Measuring Economic Vulnerability and Resilience to Climate Change

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About CoMPRA

The COVID-19 Macroeconomic Policy Response in Africa (CoMPRA) project was developed following a call for rapid response policy research into the COVID-19 pandemic by the IDRC. The project's overall goal is to inform macroeconomic policy development in response to the COVID-19 pandemic by low and middle-income countries (LMICs) and development partners that results in more inclusive, climate resilient, effective and gender-responsive measures through evidence-based research. This will help to mitigate COVID-19's social and economic impact, promote recovery from the pandemic in the short term and position LMICs in the longer term for a more climate-resilient, sustainable and stable future. The CoMPRA project will focus broadly on African countries and specifically on six countries (Benin, Senegal, Tanzania, Uganda, Nigeria and South Africa). SAIIA and CSEA, as the lead implementing partners for this project, also work with think tank partners in these countries.

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Abstract

Current climate finance levels are not only inadequate but also badly targeted to reach countries with the most urgent needs. To rectify these trends, it is important to establish the extent of climate change vulnerability and resilience of each country as a new basis for climate finance allocation. Two indices – the Climate Change and Economic Vulnerability Index and the Climate Change and Economic Resilience Index, developed by the South African Institute of International Affairs – serve this function. These indices have been developed by using relevant economic, social and climatological data to track the vulnerability and resilience of economies around the world. They show that low-income economies, many of them African, face the highest vulnerabilities and lowest resilience to climate change effects and therefore need more financing. A mapping of the 2021 OECD financing disbursements for climate change adaptation against the two indices demonstrates their practical application in climate finance decision-making and allocations. The results show that there has indeed been some misalignment between the OECD's allocation of adaptation financing and the vulnerability and resilience of different economies.

Introduction

The meeting of the 28th Conference of the Parties to the UN Framework Convention on Climate Change (COP28) in Dubai from 30 November to 13 December 2023 saw intense debate on the pressing issue of climate financing. There was a clear divide between the priorities of the Global North and the Global South. This was most apparent in terms of matters related to honouring previous financial commitments and increasing the existing climate finance envelope to address the scale of the challenge facing developing countries. While some breakthroughs were made, notably in terms of commitments to the loss and damage fund (which received pledges to the tune of $700 million),[1] more work remains to be done.

[1] UN Climate Change, "COP28 Agreement Signals 'Beginning of the End' of the Fossil Fuel Era", Press Release, December 13, 2023.

High on the agenda of developing countries has been the need to double adaptation finance by 2025 following the COP26 resolution on the same in 2021. The initial amount of $19.4 billion that was committed in 2019 was supposed to be raised to $38.4 billion by 2025. However, new analysis presented in the adaptation gap report by the UN Environment Programme shows that developing countries would need $215 billion per year by 2030 to address existing adaptation finance needs[2] and that the adaptation financing gap is now estimated at $194–$366 billion per year.

At COP28, only $188 million was pledged to the Adaptation Fund, against the billions of dollars needed to help developing countries adapt to climate change. Meanwhile, the Green Climate Fund received a sizable boost of $3.5 billion, taking the total pledges for its second replenishment to $12.8 billion, some of which will go to adaptation activities for developing countries.[3] The special fund for least developed countries (LDCs) also received pledges totalling more than $174 million.[4] Nonetheless, these pledges are not enough to build resilience to the impact of climate change on developing economies.

Bridging the adaptation financing gap is crucial to fulfil developed nations' responsibilities under the Paris Agreement, as outlined in Article 4.5.[5] However, for developing countries, it is a matter of both economic and human survival. For instance, while COP28 was in progress debating these matters, catastrophic floods killed over 350 people and displaced more than 1 million in East Africa. This highlighted the urgency of mobilising adaptation finance to mitigate such damage, as well as the urgency of the loss and damage negotiations.

Apart from increasing the momentum to mobilise more funds for loss and damage, adaptation and mitigation, any mismatch between available finance and the needs of countries resulting from their high vulnerability and low resilience to climatic shocks must also be addressed. The imperative for this is underscored by the two new indices developed by the South African Institute of International Affairs (SAIIA). These show that the climate financing gap faced by the continent is partly the result of a failure to adequately consider vulnerability and resilience when such funds are allocated.

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[2] UN Environment Programme, *Underfinanced. Underprepared: Inadequate Investment and Planning on Climate Adaptation Leaves World Exposed*, Adaptation Gap Report 2023 (Nairobi: UNEP, 2023).

[3] Green Climate Fund, "COP28: Green Climate Fund Reaches Record Funding Level", Press Release, December 2023.

[4] UN Climate Change, "COP28 Agreement Signals".

[5] See UN Climate Change, *The Paris Agreement,* Article 4.5 (November 29, 2016), 3.

This paper presents the new SAIIA indices, describing the methodological approach in their development and showcasing their usefulness by evaluating OECD adaptation finance allocations to developing countries. The overarching finding is that low-income economies, many of them African, are highly exposed to the effects of climate change while lacking the resilience to navigate such effects without suffering major economic losses. Given the large gap between national determined contributions (NDCs) and the current climate finance available for their implementation, many developing countries are wholly underprepared to face the climate crisis without better allocation of climate funds.

A review of climate indices

Over the years, several indices and other tools have been developed to quantify the level of climate vulnerability or resilience of individual countries. A prominent example is the Economic and Environmental Vulnerability Index (EVI). This is an index developed by the UN and its partners to measure countries' structural vulnerability to economic and environmental shocks. It is used to assess the economic vulnerability of low-income countries and informs the decision on whether to classify a country as an LDC.[6]

Another prominent index is the University of Notre Dame Global Adaptation Index (ND-GAIN). The ND-GAIN is aimed at assessing country needs and opportunities for improving resilience to climate change. Thus, it measures a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. The compilation of this index faced some challenges owing to the discontinuation of the World Bank's Doing Business (DB) index, which was one of the indicators for the ND-GAIN. As a temporary solution, the International Monetary Fund (IMF) adapted the index by replacing the DB indicator with a composite index containing financial inclusion and government effectiveness indicators, thus creating the IMF Adapted ND-GAIN index.

Another tool for assessing climate change vulnerabilities is the World Bank Climate Change Knowledge Portal (CCKP) for Development Practitioners and Policymakers. While not an index, the CCKP provides global data on historical and future climate vulnerabilities and impacts, thus serving as a one-stop information centre that allows some assessment of a

[6] UN Department of Economic and Social Affairs, "LDC Identification Criteria & Indicators", https://www.un.org/development/desa/dpad/least-developed-country-category/ldc-criteria.html

country's vulnerability to or readiness for hazardous climatic events.[7] The portal includes country profiles for 17 African countries. A similar platform is the Climate ADAPT platform, which aims to support European countries in adapting to climate change. It does this by providing access to and facilitating the sharing of data and information on expected climate change in Europe, as well as on the current and future vulnerability of regions and sectors, among others.

The work of Guillaumont and Simonet[8] on the vulnerability of African countries to climate change was an important step in trying to develop quantitative measures to assess climate vulnerability on the continent. Their focus on African countries is motivated by the observation that the region faces considerably high consequences of climate change despite having contributed relatively little to it. Their index, however, focusses on physical vulnerability as opposed to economic vulnerability, which is this paper's focus.

Other climate vulnerability indices have focused on specific communities within countries. For instance, the International Food Policy Research institute has developed one focusing on the South African farming sector at subnational or community levels.[9] A Livelihood Vulnerability Index was developed to analyse household livelihood vulnerability in the Mabote and Moma districts in Mozambique.[10] This index was adopted and used to estimate livelihood vulnerability among smallholder farming households in South Africa's Free State province.[11] The South African National Climate Risk & Vulnerability Assessment Framework is another country-focused climate change assessment tool, developed by the South African

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[7] See Climate Change Knowledge Portal, "South Africa: Risk", https://climateknowledgeportal.worldbank.org/country/south-africa/vulnerability

[8] Patrick Guillaumont and Catherine Simonet, "To What Extent Are African Countries Vulnerable to Climate Change? Lessons from a New Indicator of Physical Vulnerability to Climate Change" (Working Paper 8,

Fondation pour les Études et Recherches sur le Développement International, Clermont-Ferrand Cedex, November 8, 2011).

[9] Glwadys Aymone Gbetibouo and Claudia Ringler, "Mapping South African Farming Sector Vulnerability to

Climate Change and Variability: A Subnational Assessment" (Discussion Paper 00885, International Food Policy Research institute, Washington DC, August 2009).

[10] Micah B Hahn, Anne M Riederer and Stanley O Foster, "The Livelihood Vulnerability Index: A Pragmatic Approach to Assessing Risks from Climate Variability and Change – A Case Study in Mozambique", *Global Environmental Change* 19, no. 1 (2009).

[11] Collins C Okolie, Gideon Danso-Abbeam and Abiodun A Ogundeji, "Livelihood Vulnerability to the Changing Climate: The Experiences of Smallholder Farming Households in the Free State Province, South Africa", *Climate Services* 30 (April 2023).

government to assess climate vulnerability while setting up policy frameworks to address the effects of climate change.[12]

SAIIA's new vulnerability and resilience indices

Building on the above literature, SAIIA's Climate Change and Economic Vulnerability Index (CEVI) and Climate Change and Economic Resilience Index (CERI) are designed to provide quantitative measures of economic vulnerability and resilience to climate change that can be applied globally and used to facilitate needs-based decision-making, such as allocating climate funds. Having measures for both vulnerability and resilience provides a holistic picture of climate effects on individual countries. This helps decision makers with more focused targeting that considers a country's vulnerability to climatic shocks while assessing its capability to counter the related adverse impacts. This provides a much more textured lens on the climate interventions (and support) needed.

The methodology used to create the two indices follows the same approach as that used in developing SAIIA's COVID-19 Social Vulnerability and Inclusion Index.[13] Two different sets of indicators are used for each of the two indices. For the vulnerability index, seven indicators measuring economic exposure to climatic shocks are used (see Table 2). These indicators capture the likelihood of climate-related shocks, dependence on agriculture, resource stress and food security vulnerability. The resilience index, on the other hand, uses five indicators to capture efficiency in the utilisation of climate-sensitive resources, productivity in food production, economic diversification, and government effectiveness in implementing policy measures (see Table 3).

All indicators are sourced from the World Development Indicators (WDI) database of the World Bank, save for one CERI indicator – export product concentration index – which is sourced from the UNCTAD STAT database. Latest available values are used for all indicators, corresponding to 2022 data. Besides their relevance, these indicators have been selected for

[12] South Africa, Department of Environment, Forestry and Fisheries, *National Climate Risk and Vulnerability (CRV) Assessment Framework: Summary Document* (Pretoria: Government of South Africa, 2020).

[13] Joseph Upile Matola, "COVID-19 and Socioeconomic Vulnerability" (CoMPRA Policy Insight 22, South African Institute of International Affairs, Johannesburg, January 16, 2024).

their wide coverage across countries and cross-country comparability. In total, 160 countries are included for the calculation of the indices (these are the countries that have all the necessary data needed for inclusion in the index).

Table 1. Indicators used for the Climate Change Economic Vulnerability Index (CEVI)

	Indicator used	Justification
1	Number of climate-related disasters (five-year average)	Captures **increased** vulnerability owing to the possibility of a climatic shock occurring in that country
2	Temperature change corresponding to the period 1951–1980 (five-year average)	Captures **increased** vulnerability owing to the extent of climate change being experienced in that country
3	Agriculture, forestry and fishing value added (% of GDP)	Captures **increased** vulnerability owing to economic dependency on agriculture. Agriculture, forestry and fishing are sectors that are very vulnerable to climate shocks
4	Employment in agriculture (% of total employment)	Captures **increased** vulnerability of household income and/or food owing to reliance on the exposed sector (see indicator 3)
5	Arable land (hectares per person)	Captures **reduced** vulnerability owing to abundance of arable land per person
6	Level of water stress[a]	Captures **increased** vulnerability owing to an already stretched water resource
7	Prevalence of undernourishment (% of population)	Captures **increased** vulnerability owing to existing food security challenges

a) Measured as freshwater withdrawal as a proportion of available freshwater resources

Source: Compiled by author

Table 2. Indicators used for the Climate Change Economic Resilience Index (CERI)

	Indicator used	Justification
1	Energy intensity level of primary energy (MJ/GDP)[a]	Captures **reduced** resilience owing to inefficiency in the utilisation of energy resources
2	Water productivity (GDP per cubic metre of total freshwater withdrawal)	Captures **increased** resilience owing to efficiency in the utilisation of water resources that are prone to climatic shocks
3	Cereal yield (kg per hectare)	Captures **increased** resilience owing to ability to produce adequate food even with climate change/shocks
4	Export product concentration index	Captures **increased** resilience to climate shocks owing to economic diversification.
5	Government effectiveness	Captures **increased** resilience owing to government effectiveness in its efforts to responding to climate change

Energy intensity level of primary energy is an indicator of energy efficiency for SDG 7.3, which calls for global progress on energy efficiency, doubling the rate of improvement in energy efficiency globally by 2030

Source: Compiled by author

Standardisation of indicators

To ensure that the index is not affected by the measurement units of individual indicators, the mini-max data standardisation technique is employed.[14] This approach uses the minimum and maximum values of the indicators to standardise the data to a scale of 0-1. The method also allows for the rotation of indicators so that their effect on the final index follows the desired direction (ie, higher values of the standardised data correspond to higher scores of

[14] Jiawei Han, Micheline Kamber and Jian Pei, *Data Mining: Concepts and Techniques*, 3rd ed. (Waltham: Morgan Kaufmann Publishers, 2012).

the index). To do this, the variables are divided into two categories, the first consisting of variables that are positively related to vulnerability or resilience. The second category is that of variables that negatively contribute to vulnerability or resilience (see tables 1 and 2). The indicators in the first category are standardised using the formula:

$$x_{ik} = \frac{X_{ik} - min(X_i)}{max(X_i) - min(X_i)}$$

while indicators in the second category are standardised as:

$$x_{ik} = \frac{max(X_i - X_{ik})}{max(X_i) - min(X_i)}$$

Here x_{ik} represents the standardised variable corresponding to X_{ik}, the i^{th} original variable for country k, and X_i is the set containing indicator i for all countries. $min(X_i)$ denotes the lowest value of X_i among the countries and $max(X_i)$ denotes the highest value of X_i.

Derivation of weights and calculation of indices

The weights for the indicators are derived following the procedure proposed by Huh and Park for their Asia-Pacific Regional Integration Index.[15] This procedure, which is based on the Principal Component Analysis (PCA) method, is adopted owing to the advantages it offers over the equal weighting procedure used in prominent indices such as the EVI (described above) and the Human Development Index used by the UN.[16] The advantages of using the PCA approach include the elimination of subjectivity in assigning the weights, the elimination of noise through dimension reduction and the correction of overlapping information among correlated indicators.

The Huh and Park procedure used for the two indices developed here is summarised in Box 1.[17] In this procedure, PCA is done on the standardised data. The analysis produces principal components (Z_j) and eigenvalues (λ_j), which are the variances of Z_j. The first principal

[15] Hyeon-Seung Huh and Cyn-Young Park, "Asia-Pacific Regional Integration Index: Construction, Interpretation, and Comparison" (ADB Economics Working Papers 511, Asian Development Bank, Mandaluyong, 2017).

[16] The HDI is calculated as the equally weighted geometric mean of life expectancy, education and GNI per capita.

[17] Huh and Park, "Asia-Pacific Regional Integration Index".

component Z_1 explains the largest possible variation in the data, with the subsequent principal components explaining progressively lower variations in the data.[18] Following this, a decision is made on how many principal components to retain so that enough variability in the data is explained while sufficiently reducing its dimension. Here Keiser's rule is used for this decision.[19] Assuming J principal components are retained, the corresponding eigenvalues are used to derive the proportions of the variance explained by each Z_j. These proportions are constructed as $\theta_j = \lambda_j / \sum_{j=1}^{J} \lambda_j$. The final weights w_i for each indicator x_i are derived as:

$$w_i = \sum_{j=1}^{J} \theta_j \times \rho_{ij}^2$$

where ρ_{ij} are the correlation coefficients between the original variables, x_i and the principal components, Z_i, and are referred to as *loadings*.[20]

[18] See Matola, "COVID-19 and Socioeconomic Vulnerability".

[19] Henry F Kaiser, "The Application of Electronic Computers to Factor Analysis", *Educational and Psychological Measurement* 20, no. 1 (1960): 141–151.

[20] Matola, "COVID-19 and Socioeconomic Vulnerability".

Box 1. Technique for deriving weights

Steps in deriving weights for the indicators

STEP 1: Conduct PCA and get the principal components (PCs), eigenvalues and loadings.

STEP 2: Select the PCs to be used using available criteria (the Keiser criterion, in this case).

STEP 3: Square the loadings to get the proportion of variance in the variable explained by each PC.

STEP 4: Generate a new parameter, θ, by dividing each eigenvalue with the sum of all eigenvalues of the selected PCs to get the proportions of the variance explained by each of the PCs.

STEP 5: Calculate the weights as the sum of the products of θ and the squared loadings.

Source: Joseph Matola, "COVID-19 and Socioeconomic Vulnerability" (CoMPRA Policy Insight 22, SAIIA, Johannesburg, January 2024)

Following the steps laid out in Box 1, the weightings assigned to the individual indicators of the indices are assigned as in Table 3. For the vulnerability index, indicators of dependence on agriculture and food security are allocated weightings of 17–18% while water stress has the lowest weighting of 7%. The indicators of climate shocks and climate change itself get weightings of 11% and 13%, respectively. For the resilience index, the indicator of government effectiveness in responding to climate shocks has the highest weighting at 32%. This is followed by food productivity (21%) and the indicator of economic diversification (19%). Water stress gets the lowest weighting, (14%), followed by energy intensity (15%). Here, the high weighting of government effectiveness implies that economic resilience to climate change can be achieved through the right government actions. It is also worth noting that both indices place high significance on the role that agriculture plays as a point of vulnerability to climate change for many economies, as well as the role that the sector can play in mitigating its impacts.

Table 3. PCA assigned weightings for indicator (from high to low)

Climate Change Economic Vulnerability Index		***Climate Change Economic Resilience Index***	
Indicator	*Weight (%)*	*Indicator*	*Weight (%)*
Arable land (hectares per person)	17.96	Government effectiveness	31.67
Employment in agriculture	17.57	Cereal yield	21.00
Agriculture value added share of GDP	17.06	Export product concentration	18.95
Prevalence of undernourishment	16.69	Water productivity	14.81
Temperature change	12.64	Energy intensity	13.57
Frequency of climate-related disasters	11.41		
Level of water stress	6.67		
Total	100		100

Source: Compiled by author

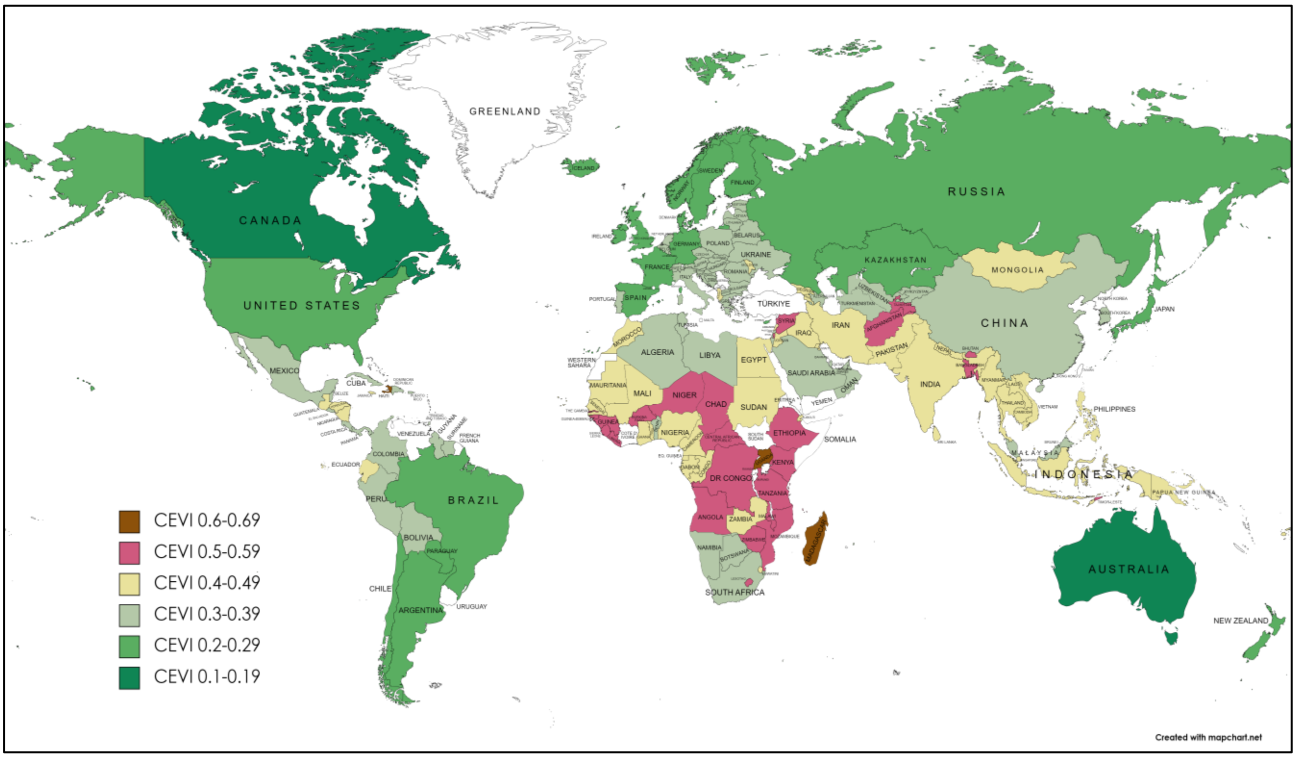
Ranking vulnerability and resilience across countries

The results of the vulnerability and resilience indices are presented as maps in figures 1 and 2, while the actual scores and country rankings are presented in tables A1 and A2 in Annexure A. In general, developing countries, especially those in Africa, score relatively high on vulnerability and low on resilience compared to more developed countries. However, although this is the case in general, high vulnerability and low resilience are not entirely dependent on income levels. As such, some countries are found to be more vulnerable or less resilient than countries that are relatively poorer.

In terms of vulnerability, the majority of the most vulnerable countries are low income, led by Madagascar, Haiti and Uganda. Eight of the 10 most vulnerable countries (and 14 of the most vulnerable 20) are low income, with Haiti and Tanzania the only lower-middle-income countries in this group. Palestine, ranked 18th, is the only upper-middle-income country among the top 20 most vulnerable countries. In contrast, nine of the 10 least vulnerable countries are high income, with only Argentina representing upper-middle-income countries in this group. A total of 15 of the 20 least vulnerable countries are high income, with Australia and Canada respectively ranked as the least and second least vulnerable countries, despite both being exposed to frequent extreme climatic events.

African countries score an average of 0.48, compared to the global average of 0.4. Thus, the average African country scores the same as the 34th ranked Djibouti (out of the 160 countries analysed). Nine of the 10 (and 15 of the 20) most vulnerable countries are African. Only seven of the 47 African countries included (Botswana, Namibia, Benin, Mauritius, South Africa, Libya and Algeria) score below the global average, that is, have lower vulnerability to climate shocks. Besides the increased temperatures and frequency of disasters in recent years, Africa's high vulnerability mainly reflects the continent's dependence on agriculture and its inability to secure adequate nourishment for its population. This suggests that there is room for vulnerability reduction through policies designed to initiate rapid structural economic transformation, as well as policies that promote climate-smart agriculture.

Figure 1. Climate change economic vulnerability across countries



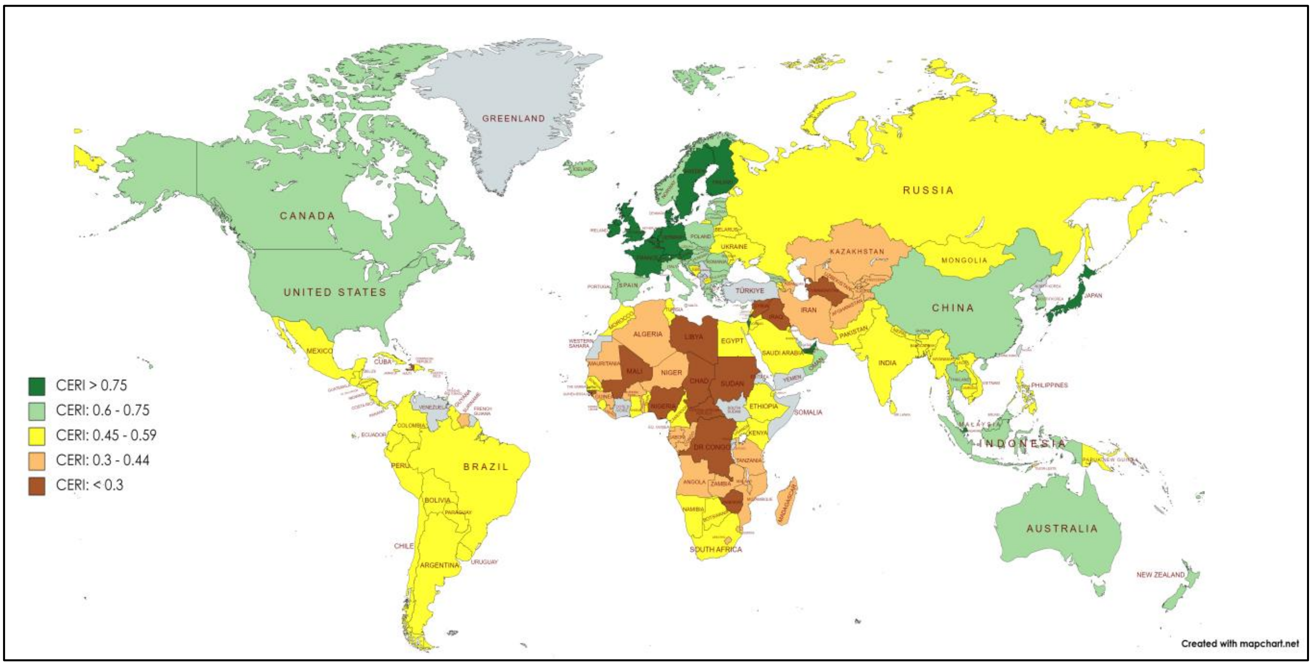
Source: Compiled by author

In terms of economic resilience to climate shocks, the results are generally the mirror image of vulnerability, with high-income countries being the most resilient and low-income countries dominating the least resilient rankings. Denmark and Luxembourg lead the world in terms of economic resilience to climate change. They are closely followed by Singapore, Switzerland and the UK. The 20 most resilient countries are all high-income countries, and mostly European (15 countries).

On the low-resilience spectrum, 11 of the 20 least resilient countries are low-income countries, along with seven lower-middle-income countries and two upper-middle-income ones. Interestingly, the least resilient country (ranked 160) is Libya, an upper-middle-income country. Libya is closely followed by the low-income Guinea-Bissau (ranked 159) and the upper-middle-income Iraq and Turkmenistan, ranked 158 and 157 respectively. As is the case with the vulnerability rankings, this shows that income level is not the sole determinant of resilience.

With an average score of 0.43, African economies again show lower resilience than the average economy analysed, which scores 0.55 on the resilience index. This score would put Africa on the same ranking as Tanzania, at position 127. Ranked 31st in the world, Mauritius stands out as the best performing African country by far, followed by Djibouti at 59 and South Africa at 63. Interestingly, while Djibouti is ranked above the global average in terms of resilience, its vulnerability ranking is poor (as mentioned above). This implies that while low-income countries are generally associated with high vulnerability and low resilience, this does not always hold. This is also seen in the case of Ethiopia which, despite exhibiting high vulnerability, also shows above-average resilience.

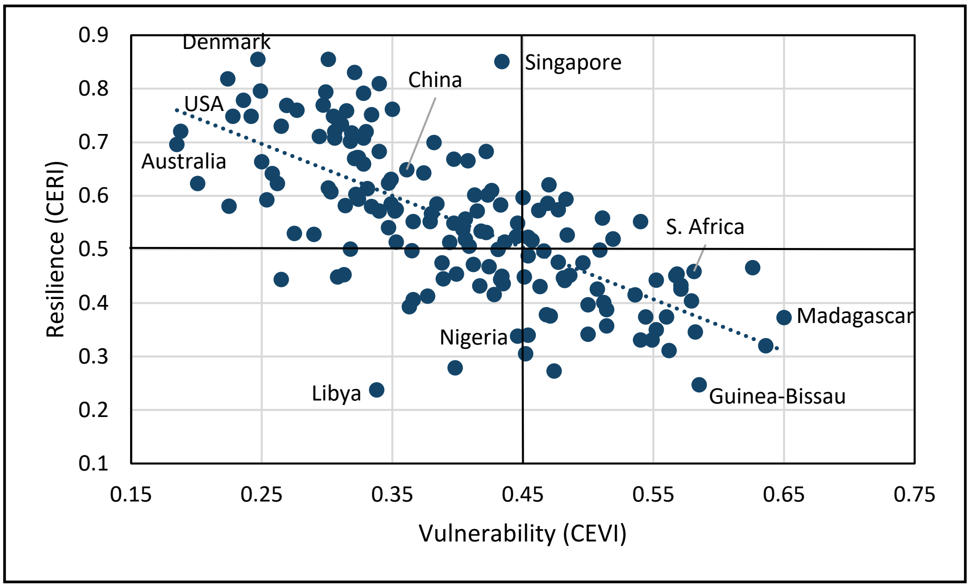
Figure 2. Climate change economic resilience across countries



Source: Compiled by author

Generally, economies that are vulnerable to the effects of climate change are also largely those that have low resilience to such impacts. A correlation analysis of the two variables reveals a negative and sizable (Pearson) correlation coefficient of -0.7, which points to a strong negative relationship between vulnerability and resilience. Figure 3 depicts this relationship by plotting country vulnerability scores (x-axis) against country resilience scores. The downward sloping fitted trend line reveals this inverse relationship. Also revealed in this graph is that many economies are either climate vulnerable and lacking resilience (bottom-right quadrant) or lower on vulnerability with high resilience (top-right quadrant), with the former largely consisting of lower-income and African countries and the latter of higher-income Western economies.

Figure 3. Vulnerability versus resilience



Source: Compiled by author

Alignment of adaptation financing to vulnerability and resilience of countries

Mobilising adequate resources to deal with the negative impacts of climate change is key in achieving the collective climate goals. However, resilience can only be achieved if the available funds are directed to the countries that need them the most. Currently, climate finance seems to be directed mostly towards lower-middle-income countries (primarily in South America, Asia and West Africa) rather than the more vulnerable and less resilient low-income countries.[21] Some analysis that was conducted by the OECD shows that 70% of all climate finance provided by developed countries between 2016 and 2020 went to middle-income countries, with lower- and upper-middle-income countries receiving 43% and 27%,

[21] Gaia Larsen, Carter Brandon and Rebecca Carter, "Adaptation Finance: 11 Key Questions, Answered", World Resources Institute, October 25, 2022.

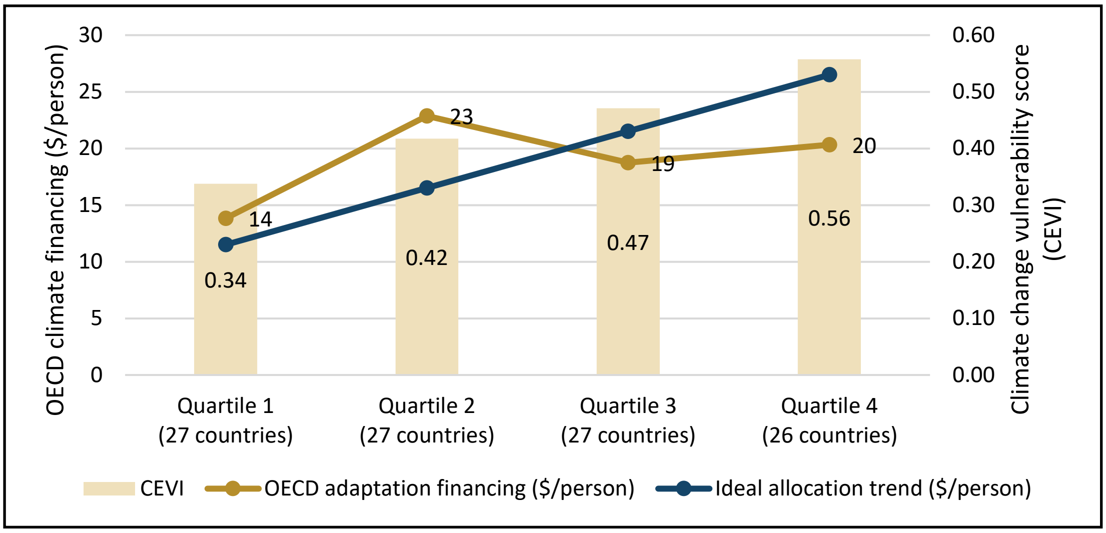
respectively.[22] Whether this implies the unequitable distribution of funds requires further probing, since a higher income level does not automatically translate to less vulnerability or more resilience to climate change.

The climate change vulnerability and resilience indices developed in this paper allow for an analysis of whether funds are being allocated according to country-specific levels of vulnerability and resilience. This is demonstrated here by analysing the latest available OECD climate financing flows to developing countries. Specifically, the 2021 climate adaptation finance flows from the OECD are mapped to countries based on their scores on the two indices. In the analysis, country recipients of OECD adaptation financing that are also part of the calculated indices – 107 countries in total – are divided into four quartiles of 27 countries (save for quartile 4, which has 26) based on their levels of vulnerability and resilience. Thus, CEVI quartile 1 is composed of the 27 most vulnerable countries (of the 107), while quartile 4 has the 26 least vulnerable countries (see Annexure B, tables B1 and B2). As for resilience, CERI quartile 1 has the 27 least resilient countries, while quartile 4 has the 26 countries with the highest CERI scores. The vulnerability and resilience quartiles are then mapped to the OECD's average adaptation finance per person for those countries (see figures 4 and 5).

The analysis reveals some misalignment between these funding allocations and levels of vulnerability and resilience to climate shocks. Under a vulnerability-based allocation (see Figure 4), the two least vulnerable quartiles receive more funding than they should, while the two most vulnerable quartiles receive less than they ideally should. In fact, countries in quartile 2 on average receive higher allocations per person ($23) than the average quartile 3 and quartile 4 countries, which get $19 and $20, respectively. Here, the three most vulnerable countries – Madagascar (ranked 1st), Haiti (2nd) and Uganda (3rd) – each got an allocation of about $11 per person (see Annexure B, Table B1). This is considerably lower than that in some much less vulnerable countries, such as Tunisia (ranked 108th), Costa Rica (104th) and Colombia (98th), which received funding of $25.6, $53.9 and $23.4 per person, respectively. Guinea-Bissau and Ethiopia only received $2.6 and $4.2 per person respectively, despite their economies' ranking 4th and 6th most vulnerable to climate change.

[22] OECD, *Climate Finance Provided and Mobilised by Developed Countries in 2016-2020: Insights from Disaggregated Analysis*, Report (Paris: OECD Publishing, 2022).

Figure 4: OECD adaptation financing by CEVI vulnerability



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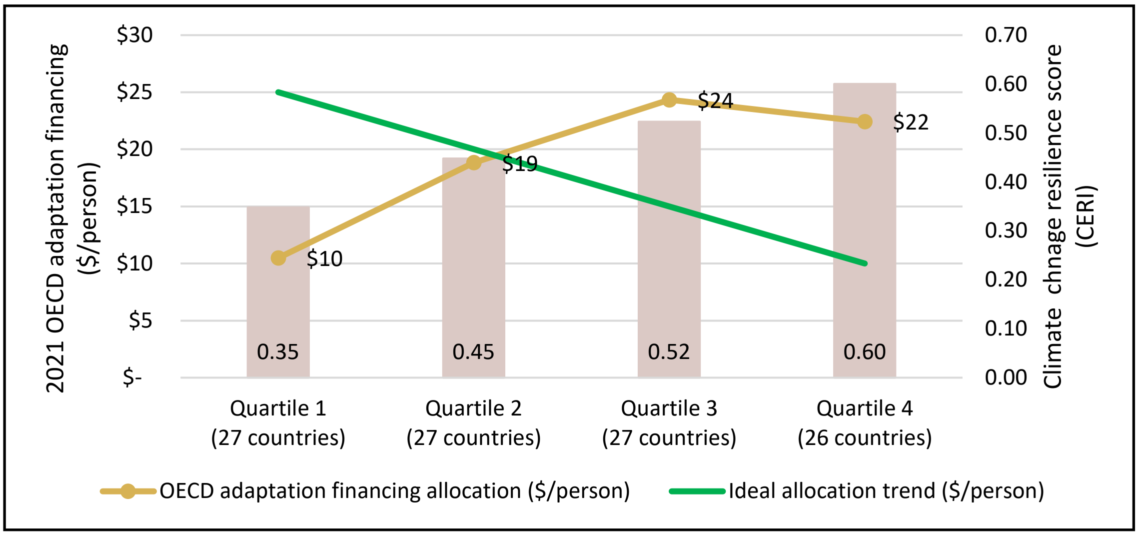
The misalignment of these funds is even more pronounced when allocations are observed through the prism of resilience to climate change (see Figure 5). Here, the allocations trend in a completely opposite direction compared to the ideal scenario, with countries that are low on resilience being allocated less than those with higher resilience. Quartile 1, which comprises the 27 least resilient countries, only gets $10 per person of adaptation financing, compared to quartile 4 (the most resilient group of countries), which gets more than double that amount at $22. The three least resilient countries – Libya, Guinea-Bissau and Iraq – each gets less than $4 per person of 2021 OECD adaptation financing. Meanwhile, the much more resilient Georgia (ranked 52nd), Djibouti (ranked 59th) and Jordan (ranked 64th) were allocated $23.6, $80.2 and $80.7 per person, respectively. Costa Rica, with its $53.9 per person allocation, is the 5th most resilient country among the 107 recipients analysed here.

However, it should be noted that on a case-by-case basis many countries received levels of funds that can be deemed fair in context. For instance, vulnerable countries such as Timor-Leste, Bhutan and the Maldives received considerably more funds per person compared to some less vulnerable (upper-middle-income) countries such as China, Indonesia, South Africa and Brazil. Furthermore, small island states such Comoros, Cabo Verde, Fiji and Maldives also were generally well targeted.

Figure 5: OECD adaptation financing by CERI resilience



Source: Compiled by authors

Given the above analysis, a key recommendation of this paper is therefore for developed nations and international financial institutions to mainstream the use of climate change economic vulnerability and resilience measures (such as the two indices developed here) in considering the allocation of climate financing support. For Africa, which averaged $16.3 per person in this instance, the realignment of external financial support based on vulnerability and resilience cannot come soon enough, especially given the large climate adaptation (and mitigation) financing gaps that it continues to experience. Most countries on the continent have set NDC targets that require significant external financial support such as that from the OECD to respond effectively to climate change.[23]

The findings also highlight the urgent need for all countries to set ambitious carbon emission targets, as the two indices indicate that not a single country will be untouched by the effects of climate change, even if some might be better prepared than others. Climate change knows no borders and global partnerships and collective action will be required to tackle it.

An important caveat to the above analysis is that it provides a one-year snapshot of adaptation financing from countries in the OECD. Thus, it is merely indicative of the current level of climate finance flows in this particular group of countries and does not provide a

[23] See Joseph Upile Matola, "Africa's COVID-19 Response: A Wasted Opportunity" (CoMPRA Policy Insight 21, SAIIA, Johannesburg, 2023), 10.

comprehensive picture of the total allocation of climate finance across the globe and over time. Nonetheless, it does expose the inequities in climate financing and the urgency of a sustained global effort to help all countries prepare for the challenges brought about by climate change.

Conclusion

The gap between the ambition of meeting the NDCs of developing countries and existing allocation patterns points to the need for changes in how climate funds, especially for adaptation initiatives, are allocated so that more go to those most in need. More funds should be directed at the least well-adapted countries rather than concentrating on middle-income countries that are better equipped to adapt, even if the need to support adaption there is also acute. While the mobilisation of adequate funds should be the ultimate goal for achieving resilience to climate change, the immediate focus should be a more equitable distribution of the funds currently available. This, in turn, requires a step change by multilateral development banks, international financial institutions, philanthropic funders, sovereign wealth funds, institutional investors, banks, corporates and governments.

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