terminology, adaptation investments are not "a separate asset class" but are action that all other asset classes more resilient.) Adaptation is an objective that complements other development and financial objectives. Over half of all project benefits that were monetized are development-oriented and do not depend on whether the anticipated disaster occurs or not. Induced development benefits include such things as new job creation, increased productivity, higher incomes, additional investment, and increased economic and financial efficiency. Many adaptation projects are also cross-cutting. For instance, resilient cities projects also reduce health damages, and flood management projects also help increase agricultural yields.

- **Recommendation: Shift the adaptation investment narrative towards projects with full triple dividends rather than stand-alone adaptation projects.** Using the triple dividends methodology supports understanding multiple and diverse benefits. Collaboration across sectors (e.g., agriculture and water, health and infrastructure) helps identify synergies and maximize adaptation benefits. The MDBs have a large role to play in setting higher standards for adaptation project design and appraisal,

supporting research on better valuing unmeasured benefits of adaptation investments, and increasing the transparency and accessibility of adaptation finance data.

Key Takeaway 3: Quantifying induced development benefits is key to mobilizing private sector support for adaptation investments. High second dividend benefits not only help position adaptation as a key part of a public growth and investment narrative, they also support private sector actors in guiding their investment choices. This is because the second dividend represents induced economic growth and higher incomes, which, in turn, form the basis for potentially attracting private investment either as direct investors or through capital markets.

- **Recommendation: Mobilize private finance by emphasizing the high and tangible economic benefits of adaptation investments.** This will require separating out benefits in line with the triple dividend of resilience to more effectively match investments to investor profiles. In this way, the TDR approach can support the development of innovative financial instruments (e.g., blended finance, risk-sharing mechanisms) to de-risk adaptation projects and attract private capital.

Key Takeaway 4: Half of adaptation investments have climate mitigation co-benefits, which shows that adaptation projects are well-aligned with climate mitigation goals. Rather than sitting in separate buckets, the two are intrinsically connected. However, the AdapTDR database shows that GHG emissions reductions are rarely quantified in adaptation projects. Emphasizing synergies will strengthen the investment case for adaptation and point to further financial opportunities, for example through the carbon markets.

- **Recommendation: Promote the strong synergies between adaptation and mitigation.** DFIs, international funds and governments should emphasize the climate mitigation co-benefits of adaptation investments based on the evidence produced ex-ante, within project, and ex-post triple dividend assessments.

Key Takeaway 5: There is a lack of complete and publicly available data on the projected and realized benefits of adaptation and resilience investments, which hinders the further allocation of resources to high-return adaptation projects. Persistent data gaps complicate weighing the distributional implications of policies and investments and understanding their impacts. A lack of common standards and methodologies is further problematic for a financial ecosystem that depends on data sharing, transparency, and interoperability between stakeholders.

- **Recommendation: Strengthen systems for collecting, monitoring, and evaluating data on adaptation projects, both ex-ante and ex-post, and improve the quality and comparability of economic appraisals.** Initiatives like the AdapTDR database can be used to improve our understanding of adaptation investment trends, priorities, and impact. (The last section of this report identifies several topics for future research building on the AdapTDR database.) DFIs, international funds, governments, and others should also be encouraged to strengthen the evidence base for adaptation investments, address data gaps for under-represented benefits, expand documentation on exemplary projects, and build capacity for integrating CBA into budgeting processes. Well-established approaches exist to help guide this process, such as the UK's Green Book and its supplementary guidance for accounting for the effects of climate change.

1. INTRODUCTION

The need for adaptation finance remains significant and unmet despite recent increases in financial flows. Though the total value of adaptation project funding has grown consistently at least since 2007,[2] the United Nations Environment Programme (UNEP) states that the "adaptation finance gap"—the difference between estimated global adaptation financing needs and actual financial flows—continues to grow and now ranges between $187 billion and $359 billion annually (UNEP 2024). Global financing needs for adaptation are estimated to be 10 to 20 times greater than the public funding currently provided, which amounted to only $21.8 billion (CPI 2024). This wide gap leaves both people and assets increasingly vulnerable to the worsening impacts of climate change while foregoing the high benefits of adaptation interventions, which the Global Commission on Adaptation (GCA) has estimated to be up to ten times larger than their cost (Global Commission on Adaptation 2019).

An incomplete understanding of the costs and benefits of addressing climate risks contributes to this persistent adaptation finance gap, which could be partially addressed by more carefully investigating how developing countries are investing in adaptation at present. This is particularly challenging because the definition of climate adaptation in global financial tracking remains unclear and non-standardized, particularly for domestic public and private spending. Among multilateral development banks (MDBs), agreement on what constitutes project adaptation "co-benefits" was only reached in 2016 (World Bank 2016). Moreover, only a minority of developing countries have clear and well-costed adaptation plans—whether in national development plans, Nationally Determined Contributions (NDCs), or National Adaptation Plans (NAPs). Climate budgeting is still in its early stages and primarily tracks expenditures, with almost no country conducting economic analyses of adaptation capital expenditures. Data on adaptation finance flows—particularly for domestic public and private finance—remains sparse and, where available, is often of questionable quality.

This study, therefore, sheds light on the characteristics of existing adaptation investments to strengthen the case for scaling them up. The Global Commission on Adaptation's 2019 "Adapt Now" report highlighted the extremely high returns on adaptation investments in five key areas: early warning systems, resilient infrastructure, productive dryland agriculture, mangrove protection, and resilient water resources management (Global Commission on Adaptation 2019). This paper deepens the empirical analysis of the economic, social, and environmental returns on adaptation investments in key sectors—agriculture, health, water, and infrastructure—using standard cost-benefit analysis (CBA) and the triple dividend methodology as elaborated in 2022 (Heubaum et al. 2022). For more details, see Box 1.

To achieve its objectives, this study applied the Triple Dividend of Resilience (TDR) framework to create a comprehensive database that emphasizes the high and diverse returns to adaptation investments. The database included twelve countries representing diverse regions and global populations**:** Bangladesh, Brazil, China, Colombia, Ethiopia, Ghana, India, Kenya, Senegal, South Africa, Uzbekistan, and Vietnam. The database highlights the full range of benefits from adaptation investments by estimating "avoided losses" from climate impacts, evaluating the development benefits of building resilience and considering non-market environmental and social benefits. By demonstrating the synergies among these three benefit categories ("dividends"), the study shifts the narrative from viewing adaptation as an unaffordable,

[2] Funding for adaptation projects supported by the financial mechanisms serving the UNFCCC and the Paris Agreement dropped by nearly $250 million in 2023 compared to 2022, but investment reflected a positive uptick again in 2024.

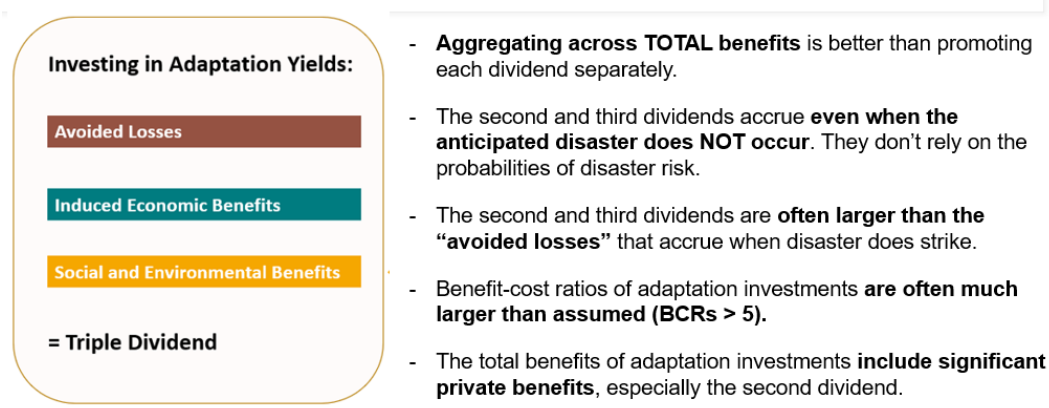
incremental cost that competes with development and mitigation priorities to one that recognizes adaptation as a critical ingredient for sustainable development.

It is hoped that this study will help scale up adaptation investments by building a compelling, evidence-based investment case to inform finance, planning, and line ministries on the cost-effectiveness and high rates of return of adaptation interventions. It should also help generate political support for adaptation investment, both nationally and internationally, by illustrating the full range of public and private benefits. Finally, a deeper understanding of the economic and financial benefits of building resilience should support the growing role of private investors in adaptation finance through the uptake and deployment of more effective blended finance models.

Box 1 - What are the triple dividends of climate resilience?

Adaptation investments can generate triple dividends. The first dividend is avoided losses—the ability of the investment to reduce future losses from climate hazards. Avoiding losses is the most common motivation for investing in resilience. Taken alone, however, this underestimates the full range of adaptation benefits to society. Many adaptation actions generate significant additional economic benefits (the second dividend) and non-market social and environmental benefits (the third dividend). The realization of these second and third dividends accrue on an ongoing basis and are not dependent on the future state of the climate. In other words, they are both more certain and more immediate.

Figure 1: The triple dividend of investing in climate adaptation



Source: Heubaum, et al, "The Triple Dividend of Building Climate Resilience: Taking Stock, Moving Forward," WRI Working Paper, 2022.

Very few project appraisal processes currently analyze – and monetarily value – the full triple dividends. When they do, many adaptation and resilience-building investments have much higher rates of return than are assumed due to the exclusion of one or more dividends. The climate community too often neglects development benefits, and governments and development agencies neglect climate benefits. This knowledge gap hinders better investment decision-making.

Applying the Triple Dividend of Resilience (TDR) approach enables the accounting of all three dividends and significantly boosts the benefit-cost ratios (BCRs) for adaptation investments. For example, the second and third dividend benefits alone are often greater than the avoided loss (first dividend) benefits and can generate BCRs greater than 1 even without considering the avoided losses benefits.

By revealing traditionally excluded economic, environmental and social benefits, the triple dividend approach can help governments, DFIs, funds, and the private sector address information market failures and catalyze the higher level of investing required to adapt at the necessary scale.

2. METHODOLOGY

2.1 Scope

This study evaluated the scale and composition of benefits from investments in adaptation approved by multilateral development banks (MDBs) and development finance institutions (DFIs), which are the largest providers of adaptation finance (UNEP 2024). Since MDBs only began emphasizing adaptation co-benefits more strongly after 2016, following the World Bank's commitment to achieving an adaptation finance target "at parity" with mitigation, the study focuses on projects approved between 2014 and 2024 to capture the growing interest in climate change adaptation. The study spanned four key sectors—agriculture, health, infrastructure, and water—further divided into nine sub-sectors that allowed for a more refined analysis (see Figure 2).

Figure 2: Sectoral and sub-sectoral framework

Agriculture	1. Sustainable Agriculture 2. Forestry/Landscapes/Nature (including wildfires)
Health	3. Health services
Infrastructure	4. Disaster Risk Management (DRM), climate services, early warning systems 5. Energy (power, renewable energy, grid resilience) 6. Resilient cities (heat, sponge cities, urban planning, green infrastructure, flooding) 7. Transport (public, connectivity, bridges, waterways, ports)
Water	8. Water supply and sanitation 9. Water resources and flood management

The study analyzed adaptation investments in twelve countries representing diverse regions and country sizes: Bangladesh, Brazil, China, Colombia, Ghana, Ethiopia, India, Kenya, Senegal, South Africa, Uzbekistan, and Vietnam. This sample represents 47 percent of the global population (World Population Review 2024) and spans three geographic regions: Africa (33 percent of the sample), Asia (50 percent), and Latin America (17 percent). It includes one low-income country (8 percent), seven lower-middle-income countries (58 percent), and four upper-middle-income countries (33 percent) (World Bank 2024a). The study did not include upper-income countries that face different planning and financing issues than developing countries.

2.2 Data Collection

Adaptation investments were primarily identified through publicly available project appraisal documents (PADs) used by governments and donors as part of the project preparation cycle. PADs typically include project objectives, components, results frameworks, costs and benefits, and rates of return. MDBs and many other donors use standard cost-benefit analysis in their economic appraisal of projects, which lends both consistency and a certain level of quality assurance to the data being collected.

The temporal, geographic, and sectoral parameters of this study were applied as search filters in the following public project databases maintained by MDBs and DFIs to identify adaptation investments for analysis:

- Adaptation Fund: Projects and Programmes[3]
- African Development Bank: Projects and Operations[4]
- Asian Development Bank: Projects and Tenders[5]
- Global Environment Facility: Projects[6]
- Green Climate Fund: Project Portfolio[7]
- Inter-American Development Bank: Projects[8]
- World Bank: Projects[9]

Google search was also used to conduct a wider desktop review with the same time, geographic, and sectoral parameters. Alongside country and sector names, a combination of cross-cutting and sector-specific search terms was used to conduct this review (see Annex 1). Projects that explicitly aimed to reduce and/or manage physical climate risks—even as a secondary objective—were included. The databases note missing information for projects.

2.3 Building the AdapTDR Database

Identified adaptation investments and their characteristics of interest to this study were compiled into the first-of-its-kind Adaptation Triple Dividends of Resilience (or AdapTDR) database. The three figures below provide an overview of the 320 adaptation investments included in the database by country, sub-sector, and funder.

[3] Adaptation Fund. 2024. Projects and Programmes. https://www.adaptation-fund.org/projects-programmes/.
[4] African Development Bank. 2024. Projects and Operations. https://www.afdb.org/en/documents/projects-operations.
[5] Asian Development Bank. 2024. Projects and Tenders. https://www.adb.org/projects.
[6] Global Environment Facility. 2024. Projects. https://www.thegef.org/projects-operations/database.
[7] Green Climate Fund. 2024. Project Portfolio. https://www.greenclimate.fund/projects.
[8] Inter-American Development Bank. 2024. Projects. https://www.iadb.org/en/project-search.
[9] World Bank Country and Lending Groups. 2024. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

Figure 3: Distribution of adaptation investments by country

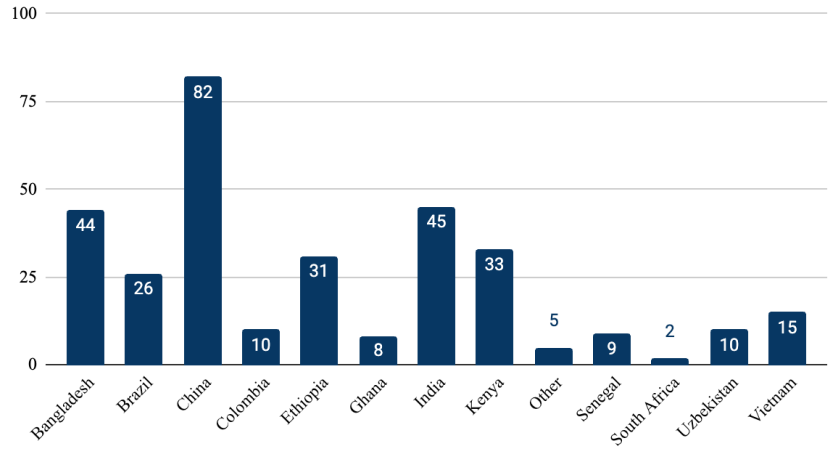


Figure 4: Distribution of adaptation investments by sub-sector

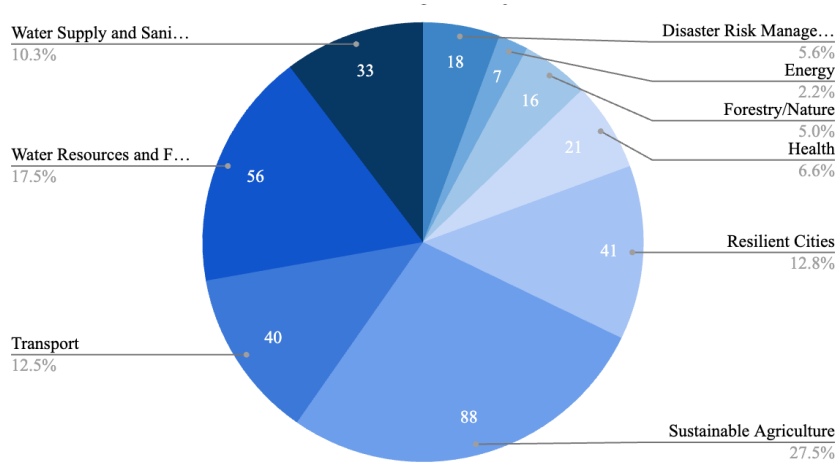
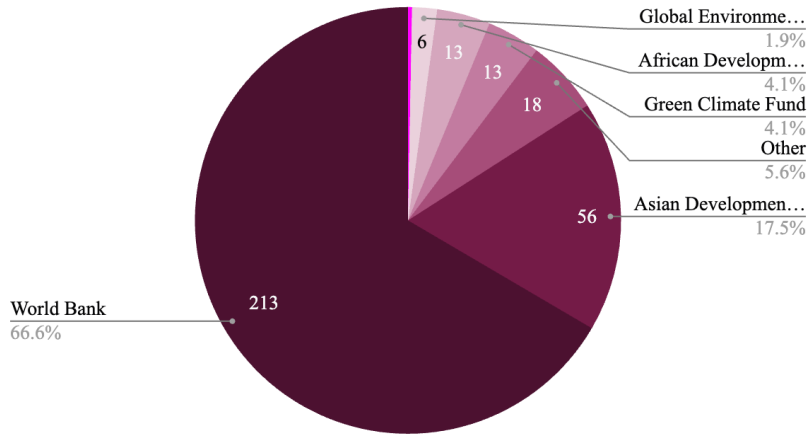


Figure 5: Distribution of investments by funder



To inform the findings of this study, the AdapTDR database first captured the overall return on each investment, including the net present values (NPVs), internal rates of return (IRRs), and benefit-cost ratios (BCRs) generated through cost-benefit analysis (see Annex 2 for details). IRRs were the most commonly available indicator, provided for 264 out of the 320 adaptation investments included in the database.

The database also captured the composition and monetary values (when provided) of expected investment benefits across the three dividends defined in the TDR methodology (see Box 1 for details). Benefits were categorized into one of the three dividends using standardized guidance to minimize variations in interpretation and classification (Figure 6).

Figure 6: Illustrative adaptation investment benefits by dividend

1st dividend (avoided losses)	
• Increased mortality (lives lost as attributable to the climate/ environmental shock) • Emergency health impacts (injuries, illnesses, hospital admissions as attributable to the climate/ environmental shock) • Public infrastructure loss/ damage • Property loss/ damage	• Productivity/ labour loss • Yield reduction/ loss • Water reduction/ loss • Energy reduction/ loss • Tourism loss • Increased travel time/ poor road performance • Rebuild/repair costs
2nd dividend (induced economic and development benefits)	
• Employment gains (as a result of the adaptation intervention) • Additional investment (infrastructure, industry, residential) attracted (due to reduction of background risk) • Appreciation of property values • Productivity/ labour gains (beyond the baseline as measured for avoided loss benefits above) • Yield gains	• Water retention/ runoff reduction gains (can also be 3rd dividend) • Energy gains • Tourism gains • Financial incentives (support schemes in place) • Reduced travel time/ increased road performance • Reduced maintenance costs
3rd dividend (additional environmental and social benefits)	
• GHG emissions reductions (can also be 2nd dividend when monetized via carbon markets) • Health improvements (wider improvements not connected to the specific climate/ environmental shock, e.g. ozone or PM2.5 reduction)	• Improved habitats supporting biodiversity • Recreational and amenity benefits • Soil nutrient/ fertility gains • Water retention/ runoff reduction gains • Wellbeing benefits (using 'WELLBY' method in UK Govt Green Book)

In most cases, when an expected benefit was not monetized, this study did not try to calculate a value due to a lack of sufficiently detailed project data and transparency around assumptions. The database instead noted which benefits were monetized and which were not.[10] However, this study developed a standardized methodology to estimate missing present values for carbon sequestration or greenhouse gas reduction benefits when identified and provided with sufficient data. Several projects, for example, estimated the total tons of CO2 equivalent (tCO2eq) to be sequestered or avoided through project activities but did not estimate the present value of those benefits. This project developed a standard

[10] The terms "monetized," "quantified," and "valued" are used interchangeably in this report. All refer to the concept of giving economic value to any project benefit, expressed in US dollars. There are many reasons why PADs might have more benefits than are monetized in the CBA. The methodology for valuing certain benefits, for example, may be difficult, the range of uncertainty may be high, and the level of benefits may already be sufficiently high that valuing further positive benefits wasn't needed to gain project approval. AdapTDR notes which benefits for each project are valued and incorporated in the economic analysis and which are not.

Present Value (PV) cost calculator to do so using the social cost of carbon suggested in the PAD (which varied across projects). In the absence of an identified social cost of carbon, this study assumed $60 per tCO2eq for projects approved from 2014-2020 and $75 per tCO2eq for projects approved from 2021 and onward. If the time horizon used in the economic analysis was not disclosed, the authors assumed a standard twenty-five-year horizon with five years of implementation. If not otherwise provided, a standard 5 percent discount rate was assumed.

2.4 Limitations of the Data

This study faced limitations in its representativeness of adaptation investments. Despite being the most comprehensive database currently available for assessing the benefits and returns of adaptation investments, extrapolating this study's findings is constrained by a relatively small sample size in some sectors, especially of projects that have fully valued benefits in all three dividends. The current sample size is constrained due to:

- The database selected 12 focus countries and not all developing countries;
- There is a limited number of adaptation investments per sector and sub-sector available for analysis in each of the focus countries;
- The triple dividends are not fully identified, and even if identified, are rarely fully valued for inclusion in the rate of return analysis. Of the 320 projects in AdapTDR, only 27 (8.4 percent) valued all three dividends.

This last point is not surprising, as the TDR approach is new. This database shows for the first time that the current state of assessing the full economic benefits of adaptation investments is incomplete. However, it also reveals that adaptation investment IRRs and BCRs, albeit extremely high, are still underestimations. Further research is needed to improve the scope and granularity of data available that can be used to evaluate and better demonstrate the economic returns of adaptation investments.

The accuracy of this study is also limited due to the many types of available studies, as well as the variance in their methodologies and assumptions. Almost all the investments included in this study were analyzed using donor PADs, which are internally reviewed but not subject to academic peer review. There is also a lack of standardization in definitions, methodology, time frames, and discount rates used by donors to conduct cost-benefit analyses. For example, every climate adaptation investment is designed to reduce an identified risk, but climate risks are inherently probabilistic. Cost-benefit analysis of those risks depends on some sort of climate scenario or projected impacts. These scenarios are not standardized across the database, nor could they be. The project appraisals are done in different years and different locations, as well as with different underlying assumptions even within the same country.

The projects in the database are all real and approved for investment. So, stepping back from detailed questions about RoI and CBA analysis, this database is valuable for simply documenting what actual adaptation investments twelve countries have made in recent years. Investment data at this level is available for very few countries, including from NDCs and NAPs. Nevertheless, while this study's data search filters are very likely to have captured virtually all donor-funded projects in these countries, few domestically funded projects were found. It is not known to what extent some of these countries, particularly the bigger ones like Brazil, China, and India, may have invested in adaptation without donor support. Therefore, this database is a positive list of ongoing adaptation investments but does not claim to be exhaustive.

3. FINDINGS

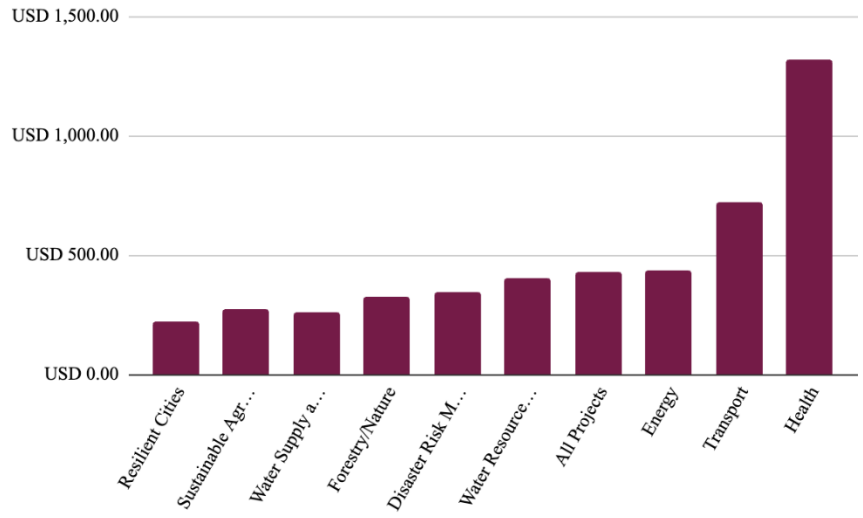
The AdapTDR database is a first-of-its-kind database of adaptation investments that highlights key information on the costs, rates of return, triple dividend benefits, and mitigation potential of adaptation (see Annex 1 for more detail on AdapTDR). All this information is instrumental in strengthening the case for scaling investment in climate change adaptation.

3.1 The Cost of Financing Adaptation

Understanding the cost of financing adaptation is vital to identifying the monetary benefits of adaptation investments, particularly in the context of the widening adaptation financing gap. The AdapTDR database captures $133 billion invested in adaptation investments in twelve countries.[11]

While the number of adaptation projects is fairly evenly distributed across sub-sectors except for health, the average costs of sub-sector projects vary widely (see Figure 7). The average project cost across all projects is $427 million, including both government and external (donor) financing, though there is a wide distribution around this number. The smallest average cost is for urban projects ($220 million), whereas health projects have the largest average cost by far ($1.32 billion). This difference is likely because urban projects tend to be local in nature, while health projects generally operate on a national scale. Projects in the water, transport, and agriculture sectors typically fall somewhere in between. Table 3 in Annex 1 displays the project shares and costs by sub-sector.

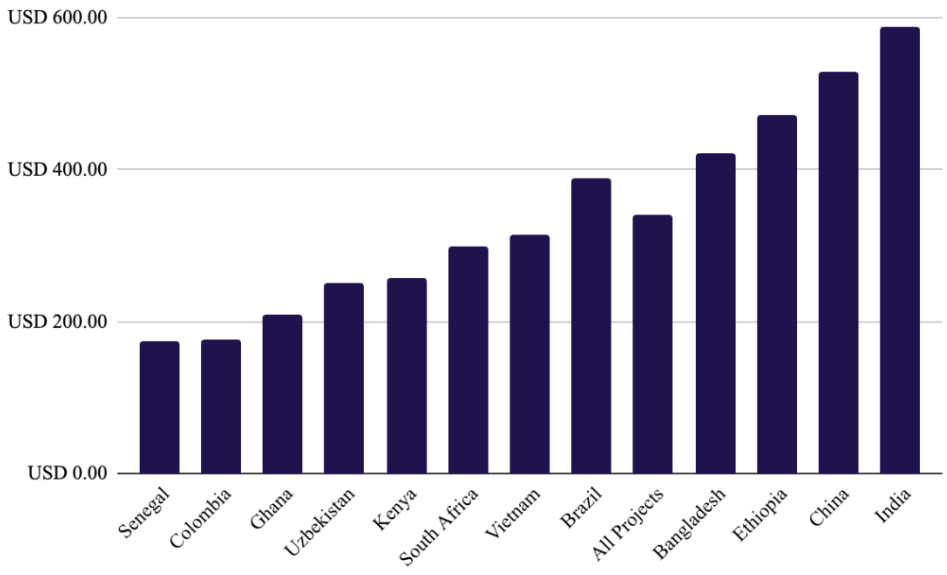
Figure 7: Average cost of adaptation projects by sub-sector (in USD millions)



The average cost of adaptation projects also varies widely by country (Figure 8). The average project cost in India is the highest, followed by China, Ethiopia, and Bangladesh. The average project cost is the smallest in Senegal, Colombia, and Ghana. Project size is influenced by many factors, including the country's population, project design, implementation capacity, fiscal space, sector-specific financing needs, and the perceived risk of doing business.

[11] The project costs shown are the full project cost including both government and donor contributions.

Figure 8: Average cost of adaptation projects by country (in USD millions)



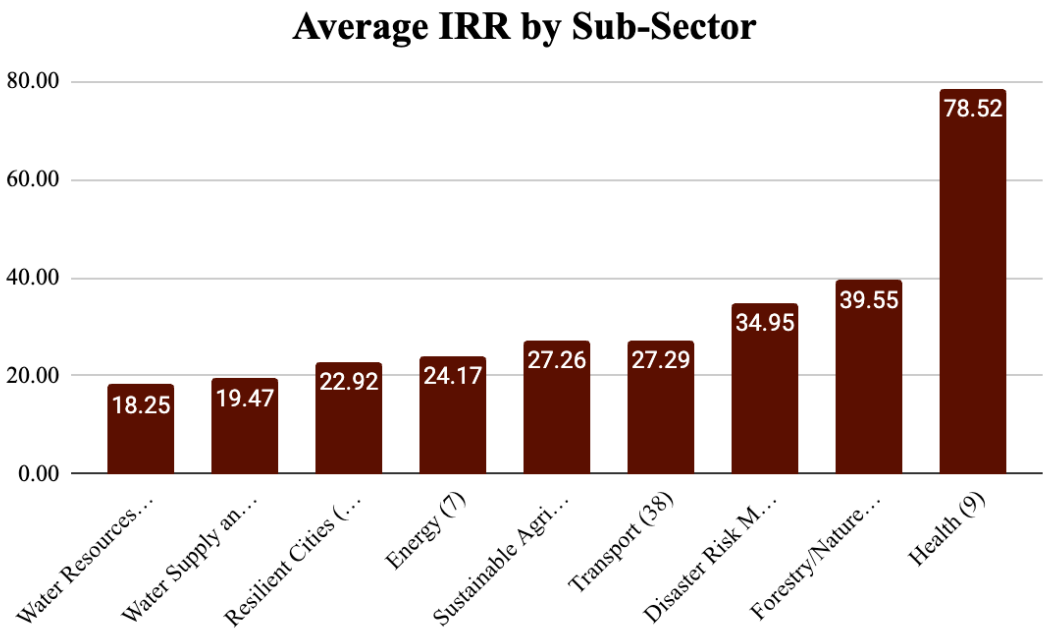
3.2 Adaptation's High Rates of Return

Adaptation projects consistently show a very high rate of return across all sub-sectors. Of the 320 projects in the AdapTDR database, 264 (83 percent) provide an IRR in their PADs, as opposed to only 34 percent that estimated BCRs. This study uses, therefore, IRRs to estimate the return on investment (see Annex 3 for more detail). On average, adaptation projects captured in the database have an internal rate of return (IRR) of 26.9 percent. This can be compared to the 10 percent IRR threshold often considered sufficient for MDB lending.

The range of average IRRs across sub-sectors is nonetheless very wide. The IRR of adaptation projects by sub-sector ranges from 18 percent for those addressing water resources and flood management to 79 percent for health projects (See Figure 9). This high degree of variation is driven by the characteristics of each sub-sector's projects, the high variation in the scope of benefits identified, and the relatively small number of projects in some sub-sectors. For example, while AdapTDR has 21 health projects, only 9 have estimated IRRs.[12]

[12] World Bank staff indicated (personal communication) that health sector projects often do not have IRRs for several reasons, including the difficulty in calculating health and welfare values and controversies over using vsl (value of statistical life) in cost-benefits analysis. Often, cost-effectiveness analysis is preferred, which focuses on costs and project efficiency more than valuing benefits in monetary terms.

Figure 9: Average IRR by sub-sector



Adaptation projects in the health sector demonstrate the highest average return on investment, which is nearly twice that of all other sub-sectors. This is not surprising since the value of avoided losses, measured in terms of lives saved and sickness avoided, is very high. Similarly, disaster risk management shows high returns based on the avoided losses of life and property. Forestry and nature-based projects have the second highest average returns given the extensive benefits associated with carbon reduction or sequestration. Figure 10 groups the sub-sectors into three terciles of upper, medium, and lower returns, recognizing that "lower" in this context still means very high RoIs.

Figure 10: Range, average, and ranking of returns on investment by sub-sector

	Range across all projects	IRR Averages	Ranking in terciles
Agriculture			
Sustainable Agriculture	11.7% - 131%	27.3%	Middle
Forestry/Nature	15.86% - 77.9%	39.6%	Upper
Health			
Health	10.5% - 291%	78.5%	Upper
Infrastructure			
Disaster Risk Management	8% - 131%	35.0%	Upper
Energy	16.7% - 39%	24.2%	Middle
Resilient Cities	9.6% - 49%	22.9%	Lower
Transport	10.8% - 167.5%	25.6%	Middle
Water			
Water Resources and Flood Management	10% - 37.5%	18.3%	Lower
Water Supply and Sanitation	11% - 43.7%	19.5%	Lower

Although there are differences across the regions, a common feature is that resilient cities, water supply and sanitation, and water resources management projects all fall in the lower range of IRRs. It appears that projects in these sub-sectors do not adequately quantify the benefits of improved health and decreased mortality. The graphs below show the average IRRs for the three regions studied—Africa, Asia, and Latin America. The average IRRs for these urban and water-related projects across the three regions range from 17 to 23 percent.

Figure 11: Average IRR in Africa by sub-sector

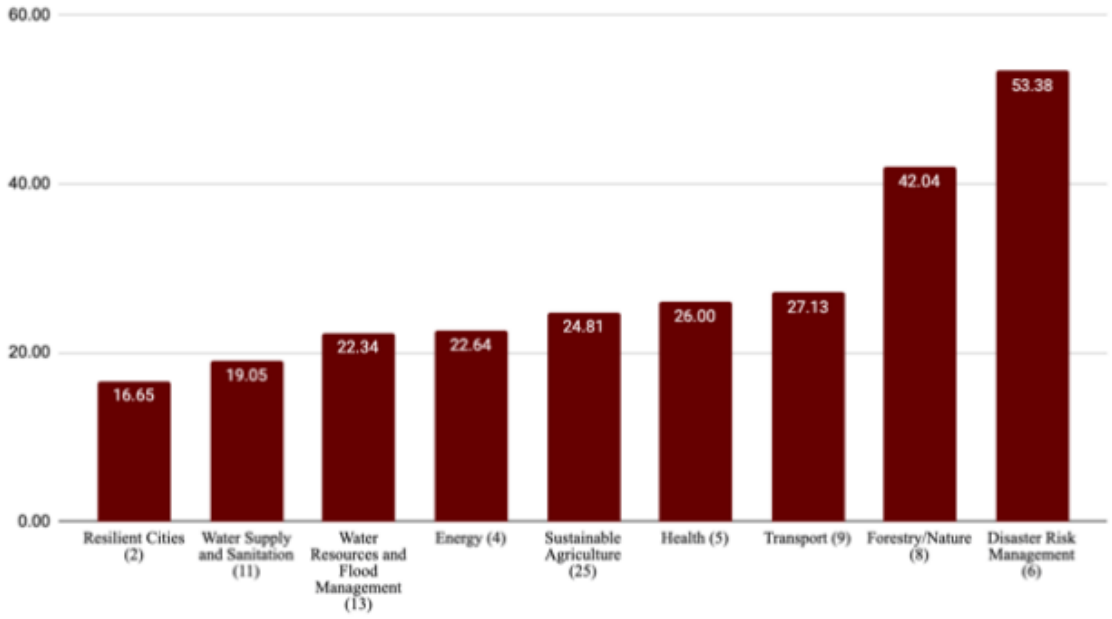


Figure 12: Average IRR in Asia by sub-sector

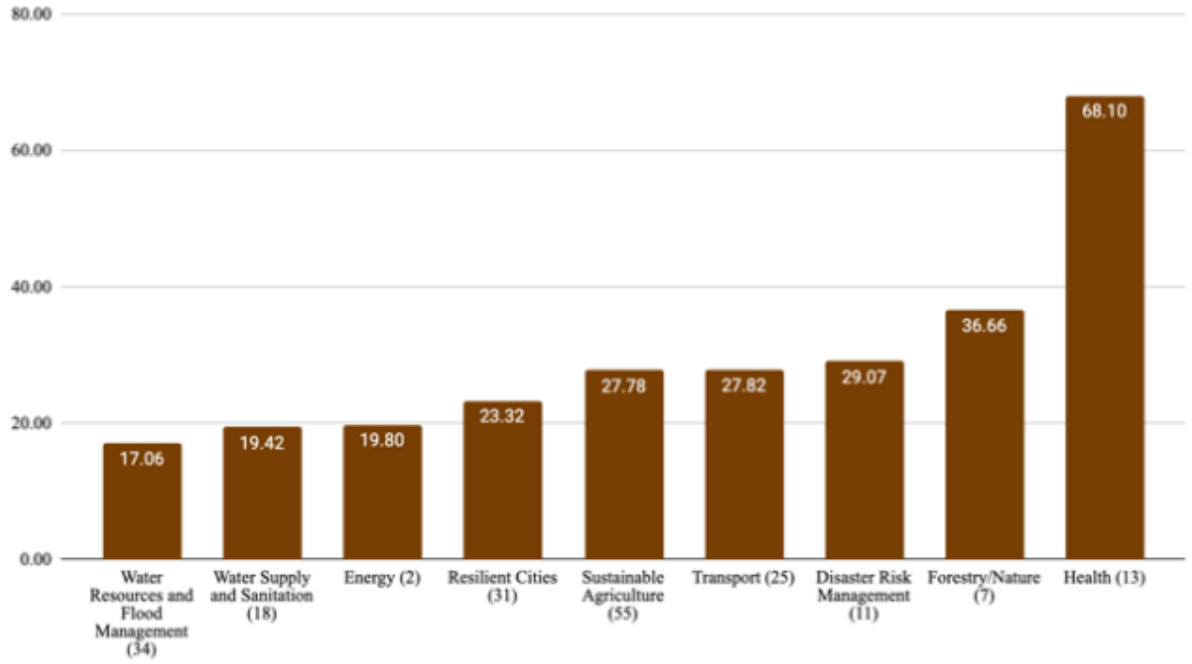
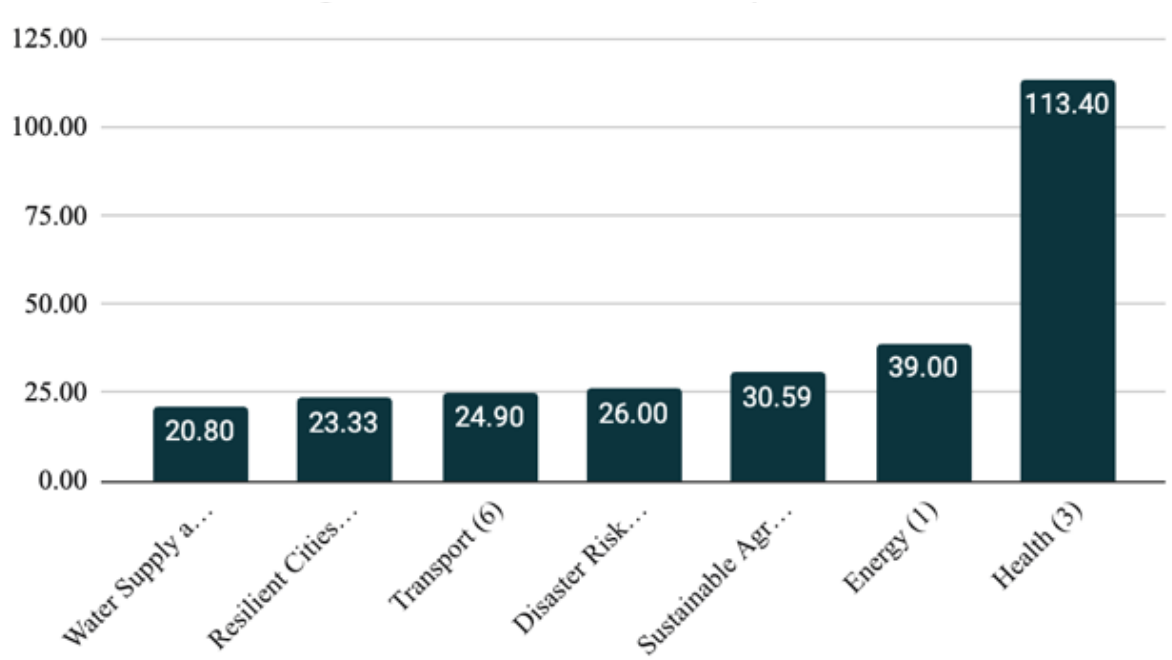


Figure 13: Average IRR in Latin America by sub-sector



Annex 3 shows average IRRs, by sub-sector, for the five countries with the greatest number of projects in the database: India, China, Kenya, Ethiopia, and Brazil. Notably, the variation in IRRs is relatively less for some of these countries. In China, the estimated IRRs for all sub-sectors fall in the relatively narrow band of 15-21 percent. Similarly, in Kenya, IRRs for all sub-sectors fall in the 22-26 percent range except for one

sub-sector. Particularly high outliers, such as one energy project in Brazil, one DRM project in Ethiopia, and three health projects in India, cannot be assumed to be representative of adaptation projects overall. More meaningful are the explanations behind these outlier projects. For example, high expected health benefits in health and DRM projects, and high GHG benefits in the energy and forestry projects, help push the expected IRRs to a quite high level.

Grouping projects into quartiles and comparing the performance across sub-sectors in quartile aggregates is a different way to look at the rates of return on adaptation investments that reduce the likely biases of a relatively small sample size. Of the 264 projects with estimated IRRs, 66 fall into each quartile. The details of this analysis are in Annex 4. The results are only marginally different from the table above and the pattern remains the same.

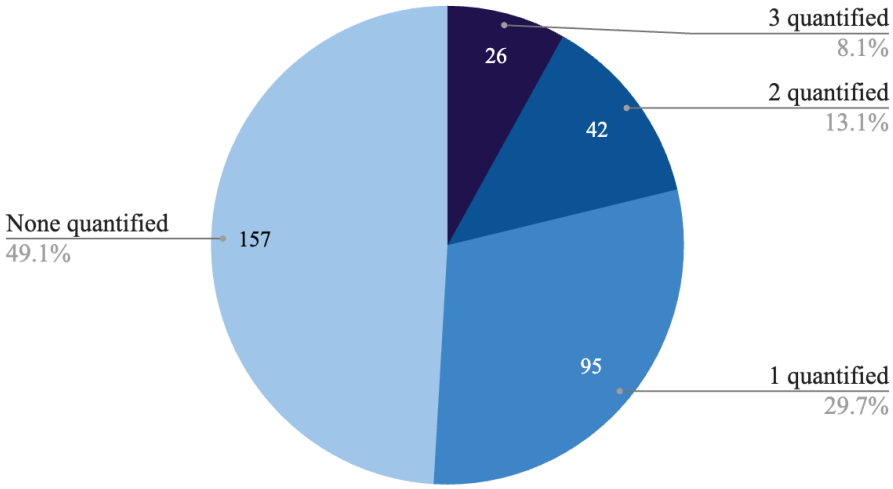
3.3. Adaptation's Triple Dividend

A major objective of this study was to investigate the triple dividend benefits of adaptation projects. This sub-section looks at how well-quantified the benefits of adaptation investments are, and the actual benefits of adaptation investments, including how well-distributed they are across the three dividends.

How well quantified are the benefits of adaptation investments?

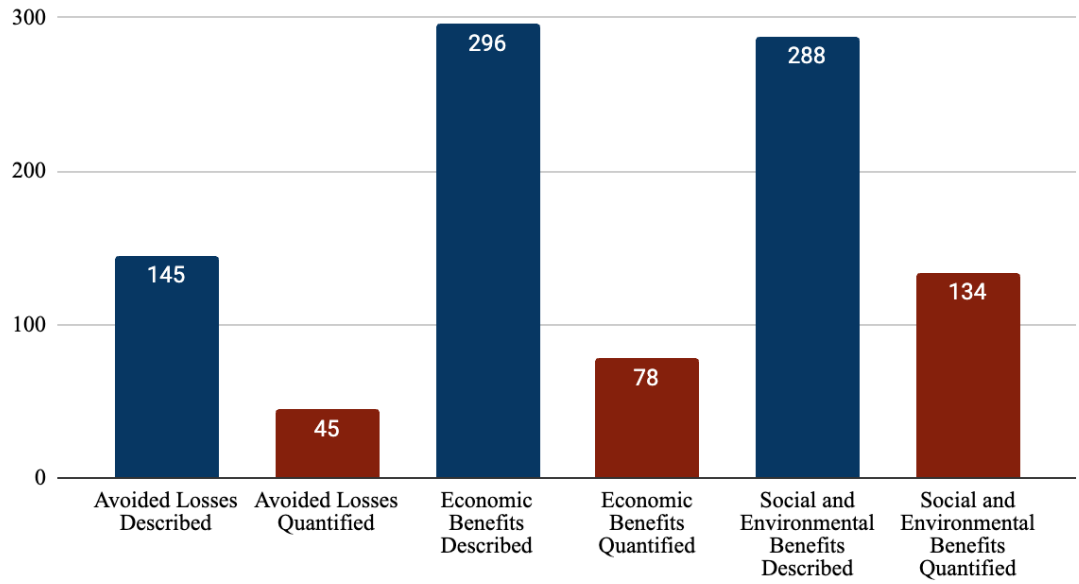
Nearly half of the adaptation projects listed in the AdapTDR database reported no quantified benefits for any of the three dividends, with only eight percent of projects quantifying at least one benefit for all three dividends. The various types of adaptation benefits noted in the AdapTDR database, as detailed in their respective PADs, were summarized into a standardized list of thirty (e.g., property loss and loss of life) and categorized into one of the three dividend types (e.g., avoided losses, induced development benefits, and non-market social and environmental benefits). As shown in Figure 14, 27 of the 320 projects in the AdapTDR database recognized benefits across all three dividends (tier 3). There are 42 projects (13.1 percent) that recognized two dividends (tier 2), 95 projects (29.7 percent) that recognized one benefit (tier 1), and 157 projects (49.1 percent) that quantified benefits in the aggregate but in such a way that they could not be assigned to a specific dividend. A quantified benefit value for a dividend does not indicate that all recognized benefits for that dividend were quantified, but rather that at least one of the recognized benefits for that dividend was quantified.

Figure 14: Investments by dividend tiers



Relatively few of the benefits that are described for adaptation projects are actually quantified (see Figure 15). In the case of avoided losses, only 45 out of 145 projects (31 percent) that described avoided losses quantified them. The share was even lower for induced development benefits (26 percent), which means that the significant benefits of these projects are not reflected in the IRRs. While social and environmental benefits are quantified in almost half of all projects (47 percent), this is likely because the authors calculated the monetary value of carbon mitigation benefits where provided (see methodology).

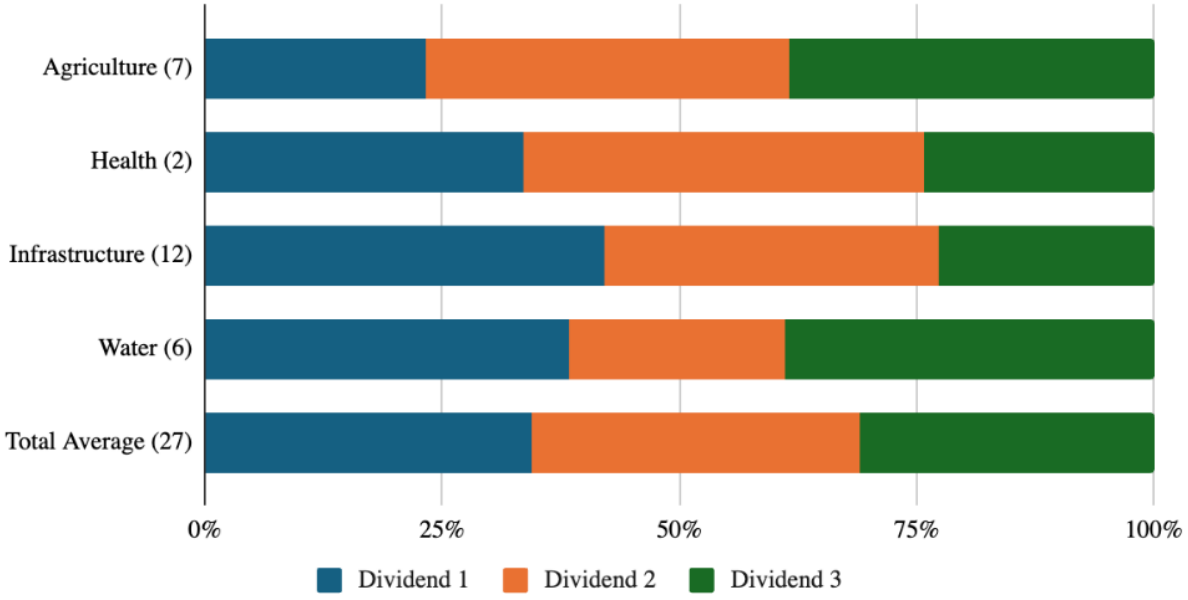
Figure 15: Total investments that describe vs. quantify dividend benefits



What are the benefits of adaptation investments?

The high returns on adaptation investments even without considering avoided losses confirm that good adaptation is good development On average, the induced economic, and social and environmental benefits (dividends 2 and 3) are double the value of avoided losses (dividend 1). This means that adaptation investments yield benefits even if the climate event never occurs. Figure 16 shows the distribution of the triple dividend for 27 projects that quantified all three dividends.[13] As shown by the bottom bar, the share of the dividends is on average very evenly distributed, accounting for 35 percent, 33 percent, and 31 percent of the total project benefits, respectively.

Figure 16: Distribution of investment benefits by dividend and sector



The breakdown of benefit values across dividends varies by sector. Agriculture and forestry/landscape projects have the highest share (over 75 percent) of dividends 2 and 3 because of the agriculture sector's high development benefits. The opposite appears to be true for infrastructure, where dividend 1 or avoided losses account for 40 percent of the benefits stream on average. This can be attributed to the high cost of disruption when extreme events occur. Health projects have a small dividend three (social and environmental benefits), as dividends related to avoided losses and economic productivity gains linked to better health outcomes are relatively larger. Water projects have the highest share of dividend three (social and environmental benefits), likely because of the benefits accruing to human welfare, nature/biodiversity, and the inclusion of carbon mitigation benefits along with adaptation benefits. This variance is explored more deeply in the discussion section.

[13] Two sub-sectors—disaster risk management and energy—are not represented in this sample of 27 tier-3 projects since none emerged in the database.

The figure below provides greater detail of the main benefits within each sector and dividend type, as well as how often those main benefits are monetized. Two-thirds of these most frequently occurring benefits across all projects are monetized less than 25 percent of the time. While the triple dividend approach shows that adaptation and development objectives are highly aligned, it also illustrates that the high estimated returns on adaptation investments would still be much higher if the full benefits were valued.

*Figure 17: Top two benefit types by dividend and sector**

Agriculture		
Dividend 1	**Dividend 2**	**Dividend 3**
Yield reduction/losses (18%)	Productivity/labour gains (4%)	Wellbeing (0%)
Productivity/labour loss (0%)	Yield gains (19%)	GHG emissions reductions (64%)
Health		
Dividend 1	**Dividend 2**	**Dividend 3**
Emergency health impacts attributable to the climate shock (22%)	Productivity/ labour gains (11%)	Wellbeing benefits (0%)
Reduced lives lost attributable to the climate shock (33%)	Financial incentives (17%)	Broader health improvements (40%)
Public infrastructure loss/ damage (17%)		
Infrastructure		
Dividend 1	**Dividend 2**	**Dividend 3**
Property loss/damage (27%)	Reduced maintenance costs/ cost savings (35%)	Wellbeing benefits (12%)
Public infrastructure loss/damage (45%)	Productivity/ labour gains (24%)	GHG emissions reductions (70%)
Reduced lives lost attributable to the climate shock (18%)		
Water		
Dividend 1	**Dividend 2**	**Dividend 3**
Property loss/damage (31%)	Reduced maintenance costs or cost savings (33%)	Water retention/ runoff reduction gains (16%)
Reduced lives lost attributable to the climate shock (0%)	Yield gains (15%)	GHG emissions reductions (46%)
		Improved habitats supporting biodiversity (14%)

Note(*) The number in parenthesis is the percent of each benefit that is monetized. If three benefits are listed, the second and third were cited equally as often.

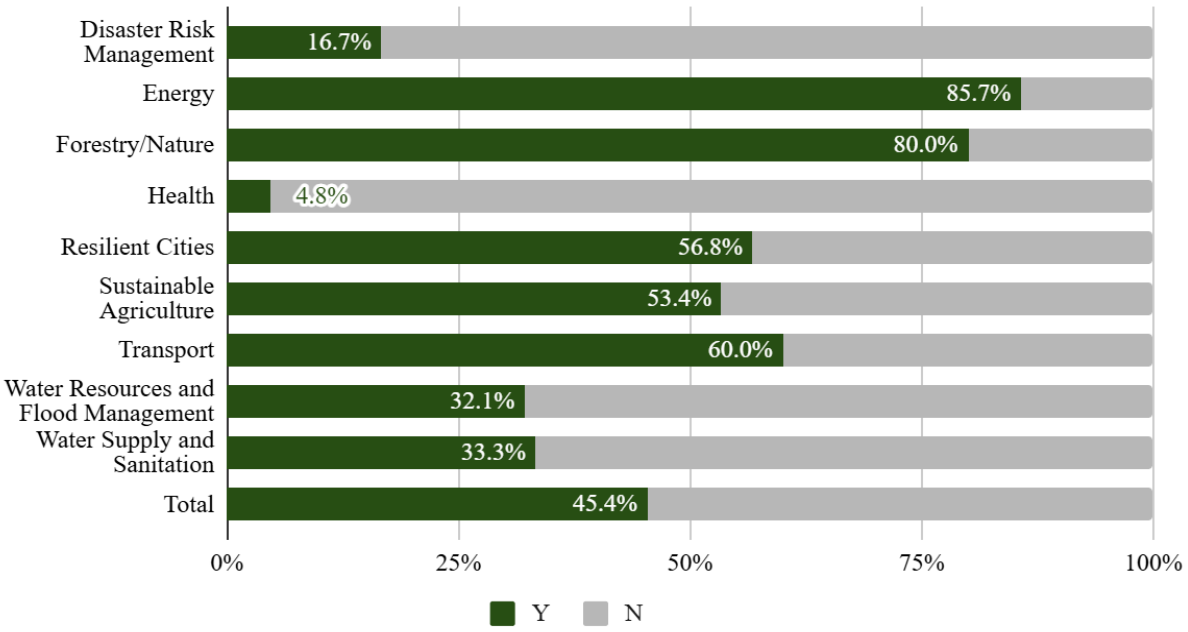
3.4 Adaptation's Mitigation Co-Benefits

One of the important findings from this analysis is that many adaptation projects contribute to reducing greenhouse gas emissions. Historically, mitigation and adaptation projects have largely been developed separately (Howarth and Robinson 2024). There is, however, significant potential for synergies between the two (UNFCCC 2022), especially in the agriculture, forestry, urban resilience, and energy sectors. The first two—agriculture and forestry—provide opportunities for enhanced carbon sequestration through climate-smart farming and silvicultural practices, while the other two—cities and energy—offer substantial potential for emissions reduction through efficiency measures.

This study finds that 143 projects (45 percent) have GHG emission reduction benefits, and only 4 (1 percent) increase emissions (see Figure 18). Moreover, dividend three benefits, which greenhouse gas emissions fall into, surpass avoided losses (dividend one) and induced economic development benefits (dividend two) in some cases.

The mitigation benefits were found to be particularly high for adaptation projects in the sustainable agriculture, forestry, energy, and transportation sub-sectors. Sustainable (or climate-smart) agriculture projects tend to reduce emissions primarily through soil and water conservation and the use of more efficient technologies and management practices, while forestry projects increase carbon sinks. The emissions reduction benefits of energy projects were due to the increased use of renewable energy sources, while both energy and transportation projects reduced emissions through efficiency gains.

Figure 18: Share of projects with expected GHG emissions reductions



Highlighting these high GHG emission reduction benefits and emphasizing synergies makes adaptation more appealing for all parties involved in climate change adaptation planning and finance. These projects align well with the IPCC's 2022 call for greater use of *climate-resilient development pathways.* Wider recognition of adaptation's potential mitigation co-benefits can help make adaptation investments more attractive to governments and donors pursuing climate adaptation and mitigation goals as spelled out in NDCs and NAPs. Due to the eligibility of emissions reduction projects for carbon finance, this can also increase their appeal to the private sector looking for carbon finance opportunities.

4. DISCUSSION

Countries and donors alike need to learn as much as possible about prioritizing adaptation resources amidst a growing adaptation finance gap. The previous section highlighted the high rate of return for adaptation investments and showcased, through the triple dividend approach, that good adaptation is also good development. Building on these findings, this section discusses how these findings can be used to enhance adaptation investments by highlighting:

- The concept of "best buys," and more importantly, "best buys for whom?";
- The information that is missing from this analysis, or what it is unable to tell us;
- The scope for private investment in adaptation; and
- Learnings from the AdapTDR database.

4.1 Best Buys for Whom: How Assessing IRRs and Triple Dividends Works Together

The AdapTDR database can point to 'best buys' that are sensible, value-for-money adaptation investments that should be pursued across sectors and jurisdictions. Nearly all projects in the AdapTDR database have high rates of return. While this is not necessarily surprising since they were all approved for implementation, these projects can also be understood as 'best buys' or top-priority projects with high rates of return and benefits across multiple dividends.

Any political or public investment planning process should aim to understand the primary demographic and sectoral beneficiaries of a given investment. This involves asking *"best buys for whom?"* and *"in what context."* Specific benefits and overall dividends vary greatly by project and depend on the context in which they are pursued. The national and local contexts include resource availability, the need for local priority-setting, the need for all sectors to take steps to adapt, and sector-specific implementation capacity. Box 2 shows four projects where the triple dividend approach helps do that.

Essentially, IRR informs the question of "best buy" whereas the triple dividend informs the question of "for whom." By combining an understanding of both the source of high IRRs and the full value of project benefits to target beneficiaries, the analytical approach can answer the question of "best buys for whom?"

Box 2: Triple Dividend Projects: High Returns, Diverse Beneficiaries

Projects in the AdapTDR database have high IRRs but accounting for all three dividends also reveals a range of benefits accruing to specific groups. Mapping interventions and their benefits to these beneficiaries can improve understanding of which interventions may be best for whom. Designing investments and improving delivery mechanisms by drawing on these insights can support the broader movement to locally led adaptation while also presenting good economic value for money.

Agriculture

Hubei Yichang Rural Green Development Project, China. Improving the climate resilience of small-scale farmers and rural populations carries high induced development benefits (the second dividend of resilience), making them economically sensible "best buys". Improvements in climate-smart agricultural practices and infrastructure, agricultural waste and water treatment systems can result in significantly increased productivity far outstripping the cost of the initial investment (by an order of magnitude). Importantly, climate-smart agriculture projects also carry high carbon sequestration and water saving benefits. Reduced losses from climate impacts themselves, while quantified, are comparatively small. With an NPV of $289m, project benefits are nearly twice the size of the original investment.

Health

Kenya Social and Economic Inclusion Project. Investments into projects responding to climate-related health emergencies in developing countries are highly beneficial "best buys" not simply because they improve safety nets and reduce emergency health impacts on the wider population but because access to improved services is particularly beneficial to poor and vulnerable households. Their increased productivity and improved learning outcomes for children are both forceful drivers of the case for investment, each exceeding the value of avoided losses by an order of magnitude. With an NPV of $112m, project benefits exceed costs by nearly three to one.

Infrastructure

Fortaleza Sustainable Urban Development Project, Brazil. Climate smart investments in urban infrastructure are highly beneficial from economic, social and environmental perspectives. The Fortaleza project builds capacity for land-use planning, strengthens urban financing instruments, and improves the urban environment through interventions in the Maritime Slope Basin and Rachel de Queiroz Park. The intervention is key to protecting public infrastructure from flooding due to extreme rainfall, but it equally saves construction costs for reinvestment and enhances biodiversity habitats. Women benefit disproportionately from the project, emphasizing its social impact. With an NPV of $85m, project benefits are twice the size of the original investment.

Water

Transformative Riverine Management in the eThekwini Municipal Area, South Africa. Nature-based solutions to address flood risk can result a myriad of benefits along all three triple dividends, making them highly relevant "best buys". The Transformative Riverine Management Programme in Durban is an example of such a beneficial natural flood management intervention. The reduction of flood losses (the first dividend) stands alongside better transport access, more jobs, increased food production and bioenergy generation (the second dividend), as well as erosion and sediment control, improved surface water quality, recreation and visual amenity, and carbon sequestration (the third dividend). With an NPV of around $2bn, benefits are nearly six times greater than the original costs of the project.

While observations relating to the IRR and TDR data across sectors are too general to be meaningfully applied in the project design process, they nonetheless shed light on broad trends:

- Looking strictly at returns on investment, the highest returns are linked to activities that save human lives, such as health and disaster risk finance. These two sectors show extremely high benefits, even without a full valuation of their various benefits.

- Sustainable agriculture and forestry show very high rates of return, driven mainly by very high induced development benefits, but also by high climate mitigation benefits. The significant contribution of GHG emission reduction benefits opens up the promising opportunity of linking carbon finance to adaptation investments in these two sectors. Also, the high development benefits ensure high rates of return even if future extreme climate events do not occur.

- Infrastructure sub-sectors, such as energy, transport, and resilient cities, have moderate rates of return and show dividends across all three project types. Urban adaptation projects show high development benefits but often neglect to value their adaptation (avoided losses) elements.

- Water projects represent a special case across both the water resources and flood management and water supply and sanitation sub-sectors. Though they are at the center of adaptation concerns, these sub-sectors oddly have relatively lower average IRRs.[14] This is likely due to the low level of benefits valuation in water project cost-benefit analysis. Both reflect among the lowest levels of valuation of all sub-sectors, along with health and disaster risk management, but lack the high values of human lives saved lift their IRRs. On average, water projects have relatively fewer induced development benefits compared to dividends one and three, which suggests a low valuation of these benefit types.

In short, the above findings prioritize adaptation investments with high IRRs and a wide diversity of dividends. These investments are robust, generate benefits independent of actual future climate impacts, and can measurably reduce climate risks. Many such projects implement low-regret and relatively low-cost actions to reduce climate risks. They also help integrate adaptation into decisions with long lifetimes to avoid lock-in effects or future maladaptation.

4.2 What is Missing?

Many adaptation projects don't quantify avoided loss benefits despite this being a major objective. Figure 19 shows in greater detail the extent to which all 320 projects quantify dividends. Almost three-quarters (74 percent) of all projects that cite avoided losses benefits do not value them. This is likely true for three reasons:

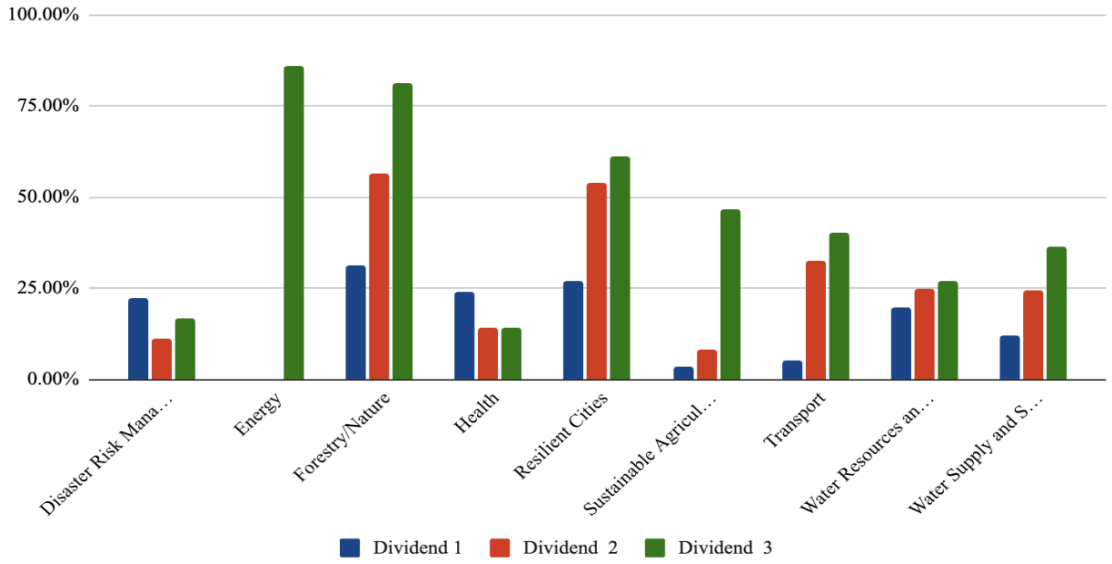
- Valuing avoided losses is difficult to do properly since it requires assessing risk and probabilities. Given the state of the play of cost-benefit analysis in most MDBs and governments, practitioners may be not suitably trained.

- This evaluation is not required since adaptation projects have very high IRRs, even without including avoided losses. Valuing avoided losses is not required, therefore, to attain IRRs high enough to ensure project approval.

[14] There is a common saying that "Water is to adaptation what energy is to mitigation," due to the water sector's prominence in storms, floods, droughts, and sea level rise.

- Development agencies still consider climate change benefits as "co-benefits" compared to core development benefits. Therefore, if the developmental or social and environmental benefits—dividends 2 and 3—more than justify a project, there is no reason to quantify the co-benefits. Using the co-benefits methodology, an MDB can "take credit" for financing adaptation without having to actually value avoided losses.

Figure 19: Share of total quantified dividends by sub-sector



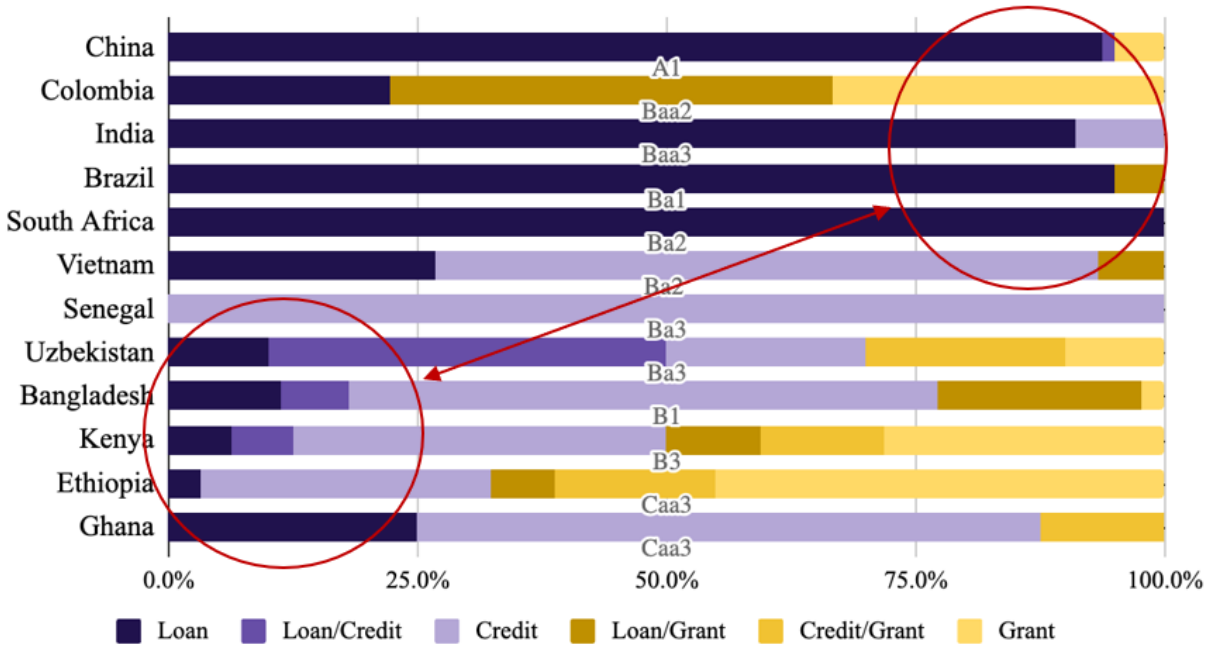
This finding confirms that the risk reduction contributions of these projects are not well understood and will not be better understood without a more careful assessment of the full scope of the triple dividends. The challenge of finding suitable metrics for building climate resilience remains even after several years of effort. Improved assessments of avoided losses (dividend 1) in the triple dividend approach can become a useful data source for pricing both risk and risk reduction.

4.3 Scope for Private Investment in Adaptation

The maturity of a recipient country's development status and finance and its sovereign credit rating plays a role in determining the type of adaptation finance instrument extended to it by MDBs (Figure 20)**.** The AdapTDR database reflects a diversity of financing modalities, including loans, credits,[15] grants, preferred debts, short-term maturity loans, or a combination of two or more instruments. For instance, China is the highest-rated country in this study, with a Moody's rating of A1 (Moody's). Over 92 percent of China's projects were loans. Ethiopia, by contrast, has the lowest Moody's credit rating among countries included in this study and received only one loan among its thirty-one projects—a mere three percent.

[15] Low-interest loans issued by the International Development Association

Figure 20: Funding modality and creditworthiness by country



Adaptation investments are diverse in scope and this diversity can help attract interest from the increasingly diverse private finance landscape. Private sector actors include large international or regional commercial banks, multinational companies, venture capital firms, private equity, small and medium enterprises, impact investing firms, endowments, and philanthropies, among others. This diversification is significant because it can enable the matching of investor profiles, including their goals, to the project's objectives, components, and benefit types.

Different types of projects must play to the strengths and interests of different stakeholders while including them in a project-based capital stack. A diverse range of financial instruments can also be deployed within a single capital stack to allow several stakeholders to contribute while meeting their needs, goals, and standards. Private finance can be leveraged by providing greater clarity to the financers on the link between their mandates and potential adaptation benefits that can be generated.

The AdapTDR database provides two initial insights into this, thereby compelling market participants to better understand the returns on investment. First, quantifying the second dividend, induced development benefits is key to finding opportunities for private sector support for adaptation investments. High second dividend benefits are not only a key part of a public growth and investment narrative; they also support the investment choices of private sector actors. This is because the second dividend represents induced economic growth and higher incomes, which, in turn, form the basis for potentially attracting private investment either as direct investors or through capital markets. Second, 45 percent of adaptation projects in AdapTDR are net carbon positive. This potential for adaptation projects to enhance carbon sequestration invites the participation of financing entities capturing future revenue streams through carbon markets and carbon offset programs.

4.4 Learning from the AdapTDR Database

The AdapTDR database provides an important basis for encouraging private sector investment in adaptation. The AdapTDR evidence base will help support private sector investment, which needs a pipeline of projects with clear ROIs to invest in. The private sector is most interested in adaptation projects that either generate development value-added and higher incomes, or carbon credits. Data drawn from the AdapTDR database can help provide a framework to identify the different forms of returns that could be matched against the interest of different types of capital.

The database can also support the public sector's business case for adaptation interventions. Over time, data of this nature can help governments define good adaptation projects and strengthen their access to finance (for example, in GCF proposals). Having a typology of benefits identified and quantified can help DFIs, governments, subnational governments, NGOs, and others to adapt, map, and or improve their own supplementary guidance, evaluation, and analysis. This is an already ongoing process in some countries. For example, the UK is currently updating its supplementary guidance to the Green Book.

It also highlights large data gaps in current global tracking of what constitutes adaptation actions and where they are being made. For reasons mentioned throughout this study, the AdapTDR database is an important new knowledge base for better understanding and promoting climate adaptation investments. We expect that making AdapTDR publicly available will trigger interest, additional inputs, and follow-up analysis. In Box 3 are six ideas for future work using this new database of adaptation investment projects. Its continued development will show (a) where climate adaptation finance is flowing; (b) the wide range of benefits generated by adaptation projects, beyond normal expectations; (c) the cost of reducing climate risk through good climate planning in NDCs and NAPs; and (d) the range of impacts that can be evaluated upon completion of a project.

Box 3: Ideas for Future Work Based on the AdapTDR Database

1. Better case studies of exemplary adaptation projects and financing options. This would illustrate more clearly the actions already being prioritized by donors and countries and could help other authorities decide what to invest in. It would also help DFIs and governments improve their analysis, guidance, and investments.

2. Gap analysis of the types of benefits identified vs the types of benefits quantified. This would illustrate areas where project returns are under-estimated.

3. Showing "how much resilience" can be purchased and at what cost. Using the avoided loss dividend in a comparative way would illustrate the cost of building resilience by project type.

4. Screening of benefit types by relative attractiveness to the private sector. This would suggest ways to structure adaptation investment financing arrangements differently.

5. Deeper analysis of the synergies between adaptation and mitigation co-benefits. This would show that good adaptation projects are also mitigation projects and avoid trade-offs between the two.

6. Building a growth and development narrative. Showing how second and third dividend benefits build the case for climate-smart and resilient economic growth through good adaptation.

5. KEY TAKEAWAYS AND RECOMMENDATIONS

The triple dividend approach pushes the adaptation narrative beyond simply avoided losses by both broadening and deepening our understanding of the beneficial impacts of climate adaptation interventions. It quantifies and illustrates—and therefore incentivizes—the alignment of adaptation benefits with equitable, sustainable, and resilient development. By combining an understanding of both the source of high IRRs and the full value of project benefits, the TDR approach answers the question of "best buys for whom?" As the AdapTDR database illustrates, high-return projects have benefits that are evenly balanced across all three dividends, reinforcing good adaptation as good development, and vice versa.

Key Takeaways and Recommendations

Key Takeaway 1: Climate adaptation projects average returns on investment (RoI's) are 27 percent, which is extremely high. Since many diverse benefits are not monetized, even these high RoIs are under-estimates. Health and disaster risk management sub-sectors show high returns based on reducing mortality and morbidity. Sustainable agriculture and forestry/landscape projects show high returns based on high poverty reduction benefits as well as low-carbon benefits. Infrastructure-related adaptation projects, such as in energy, transport, and cities, show benefits across all three types of dividends.

- **Recommendation**: **Work with DFIs and governments to increase awareness of these high returns on investment from adaptation and teach them to calculate their own going forward.** The AdapTDR database shows the many different types of benefits accruing to these projects. Lessons specific to high-return projects in different sectors and regions can be used to inform project design in other countries and geographies. But the data can also be used to focus on priority beneficiaries. Several projects in the AdapTDR database show a combination of high economic returns ("best buys") and benefits for priority socio-economic groups, sectors, or regions ("best buys for whom"), suggesting that well-designed investments do not just present value for money but can also support the broader movement toward empowering local communities to ensure that interventions are appropriate for their local contexts.

Key Takeaway 2: Adaptation projects are good development. Rather than being considered stand-alone projects, adaptation investments should be thought of as adding resilience to good development projects. (In private sector terminology, adaptation investments are not "a separate asset class" but are action that all other asset classes more resilient.) Adaptation is an objective that complements other development and financial objectives. Over half of all project benefits that were monetized are development-oriented and do not depend on whether the anticipated disaster occurs or not. Induced development benefits include such things as new job creation, increased productivity, higher incomes, additional investment, and increased economic and financial efficiency. Many adaptation projects are also cross-cutting. For instance, resilient cities projects also reduce health damages, and flood management projects also help increase agricultural yields.

- **Recommendation: Shift the adaptation investment narrative towards projects with full triple dividends rather than stand-alone adaptation projects.** Using the triple dividends methodology supports understanding multiple and diverse benefits. Collaboration across sectors (e.g., agriculture and water, health and infrastructure) helps identify synergies and maximize adaptation benefits. The MDBs have a large role to play in setting higher standards for adaptation project design and appraisal, supporting research on better valuing unmeasured benefits of adaptation investments, and increasing the transparency and accessibility of adaptation finance data.

Key Takeaway 3: Quantifying induced development benefits is key to mobilizing private sector support for adaptation investments. High second dividend benefits not only help position adaptation as a key part of a public growth and investment narrative, they also support private sector actors in guiding their investment choices. This is because the second dividend represents induced economic growth and higher incomes, which, in turn, form the basis for potentially attracting private investment either as direct investors or through capital markets.

- **Recommendation: Mobilize private finance by emphasizing the high and tangible economic benefits of adaptation investments.** This will require separating out benefits in line with the triple dividend of resilience to more effectively match investments to investor profiles. In this way, the TDR approach can support the development of innovative financial instruments (e.g., blended finance, risk-sharing mechanisms) to de-risk adaptation projects and attract private capital.

Key Takeaway 4: Half of adaptation investments have climate mitigation co-benefits, which shows that adaptation projects are well-aligned with climate mitigation goals. Rather than sitting in separate buckets, the two are intrinsically connected. However, the AdapTDR database shows that GHG emissions reductions are rarely quantified in adaptation projects. Emphasizing synergies will strengthen the investment case for adaptation and point to further financial opportunities, for example through the carbon markets.

- **Recommendation: Promote the strong synergies between adaptation and mitigation.** DFIs, international funds and governments should emphasize the climate mitigation co-benefits of adaptation investments based on the evidence produced ex-ante, within project, and ex-post triple dividend assessments.

Key Takeaway 5: There is a lack of complete and publicly available data on the projected and realized benefits of adaptation and resilience investments, which hinders the further allocation of resources to high-return adaptation projects. Persistent data gaps complicate weighing the distributional implications of policies and investments and understanding their impacts. A lack of common standards and methodologies is further problematic for a financial ecosystem that depends on data sharing, transparency, and interoperability between stakeholders.

- **Recommendation: Strengthen systems for collecting, monitoring, and evaluating data on adaptation projects, both ex-ante and ex-post, and improve the quality and comparability of economic appraisals.** Initiatives like the AdapTDR database can be used to improve our understanding of adaptation investment trends, priorities, and impact. (The last section of this report identifies several topics for future research building on the AdapTDR database.) DFIs, international funds, governments, and others should also be encouraged to strengthen the evidence base for adaptation investments, address data gaps for under-represented benefits, expand documentation on exemplary projects, and build capacity for integrating CBA into budgeting processes. Well-established approaches exist to help guide this process, such as the UK's Green Book and its supplementary guidance for accounting for the effects of climate change.

6. APPENDIX

6.1 The AdapTDR Database

Database structure

1	**Sector**	12	**Analytical Assumptions**	Time Horizon (years)
2	**Sub-sector**			Discount Rate (%)
3	**Country**			Social Cost of Carbon
4	**Project Title**	13	**Triple Dividends Breakdown**	Number of Quantified Dividends
5	**Year**			Dividend Type
6	**Funder**			Benefits
7	**Report Number**			Monetary Value (USD million)
8	**Project Cost (US$ mil)**	14	**Economic Analysis**	Net Present Value (USD million)
9	**Summary of Objectives**			Benefit-Cost Ratio (BCR)
10	**Project Components**			Economic Internal Rate of Return (IRR, %)
11	**Project Indicators: Input/Output/Outcome**	15	**Climate co-benefits**	GHG Mitigation
		16	**Document Link(s)**	

Sectors and Subsectors

1. Agriculture
- Sustainable Agriculture
- Forestry/Landscapes/Nature

2. Health services

3. Infrastructure
- Disaster Risk Management (DRM), climate services, early warning systems
- Energy (power, renewable energy, grid resilience)
- Resilient cities (heat, sponge cities, urban planning, green infrastructure, flooding)
- Transport (public, connectivity, bridges, waterways, ports)

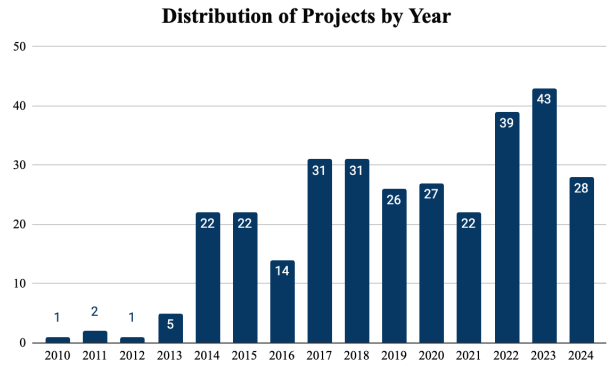
4. Water
- Water supply and sanitation
- Water resources and flood management

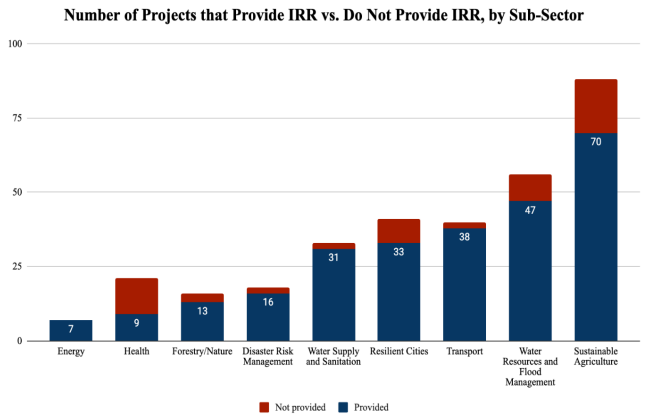
Table 2: Internet search terms utilized to identify projects

Cross-cutting	Agriculture	Water	Infrastructure	Health
Adaptation	Afforestation	Desalination	Building code	Cooling centers
Coastal flooding	Climate-smart agriculture	Irrigation	Blue-green infrastructure	Disease
Drought	Early warning	Rainwater	Climate-resilient infrastructure	Early warning systems
Extreme heat	Ecosystem-based adaptation	Sanitation	Coastal defense	Hazard alerts
Exreme weather	Ecosystem services	Stormwater	Connectivity	Health
Disaster	Food storage	Water	Cooling	Health action plan
Disaster risk	Food waste	Water conservation	Early warning systems	Health care
Flood control	Irrigation	Water distribution	Energy	Hospital
Flood risk	Natural regeneration	Water harvesting	Flood management	Labor protection
Heat	Rural inclusive growth	Water quality	Green infrastructure	Nutrition
Heatwave	Reforestation	Water contamination	Green space	Public health
Resilience	Soil conservation	Water regulation	Greening	
Riverine flooding	Sustainable agriculture	Water resources	Early warning systems	
Urban flooding	Yield	Water scarcity	Reservoir	
Urban heat		Water supply	Sea walls	
		Water use efficiency	Settlements	
		Watershed	Sewage	
			Shelter	
			Smart infrastructure	
			Sponge cities	
			Stormwater	
			Transport	
			Wind break	

Table 3: Profile of Projects in the AdapTDR Database

Sub-sector	Number of Projects	Share of Total Projects	Total Cost of Projects (in USD billion)
Sustainable Agriculture	89	28%	24.2
Water Resources and Flood Management	56	18%	21.9
Resilient cities, urban planning, green infrastructure, urban flooding	41	13%	8.1
Transport, roads, bridges, waterways, ports	39	12%	29.9
Water supply and sanitation	33	10%	8.6
Health services	21	7%	27.7
Disaster risk management, climate services, early warning systems	18	6%	6.3
Forestry/Landscapes/Nature	16	5%	4.6
Energy, renewable energy, grid resilience	7	2%	3.0





Sample of a Few Database Columns Related To Benefits, Monetary Valuation, and IRRs

Project Title	Number of Quantified Dividend	Dividend	Benefit	Monetary Value (USD mil)	Economic Internal Rate of Return
Weather and Climate Services Regional Project	2	Avoided Losses	Improved capacity for weather forecasting through improvements in	USD 59.00	75.07%
		Avoided Losses	Benefits of EWS in Reducing Loss of Life	USD 34.00	
		Induced Economic Benefits	Improved service delivery to targeted agriculture sector beneficiaries	USD 10.50	
Sao Paulo Sustainable Transport Project	3	Avoided Losses	Rebuild/repair costs	USD 403.55	48.00%
		Induced Economic Benefits	Reduced travel time/ increased road performance	USD 9.55	
		Social and Environmental Benefits	GHG emissions reductions	USD 11.64	
West Africa Coastal Areas Resilience Investment Project 2	2	Avoided Losses	Densu delta=avoided damages	USD 42.10	8.00%
		Avoided Losses	Keta lagoon=avoided damages	USD 132.10	
		Avoided Losses	Korle lagoon=avoided damages	USD 14.85	
		Avoided Losses	Avoided damages = Mangroves	USD 42.80	
		Social and Environmental Benefits	Benefit is based on component 2 - includes institutional strengthening	USD 8.60	
		Social and Environmental Benefits	The project will generate net emissions reductions of 2.56 million tCO2e	USD 153.60	

Details on the distribution of dividends in projects that quantify all three types.

Sub-Sector	Comments	Dividend 1	Dividend 2	Dividend 3
Sustainable agriculture (3)	Development benefits dominate	5.1%	63.5%	31.7%
Forestry/ landscapes (4)	Social and environmental benefits dominate	37.1%	19.3%	43.7%
Health (2)	Development benefits dominate	33.6%	42.1%	24.3%
Resilient Cities (11)	Development benefits and avoided losses are comparable	37.4%	38.0%	24.6%
Transport (1)	Avoided losses dominate	95.0%	2.2%	2.7%
Water Resources and Flood Mgt (2)	Avoided losses and social/environmental benefits are comparable	43.3%	13.1%	43.6%
Water Supply and Sanitation (4)	Avoided losses and social/environmental benefits are comparable	35.9%	27.6%	36.5%
Total Average (27)	The dividend values are evenly distributed, about one-third each	35.8%	33.7%	30.5%

Note: green shading illustrates the higher percentage dividends for each sub-sector.

6.2 Glossary of Financial Terminology

Discount rate: Considering the time value of money, the discount rate is the rate of return used to discount future cash flows back to their present value. Climate adaptation projects typically apply a 'social' discount rate which is lower than a private discount rate. This is because social discount rates evaluate the benefits of investments with considerably longer payback periods from a wider societal perspective. Social discount rates can sit between 3 percent to 10 percent whereas private discount rates are usually 10 percent or higher. (The UK Green Book (supplementary guidance) applies a standard discount rate of 3.5 percent per annum to future benefits and costs.) This study, such as in the valuation of future benefit streams, uses a discount rate of 5 percent unless a rate is stated in the PAD.

Present value (PV): The discounted value of a benefit or cost. For example, if a 30-year project generates an annual benefit of $10 million per year starting the 6th year of implementation, the present value of those benefits is less than $250 million. Assuming a discount rate of 5 percent, the present value of that benefit stream at the start of the project is only $116 million.

Net present value (NPV): the economic value of the total investment valued at the start of the project. The NPV is the difference between the projected discounted cost and benefit streams. If the present value of the benefits exceeds that of costs, it is a measure of additional value generated by the project beyond its costs. Projects with negative NPV are not usually implemented.

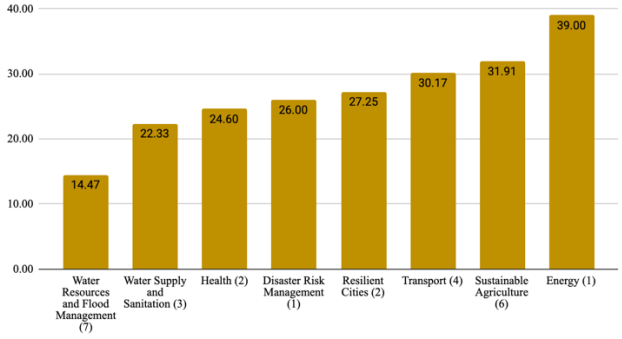
Benefit cost ratio (BCR): Ratio of discounted benefits of an investment relative to its discounted costs. A benefit cost ratio (BCR) greater than 1 represents an economically beneficial investment with a positive NPV, whereas a BCR smaller than 1 represents a negative NPV and an investment which may not be considered economically sensible (although there may be reasons for investment beyond those of a purely economic nature). In practice, an investment case may require a BCR of above 1.5 due to prevailing uncertainties over costs and benefits over longer periods of time (e.g., 20-30 years in adaptation projects).

Internal rate of return (IRR): an estimate of the future annual rate of return of a project taking into account all projected costs and benefits. It is defined as the interest rate at which the total present value of costs (negative cash flows) equals the total present value of the benefits (positive cash flows). IRRs can be calculated using strictly financial costs and benefits or can be broadened to include non-monetary benefits representing social goods, such as poverty reduction, increased exports, or greenhouse gas reduction. The IRRs referenced in AdapTDR include economic benefits to the extent available.

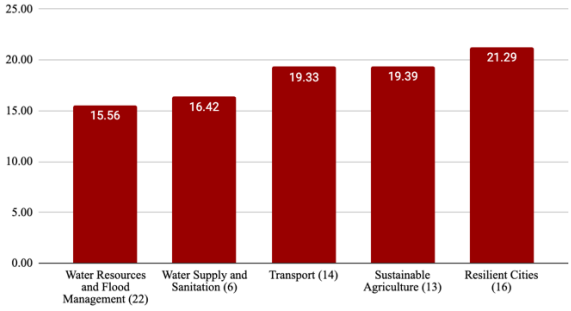
Return on investment (RoI): the percentage increase or decrease in an investment over a set period, typically start to finish. RoI indicates total growth, start to finish, of an investment, while IRR identifies the annual growth rate. Given differences of time horizons in the AdapTDR PADs, IRRs are used to compare across projects since the annualized time frame is standardized.

6.3 Average IRRs across Select Countries, by Sub-Sector

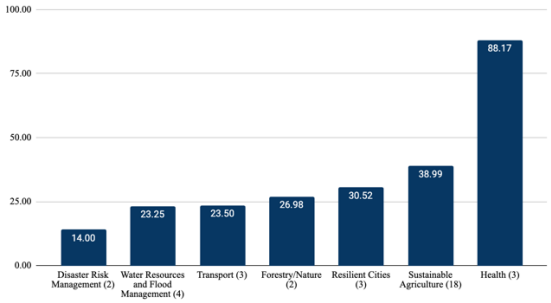
Average IRR across Sub-Sectors in Brazil



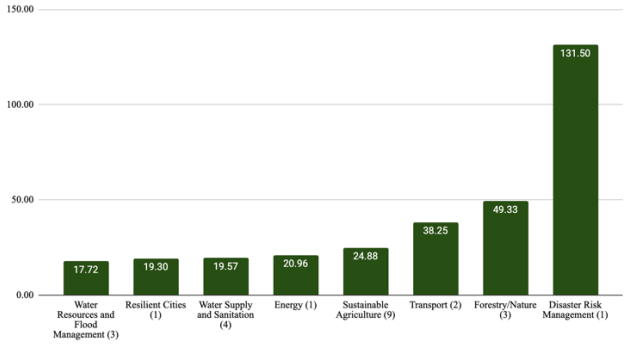
Average IRR across Sub-Sectors in China



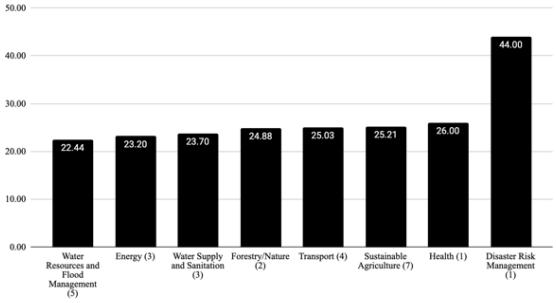
Average IRR across Sub-Sectors in India



Average IRR across Sub-Sectors in Ethiopia

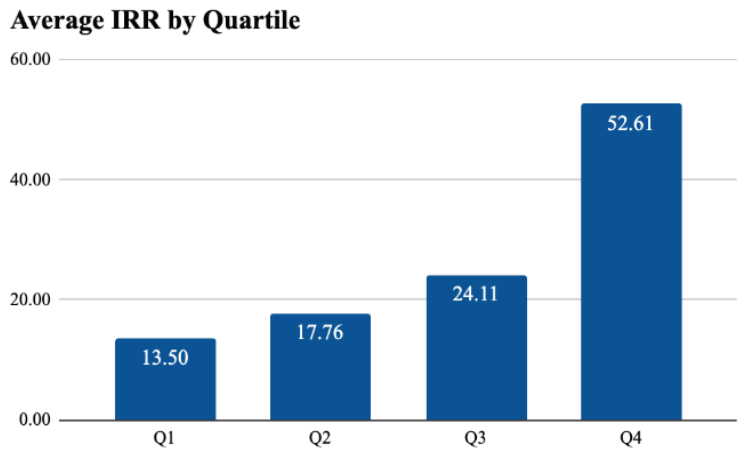


Average IRR across Sub-Sectors in Kenya



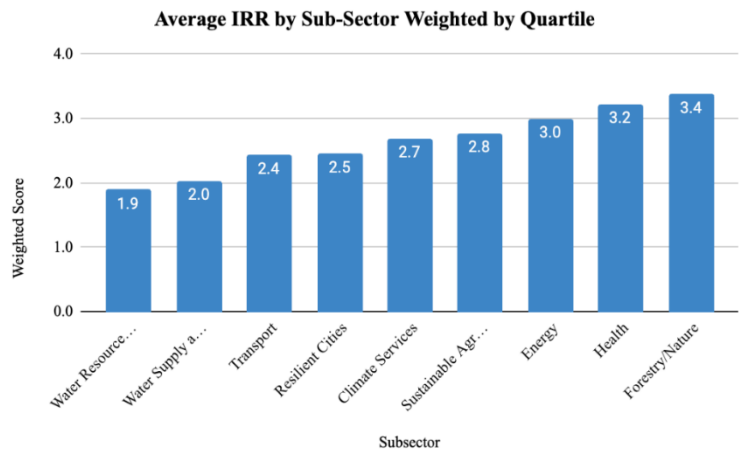
6.4 Quartile Analysis of the Sub-Sector Returns on Investment

Averaging across 83 percent of the projects in AdapTDR (264 projects), IRRs for each quartile rise from 13.5 percent in quartile 1 to 52.6 percent in quartile 4.



The question arises: how are the sub-sectors distributed across these quartiles? Is one sub-sector predominately in a lower quartile and another predominately in a higher one? Or are high and low-return projects within each sub-sector evenly distributed across all four quartiles?

Weighted averages show where each sub-sector is positioned along this spectrum. For example, a sub-sector whose projects are all in the lower quartiles would have a score between 1 and 2. A sub-sector whose projects were primarily in the higher quartiles would have a score of 3 to 4. This analysis reveals this ranking of sectors by quartile.



This is consistent with the findings presented in the main text (Section 2C2). Water and some infrastructure sub-sectors are positioned more in the lower quartiles while health, forestry, and sustainable agriculture are positioned more in the higher quartiles. (Energy also scores high but has a small sample size.)

6.5 Exemplary Climate Adaptation Projects

Given the data collection effort that has gone into AdapTDR, it is only sensible to highlight what appear to be "exemplary" projects. The criteria for selecting these projects were:

- Has high projected returns;
- Has quantified at least two of the triple dividends, ideally including the projected avoided losses;
- Has a clear climate adaptation narrative.

The following adaptation investments emerge as "exemplary" by applying this criterion. Short write-ups follow the table below.

Sub-sector	Africa	Asia	Latin America
1. Sustainable agriculture	1a. Ethiopia: Resilient Landscapes and Livelihoods Project	1b. India: Odisha Integrated Irrigation Project for Climate Resilient Agriculture 1c. China: Hubei Yichang Rural Green Development Project	
2. Forestry/ landscapes	2a. Ethiopia: Climate Action Through Landscape Management Program for Results	2b. India: Meghalaya Community-led Landscapes Management Project	
3. Health	3a. Kenya: Social and Economic Inclusion Project	3b. India: Andhra Pradesh Health Systems Strengthening Project	
4. Disaster risk management		4a. Bangladesh: Weather and Climate Services Regional Project	
5. Energy	5a. Ethiopia Access to Distributed Electricity and Lighting		
6. Resilient Cities		6a. Tamil Nadu Climate Resilient Urban Development Program 6b. Jilin Yanji Low-Carbon Climate-Resilient Healthy City Project (Sponge city component)	6c. Fortaleza Sustainable Urban Development Project
7. Transport			7a. Improving mobility and urban inclusion in the Amazonas corridor in Belo Horizonte

8. Water Supply and Sanitation	8a. Greater Accra Metropolitan Area Sanitation and Water Project 8b. Kenya: Water, Sanitation, and Hygiene Program		
9. Water Resources and Flood Management	9a. South Africa - Transformative Riverine Management Program (TRMP) in the eThekwini Municipal Area (Durban)	9b. China Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project 9c. Vietnam Vinh Phuc Flood Risk and Water Management Project	9d. Brazil: Espírito Santo Water Security Management Project

1. Sustainable agriculture

1a. Ethiopia: Resilient Landscapes and Livelihoods Project

At a total cost of $129 million, the World Bank-funded Ethiopia's Resilient Landscapes and Livelihoods Project aims to improve climate resilience, land productivity, and carbon storage, and increase access to diversified livelihood activities in selected rural watersheds. It invests in green infrastructure and resilient livelihoods, institutions and information for resilience, and rural land administration and use. The project has a net present value of $1.70 billion, a benefit-cost ratio of 5.3, and high rate of return at 60 percent. The project is estimated to generate a wide range of benefits, ranging from net benefits to crop producers through incremental improvements in gross margins for different crops and cropping patterns in the targeted watersheds; direct net benefits to livestock producers through incremental improvements in gross margins for different livestock production systems; direct net benefits to forests and other non-cropland through net improvement in gross margins for different categories of land use including forest plantations, green corridor plantations, bush, shrub, and grassland; and direct benefits from the creation of new storage facilities and by promoting energy efficiency. The project also has a positive effect on carbon balance by reducing 19.7 million tons of CO2-eq over 25 years.

1b. India: Odisha Integrated Irrigation Project for Climate Resilient Agriculture

With benefits expected to be spread over 26 years, this $ 235.54 million project seeks to intensify and diversify agricultural production, and enhance climate resilience in selected districts of the Indian state of Odisha. The project provides biophysical quantification of induced economic as well as social and environmental benefits in terms of the number of beneficiaries. Benefits range from agriculture (increased intensification, diversification, and climate resilience of crop production), climate (adoption of improved water and farm management and climate-smart agricultural practices), aquaculture (intensification of fish production), to increased access to markets, capacity building of marginalized groups including women, and mitigation benefits through GHG emissions reduction. The project provides 3 scenarios in its estimation of economic and financial returns of the project, (i) without including climate co-benefits, (ii) including climate benefits at low social cost of carbon, and (iii) including climate benefits at high social cost of carbon. The Economic Net Present Value (ENPV) of the project ranges between US$ 132 million to US$ 241 million; the Economic Rate of Return (ERR) between 10.8 percent to 14.2 percent and the Benefit-

Cost Ratio (BCR) between 1.8 to 2.45. Overall, the project has 72 percent adaptation co-benefits, reaching a significant proportion of beneficiaries.

1c. China: Hubei Yichang Rural Green Development Project

The project aims to modernize the agriculture sector in Yichang City of Hubei Province, China, including strengthening institutions, knowledge, and research, enhancing value addition and efficiency in agribusiness and food supply chains, reducing climate and environmental impacts of agricultural activities, and improving the resilience of rural infrastructure. This project specifically focuses on the well-being of small-scale farmers and rural populations through approaches such as enhancing institutional capacity in modern agricultural practices, improving smart green agricultural practices, installing agricultural waste and water treatment systems, etc. In terms of return on investment, the project has an IRR of 17.8 percent, with a positive NPV of $288.19 million, indicating a significant economic benefit. The project is expected to yield triple dividends, with substantial induced economic benefits, including reduced water loss due to efficient irrigation systems amounting to $164.50 million in savings, and increased agricultural productivity valued at $3,291.11 million. The project could also help avoid losses due to increased climate risks by reducing flood losses of $0.24 million and generate social and environmental benefits by improving rural sanitation and waste management systems and reducing greenhouse gas emissions.

2. Forestry/ landscapes

2a. Ethiopia: Climate Action Through Landscape Management Program for Results

The World Bank-funded Ethiopia Climate Action Through Landscape Management Program for Results is a $2.52 billion (majority government funded with a $500 million grant from IDA) project that aims to increase the adoption of sustainable land management (SLM) practices and to expand access to secure land tenure in non-rangeland rural areas. SLM practices are climate-smart, not only increasing agricultural productivity but also building resilience to climate change and reducing GHG emissions. The program invests in the adoption of sustainable land management practices, access to secure land titles, participatory watershed management, and rural land administration. It has a net present value of $12.3 billion, a benefit-cost ratio of 2.7 and an economic rate of return of 35 percent. It generates important economic and social-environmental benefits including improving livestock production, cropland benefits, avoiding soil erosion, reducing greenhouse gas emissions, and non-cropland benefits.

2b. India: Meghalaya Community-led Landscapes Management Project

A US$ 60 million project, its objective is to strengthen community-led landscapes management in selected landscapes in the Indian state of Meghalaya. With adaptation co-benefits of 30 percent and mitigation co-benefits of 70 percent, this World Bank supported project seeks to increase crop productivity, cropping intensity and horticulture by 10 percent in addition to reducing Greenhouse Gas (GHG) emissions through carbon dioxide (CO2) sequestration of 3,508,376 tons over a period of 20 years, as well as increased crown density through conversion of open forests in Meghalaya and conversion of cultivable wasteland into agroforestry in addition to conservation of ecology and watershed management practices. The project estimates an Economic Net Present Value (ENPV) of US$ 46.12 million and an IRR of 38.1 percent) at a discount rate of 6 percent with benefits extending between 10 to 50 years, yielding an approximate Benefit-Cost Ratio (BCR) of 5.14.

3. Health

3a. Kenya: Social and Economic Inclusion Project

This health project aims to strengthen delivery systems for enhanced access to social and economic inclusion services and shock-responsive safety nets for poor and vulnerable households in Kenya. With a project cost of $1.34 billion, the project will strengthen social protection delivery systems, increase access to social and economic inclusion interventions, and improve the shock responsiveness of the safety net system. The project is expected to yield triple dividend benefits including enhancing the scope and coverage of the single registry, expanding the nutrition-sensitive safety net since food insecurity has been linked to droughts, improve the shock responsiveness of the safety net system that will enhance beneficiaries' resilience to the droughts induced by climate change, lower the incidence of disease and better learning outcomes in school for children, and generate positive impacts on health-seeking behaviour, micronutrient supplementation, and access to healthy foods, among several other benefits. The project has a benefit-cost ratio of 2.83, and an economic rate of return of 26 percent. At the intersection of health and climate adaptation, this project exemplifies how health challenges induced by climate change can be addressed.

3b. India: Andhra Pradesh Health Systems Strengthening Project

This project seeks to improve the quality and responsiveness of public health services and increased access to an expanded package of primary health services to the population, keeping in mind the need to strengthen facilities to expand on their capacity to respond to increasing disease incidence due to enhanced climate vulnerabilities. While not designed specifically as an adaptation project, this $3441 million project with a $328 million loan from the World Bank lists several climate co-benefits including adaptation and mitigation benefits. The project offers triple dividends of avoided losses, induced economic benefits as well as social and environmental benefits through increased capacity and quality of healthcare and use of renewable energy to back-up facilities. All the dividends are also valued in monetary terms, and benefit-cost analysis suggests that the 289,000 DALYs (Disability Adjusted Life Years) can be saved annually to 'break even', which is surpassed through the project's estimated outreach of over 70 million outpatient contacts per year through the planned 6,190 e-SCs (e-Sub-Centres at the grassroot level).

4. Disaster risk management

4a. Bangladesh: Weather and Climate Services Regional Project

Bangladesh's Weather and Climate Services Regional Project is a World Bank-funded $129 million project that aims to strengthen the highly vulnerable South Asian country's capacity to deliver reliable weather, water and climate information services and improve access to such services by priority sectors and communities. The project invests in strengthening meteorological information services, strengthening hydrological information services and early warning systems, and developing agrometeorological information systems. The project benefits include $93 million in avoided losses through improved capacity for weather forecasting through improvements in Public Weather Services (PWS) and EWS that reduce the loss of life, and economic benefits of $10 million through the improved service delivery to targeted agriculture sector beneficiaries. The project net present value is $414.30 million, the benefit-cost ratio is 2.67, and the economic rate of return is 75.1 percent.

5. Energy

5a. Ethiopia Access to Distributed Electricity and Lighting

This $500 million project seeks to increase access to reliable electricity for households, social institutions, and enterprises in Ethiopia. Funded by the World Bank, the Access to Distributed Electricity and Lighting project will strengthen the electricity network for improved reliability of supply in urban areas, invest in solar-hybrid mini grids for rural economic development and solar home systems for households, small-holder farmer and small businesses, create standalone solar systems for health and education facilities, and build capacity and provide technical assistance and implementation support. The project is expected to improve access to energy and reduce carbon emissions up to 3.75 million tonnes CO2e. With an economic rate of return of 21.0, the project is a strong example of a climate investment.

6. Resilient Cities

6a. India: Tamil Nadu Climate Resilient Urban Development Program

The $ 300 million IBRD (total project value at $ 840 million) funded project aims to strengthen urban management, specifically increasing access to and coverage of urban water and sanitation facilities in urban local bodies across Tamil Nadu, India. It delivers all three benefits firstly through avoided losses due to health issues from diarrhoea, and improved health conditions. Secondly, it also leads to greater cash revenue for ULBs due to better metering, tax restructuring, billing, and more water and sewage connections. It has also integrated climate resilience into urban planning and water-sewage management and expected to enhance public finance management systems within the ULBs.Thirdly, it improves water supply and sanitation facilities for urban populations and reduces the cost of water collection for them. The project also estimates an emission reduction of 6,786,713 tCO2-eq during its economic lifetime. Two of its results areas have BCRs of 9.45 and 7.47 and NPVs of 166 Million (of a total cost 207.6 Million) and 8.8 Million (of a total cost 13.95 Million) respectively. The IRR is estimated to be 21.6 percent which are also relatively high.

6b. China: Jilin Yanji Low-Carbon Climate-Resilient Healthy City Project (Sponge City Component)

The sponge city construction in Yanjin City of Jilin Province is aimed to address the urgent challenges of climate change and urban flooding in this city, through developing green infrastructure that effectively manages stormwater, reduces flood risks, and improves urban environment. The project is expected to deliver significant returns on investment, with avoided losses totaling $118.53 million from reduced flood damage. These savings include fewer days of road and transport network flooding, as well as less damage to agricultural crops and residential properties. Economic benefits are further driven by a $6.91 million saving in wastewater treatment costs, due to the separation of 30 percent of stormwater from the wastewater system, which reduces the load on the city's treatment plant. The project also enhances the value of green spaces, generating an induced economic benefit of $7.65 million, which reflects the increased desirability of green spaces and their associated improvement in quality of life. Environmental and social benefits are also central to the project with carbon sequestration from tree planting, contributing $0.29 million in value. The project's NPV is $71.07 million, and its BCR stands at 3.32, meaning that for every dollar invested, $3.32 worth of benefits can be generated. The IRR is a strong 15.5 percent, highlighting the project's economic viability and effectiveness.

6c. Brazil: Fortaleza Sustainable Urban Development Project

The project, funded by a US$ 73.3 million IBRD loan, aims to strengthen Fortaleza's capacity for land-use planning, urban financing instruments, and improve the urban environment through interventions in the Maritime Slope Basin and Rachel de Queiroz Park. Benefiting 319,774 people directly (53 percent women) and indirectly 2.6 million residents across 14 neighborhoods, it demonstrates strong economic viability. With an IRR of 12 percent (above the 6 percent discount rate), an NPV of $85.7 million, and a BCR of 2,

indicates that the project is highly efficient. It also delivers three key dividends: avoiding $70.73 million in infrastructure losses, saving $83.43 million in rebuilding costs, and enhancing biodiversity habitats valued at $18.91 million. With a Sensitivity Analysis, the project feasibility is robust even under conservative scenarios, indicating that returns remain positive under conditions of lower performance in certain subcomponents.

7. Transport

7a. Brazil: Improving mobility and urban inclusion in the amazonas corridor in Belo Horizonte

The $80 million IBRD-funded project aims to enhance public transport on the Amazonas Express corridor and improve living conditions in poor settlements in Belo Horizonte, Brazil. It benefits 815,000 Amazonas Express users, 513,000 residents in the corridor's influence area, and 20,000 low-income Cabana slum residents, with indirect benefits for 5.9 million Metropolitan Region of Belo Horizonte inhabitants through reduced congestion, pollution, and accidents. Economically viable, the project has an NPV of $124.4 million and an IRR of 31.7 percent, reflecting strong returns. Key outcomes include $192.75 million in avoided losses, $17.1 million in economic gains, and $1.5 million in environmental and health benefits.

8. Water Supply and Sanitation

8a. Ghana: Greater Accra Metropolitan Area Sanitation and Water Project

The objective of the project is to increase access to improved sanitation and improved water supply in the GAMA, with emphasis on low-income communities, and to strengthen the management of environmental sanitation in the GAMA. To achieve these objectives, the project would support: (i) The provision of community water points, household water connections, and toilet facilities to people in low-income areas, which would require expansion and improvements of the water distribution network as well as of the waste collection, treatment and disposal services; and, (ii) The provision of technical assistance to improve the planning, implementation and management of environmental sanitation services in an integrated manner. Behavior change campaigns on hygiene, sanitation, and safe water will also be promoted through social mobilization activities, as well as social accountability and regulation to ensure the sustainability of facilities and services. At a cost of $150 million and a 20-year time horizon, the project has an NPV of $ 26.12 million and an IRR of 14 percent, reflecting strong returns. Key outcomes include $ 4.33 million in avoided losses, $17.48 million in economic gains, and $2.26 million in environmental and health benefits.

8b. Kenya: Water, Sanitation, and Hygiene Program

The Kenya Water, Sanitation, and Hygiene Program aims to increase sustainable access to improved water and sanitation services, eliminate open defecation, and improve the financial performance of water service providers in selected counties, including refugee-hosting counties of the country. With a total project cost of $458 million, the project invests in storage infrastructure and bulk water transmission systems, urban water supply and sanitation services, rural water supply and sanitation services, support for sector efficiency improvement, and policy reforms program. and program coordination, capacity building, and monitoring and evaluation to achieve this goal. It is expected to generate GHG benefits of 540,768 tCO2e annually or 16.2 million tCO2e over the 30-year analysis period, improve service delivery, reduce health expenditure or savings in healthcare costs due to improved health outcomes, and improve overall health outcomes. With a net present value of $2.57 billion and an economic rate of return of 11 percent, the project exemplifies an investment in the water sector that yields health and climate adaptation benefits.

9. Water Resources and Flood Management

9a. South Africa: Transformative Riverine Management in the eThekwini Municipal Area (Durban)

The project broadly recognizes that rivers are complex social-ecological systems, so to deal with issues of flooding and other challenges related to water, the project seeks to effect a system overall, including challenging entrenched power, policy and technical norms. With a time horizon of 20 years, the project outcomes include annual avoided losses of over US$22 million, 5098 jobs created and 765 cooperatives created. Further, the project provides detailed economic analysis of varying land tenure arrangements, unbundling complex interconnections within riverine management processes.

9b. Water Resources and Flood Management, China: Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project

The project is designed to assist the Xinyu City Government of Jiangxi Province in effectively managing and mitigating flood and environmental risks. By adopting a comprehensive and integrated approach, combining structural and nonstructural interventions, this project is divided into three main components: construction of integrated rural and urban flood management infrastructure, improvement of solid waste and wastewater management systems, and enhancement of flood and environmental risk management capacity. The project is expected to yield significant benefits, with the most notable avoidance of losses estimated at $138.5 million due to reduced flood damage. The project is also projected to generate induced economic benefits through improved flood management, and considerable social and environmental benefits with improved water quality contributing an estimated $10.60 million and the development of urban greenspace adding $20.46 million in value. Overall, the project has an IRR of 14 percent, indicating strong economic viability. The BCR is 1.15, suggesting that for every dollar invested, there is a return of $1.15.

9c. Vietnam: Vinh Phuc Flood Risk and Water Management Project

This project aims to directly benefit people living in flood-prone areas in Vinh Phuc province by strengthening the flood risk management capacity and improving wastewater management. Flood risk management activities represent 82 percent of the total project cost and include the construction and rehabilitation of retention lakes to increase regulation capacity, the construction of drainage pumping stations to divert stormwater, and dredging of key sections. Project activities also include the construction and rehabilitation of wastewater collection and treatment facilities to improve water quality and support for water resources, flood information, and early warning systems. These activities are expected to save $338.8 million in damage from future flooding, reduce healthcare-related costs, and safeguard incomes that might be jeopardized by floods. Based on these benefits, the project's overall economic return is estimated to be 16.4 percent.

9d. Brazil: Espírito Santo Water Security Management Project

The Espírito Santo Water Security Management Project, funded by IBRD with US$ 86.1 million (totaling US$ 113.6 million with counterpart funding), aims to strengthen the state's capacity to manage water risks amid climate change and reduce vulnerabilities in key areas. The project focuses on flood risk reduction in Águia Branca, João Neiva, and Ibiraçu, and improves drought management in northern basins, indirectly benefiting 4.1 million residents through enhanced water security and disaster preparedness. Key actions include expanding the Reflorestar Program, investing in green and gray infrastructure, and boosting institutional capacity for water and disaster risk management. Economically viable, the project reports a BCR of 1.4, and an IRR of 14.9 percent, supporting long-term climate resilience and socioeconomic stability.

REFERENCES

Adaptation Fund. 2024. Projects and Programmes. https://www.adaptation-fund.org/projects-programmes/.

African Development Bank. 2024. Projects and Operations. https://www.afdb.org/en/documents/projects-operations.

Asian Development Bank. 2024. Projects and Tenders. https://www.adb.org/projects.

CPI, "Global Landscape of Climate Finance 2024." n.d. Climate Policy Initiative. Accessed February 26, 2025. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2024/.

Global Environment Facility. 2024. Projects. https://www.thegef.org/projects-operations/database.

Green Climate Fund. 2024. "Approved Projects." https://www.greenclimate.fund/projects.

Heubaum, Harald, Carter Brandon, Thomas Tanner, Swenja Surminski, and Viktor Roezer. 2022. "The Triple Dividend of Building Climate Resilience: Taking Stock, Moving Forward," World Resources Institute. https://www.wri.org/research/triple-dividend-building-climate-resilience-taking-stock-moving-forward.

Howarth, C. and E. J. Robinson (2024), "Effective climate action must integrate climate adaptation and mitigation", *Nature Climate Change* 14, 300-301.

Inter-American Development Bank. 2024. Projects. https://www.iadb.org/en/project-search.

Moody's. "Research & Ratings: Sovereign & Supranational." Accessed February 26, 2025. https://www.moodys.com/Pages/rr005_0.aspx?bd=005005&ed=4294966623&rd=&tb=0&po=0&lang=en&cy=global&kw=.

UNEP. 2024. *Come Hell and High Water: As fires and floods hit the poor hardest, it is time for the world to step up adaptation actions.* Nairobi: UN Environment Programme. https://www.unep.org/adaptation-gap-report-2024.

UNFCCC. 2022. *Information Paper on linkages between Adaptation and Mitigation: Information Paper by the Adaptation Committee.* Bonn, Germany: UNFCCC. https://unfccc.int/sites/default/files/resource/linkages_mitigation_adaptation_infpaper.pdf.

World Bank, "Joint Methodology for Tracking Climate Change Adaptation Finance." 2022. https://thedocs.worldbank.org/en/doc/20cd787e947dbf44598741469538a4ab-0020012022/original/20220242-mdbs-joint-methodology-climate-change-adaptation-finance-en.pdf.

World Bank. "World Bank Country and Lending Groups – World Bank Data Help Desk." https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

World Resources Institute. 2019. *Three Revolutions to Accelerate Adaptation | Adapt Now Report*. Washington, D.C.: World Resources Institute. https://www.wri.org/initiatives/global-commission-adaptation/adapt-now-report.