

Assessing the Nexus between Climate Finance and State Vulnerability in Africa

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ABSTRACT

The severity and intensity of climate change in Africa are incomparable to those in other parts of the world, as adaptation and mitigation frameworks are unable to withstand the shocks of climate change. The recognition of the vulnerable nature of developing states to climate change, particularly Africa, has enjoined developed parties whose Anthropogenic contribution to climate change surpasses 70% of global GHG emissions, a financial obligation. The study used a mixed-methods approach with data from the Notre Dame Global Adaptation Initiative's (ND-GAIN) vulnerability index and the Climate Policy Initiative's (CPI) climate finance tracking data set and qualitative interviews with key experts in climate finance and climate risk assessment in Africa. The study assesses the level of risk climate change has on Africa in particular areas that are critical to the continent's efforts to achieve its SDGs. The study notes a huge average annual climate financing gap with the use of a Sample-T test to assess climate needs as against climate funds received by Africa while establishing an inverse relationship between vulnerability and readiness to adapt to climate vulnerabilities. The study identifies the need for a sustainable finance framework for Africa to raise internal funds for climate resilience.

Keywords: Climate finance, climate change, state vulnerability, resilience, adaptation, mitigation

INTRODUCTION

The global environmental landscape has witnessed a massive transformation, which has negative implications for human, plant, and animal survival. As a result, the discourse on climate change has received a global call for collaborative governance networks to safeguard human, animal, and plant survival. The causes of contemporary climate change have been associated with the Anthropocene discourse, which seeks to emphasize the massive contribution of human activities to the impact of global climate change (Simangan, 2020). This has arguably been associated with the emission of greenhouse gases into the atmosphere. The intensity and degree to which humans contribute to the massive destruction of the ecosystem has necessitated a rethinking of the way people ought to make good use of the environment without destroying the climatic conditions that may result in a threat to human survival if not already threatened (Antadze, 2019). The excesses of climate change in terms of its impacts have negative consequences for the health sector of states across the world, especially African states (Moda et al., 2019). The primary contributory factor, which is the massive release of greenhouse gases (GHG), is the precursor for infectious and non-infectious diseases, water insecurity, declining nutrition, natural degradations, social disruptions, and declining quality of life (Mikhaylov et al., 2020). The historical impact of climate change has been conspicuous within the last two decades, as evidenced in human health, agriculture, and ecosystem devastation. The Intergovernmental Panel on Climate Change (IPCC) reports that the average surface temperature of the world's land and oceans rose by 0.85 °C between 1880 and 2012 and is expected to continue to rise by more than 1.5 °C by the end of the 21st century (Allen et al., 2021; IPCC, 2014). Variations in rainfall patterns will occur in different parts of the world under the RCP8.5 scenario, with increased precipitation in the equatorial Pacific and high latitudes, and decreased precipitation in the mid-latitudes and subtropics (Giorgi et

al., 2018). In addition, the wet tropics and damp mid-latitudes will receive more rainfall than usual, causing floods. This underscores the variant forms of destruction, which are geographic specific.

The inability of states to respond with countermeasures to ensure that the devastation of climate change may have adverse effects translates directly to their vulnerability to climate change consequences. With the collective recognition of climate change as a global threat to humans and other living species, there is always the question of who the main contributors are to the destruction of global climatic conditions by the Anthropocene discourse. This brings into the debate the issue of losers and winners within the whole discourse of climate change. This is to imply that climate change as a global existential threat has made winners and losers by the very recognition that the more one is able to cause destruction to the atmospheric condition by way of massive environmental pollution through the emission of greenhouse gases, faunal destruction, and unrepairable floral catastrophe, the greater the reward of unquestionable rapid development. This then raises the question of whether the consequences of climate change are equally distributed, retributively distributed, unequally distributed, or randomly distributed. Diffenbaugh and Burke (2019) associate global warming with economic inequality. Their research suggests that the current growing global inequality has a direct link to historical temperature fluctuations. Poorer countries have been postulated to be direct losers in the whole discourse of climate change due to the fact that they do not have the needed resources to be able to adapt and mitigate effectively to the consequences of climate change, especially those in warmer regions, since there is an unusual additional temperature above the global average for them, which can be detrimental to health and productivity (Duffy et al., 2019). This then suggests that African states are largely the direct losers within the context of analyzing the shared legacies of climate change. It is therefore important to identify the winning side, of which most are developed states, since their associated advanced development is on the back of climate change through the massive release of GHG through unbridled industrialization, which is associated with the industrial revolution, which saw the development of coal powered engines, which emit massive amounts of carbon and other harmful gases into the atmosphere. It is no surprise that the Group of Twenty (G20), with the exception of the European Union (EU), possesses 77.1% of the global economy and emitted an approximate 74.9% of global CO₂ in 2014. They are the world's leading economies, associated with the highest emission levels of CO₂ (Qiao et al., 2019). This level of historical emissions, which has characterized advanced economic growth, still persists, yet the conversation of a global response to climate change leaves poorer states, who are predominantly in Africa, to face the brunt of climate consequences through long droughts, floods, heat strokes, erratic rainfall, and water shortages, among several others, that exacerbate the already weak and porous social, economic and governance infrastructure of these states. The degree to which underdeveloped states are the losers in the climate change conversation has been recognized by organizing partners and agencies of global climate change, including the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC), the Green Climate Fund (GCF), and the World Bank Group (WBG), among a host of others.

Due to the asymmetric share of climate change consequences between developed states and developing states, there has been elaborate commentary on climate change injustice, which is deemed to be perpetuated against most developing states that are located in Africa (Mason-Case & Dehm, 2020). Such consequences have exposed most African states to devastating climatic conditions that threaten their survival and, by extension, their human security. Climate finance has been identified as the surest means of ensuring that the risk that is posed to African states is minimized through climate change adaptation and mitigation mechanisms, which can be effectively deployed provided there is a sustainable financial framework for them. The UNFCCC defines climate finance as “*local, national, or transnational financing—drawn from public, private, and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change.*”

According to the IPCC, vulnerability implies exposure or the propensity to be adversely affected. Within the discourse of climate change, vulnerability implies the degree of susceptibility to the harms of climate change adversity and the inability of states to cope and adapt. According to Ayanlade et al. (2023), vulnerability is shared unevenly globally since the sensitivity to climate change impacts varies. Islam (2022) therefore argues that for a low-carbon and climate-resilient global future, climate financing will be the game changer. This assertion was also affirmed by Yeo (2019), who stated that trillions of dollars are required to make such a transition a reality. The degree of vulnerability of African states to climate change may hinder such states from attaining the Sustainable Development Goals (SDGs), since such achievements may hinge on a resilient African society's ability to adapt to the negative implications of climate change through adaptation and mitigation.

It is therefore stated in Article 9 of the Paris Agreement that developed parties will provide financial support to developing parties to commit to climate change adaptation and mitigation. Inclusively, according to the UNFCCC, developed countries are expected to provide financial assistance to less developed countries, including those in Africa, to prepare for and cope with the impacts of climate change. Inclusively, the Kyoto Protocol, the Marrakesh Accord, and the Copenhagen Pledge are all testaments to the agreements laid before underdeveloped states that have been identified as being most vulnerable to the adversities of climate change (Hauser, 2023). The effectiveness of these funds depends on the amount raised and how they are allocated, but there is currently no comprehensive analysis of all the money that flows to African states for climate adaptation (Savvidou et al., 2021). The UNFCCC has pledged to raise USD 100 billion annually by 2020 to support climate action in underdeveloped countries, including Africa.

The study analyzes the relations that exist between climate financing and state vulnerability by way of African states' ability to adapt and mitigate climate vulnerabilities. The study employs a sub-regional level analysis to determine climate finance requirements, the distribution of climate funds to African states, the efficacy of climate finance for African states, and its influence on the worldwide pursuit of net zero, a key objective of the UNFCCC, particularly in the Paris Agreement.

A study by Schilling et al. (2020) suggests that the combined efforts of the physical and social consequences of climate change undermine government efforts, thereby increasing the unmet demands of citizens for social and economic growth in the northern part of Africa, where drought and water accessibility are major climate consequences. This has deepened the vulnerability of African states to climate change. The study therefore suggested a regional and subnational assessment of climate risk. Most of these studies have assessed climate finance and climate vulnerability from a national perspective. An identification of the absence of a sub-regional assessment of climate financing regimes in line with climate vulnerability at the sub-regional level was identified as a gap in existing knowledge in climate financing and state vulnerability in Africa. The study therefore fills the gap in existing literature by providing a sub-regional assessment of the nexus between climate finance and climate vulnerability in Africa.

Without a more dispersed comparative analysis of climate need and actual climate funds available to African states in different sub-regions of the continent, it will be difficult to critically understand and appreciate the impact of these funds in mitigating and adapting to the consequences. Climate vulnerability is an unavoidable reality that confronts most African states. Climate financing has been identified as a solution that can aid states in mitigating and adapting. A sub-regional appreciation of vulnerability assessment with climate funds that are made available establishes the realities as to whether climate funds that are being disbursed are either sufficient, less than sufficient, effective, or ineffective in reducing the vulnerability of African states to climate change.

The specific objectives of the study include the following;

1. To assess the level of risk climate change consequences, have on African states.
2. To quantify the amount of financial flows to African states towards climate change mitigation and adaptation in 2020 as compared to the estimated amount needed by selected states and sub-regions.
3. To assess whether the current state of climate financial flows decreases or exacerbates the vulnerability of African states to climate change consequences.
4. To assess the contribution of African climate finance and how African states can raise money for building climate resilient societies.

Theoretical Framework

Sustainable finance theory

The 2008 financial crisis has provided good evidence to suggest that there is a negative consequence in the management of the international financial system as a result of poor regulations that have a negative impact on vulnerable societies (Sandberg, 2018). The financial system of our time has been associated with the inability to

ensure the interests of the poor and also address global issues, including climate change. The role of the financial markets in addressing the needs of society has become a collective burden for both global leaders and researchers (Sandberg, 2018). The mainstream characterization of the financial system is one that is driven by the maximization of profits, which comes with high consequences when financial firms fail to recognize and address the issues surrounding the social aspect of profit maximization. This is the traditional notion of the financial markets, which has been driven on the wheels of neoclassical economic theories that see the markets as a rational outcome of the maximization of self-interested utility (Sandberg, 2018). The discontent that has been recently associated with the traditional view of the financial world has been refreshing (Santoro & Strauss, 2013). Since the great depression, the 2008 financial crisis has been described as the worst in recent history as a result of the global nature it took and how it further shifted poor and vulnerable societies into extreme poverty and also opened up the global cracks of the financial system to worsen global problems, of which climate change is the most conspicuous (Sapountzaki, 2019). The crisis was associated with the rationale of the dominant views of the financial market system of profit maximization, which enticed financial firms to excessively lend to subprime borrowers with massive investment into unknown financial innovations, including collateralized debt obligations (CDOs), without the necessary reserved capital to make up for high levels of systemic risks (Barth, 2009; Quail, 2010). Stiglitz (2010) therefore suggested that instead of just managing the financial system, there is a need for a new vision for the financial system. The use of the financial system has therefore been recommended to include a social responsibility aspect for various financial institutions, taking into consideration Environmental, Social, Economic, and Governance (ESG) issues (Stiglitz, 2010). Sustainable finance theory has become important in the wake of critical investigations and advocacy for natural and environmental protection (Strauß, 2023). Therefore, there cannot be an environmental protection policy without financial support. Migliorelli (2021) therefore defines sustainable finance as finance that is purposed for the achievement or implementation of any of the sustainable dimensions of development. It is also the view of Ozili (2023) that sustainable financing refers to the consideration of environmental, social, and governance (ESG) factors before a financial institution makes a financial commitment. According to the International Capital Market Association (ICMA, 2020), sustainable finance encompasses climate, green, and social finance, while also considering the long-term economic sustainability of the organizations being financed and the stability of the overall financial system they operate within. The United Nations Environment Program (UNEP, 2017) defines sustainable finance as financial activities that address the long-term requirements of a sustainable and inclusive economy, considering economic, social, and environmental factors that contribute to achieving these goals. The issue of sustainable finance lies in ensuring social equity and the promotion of investments that cut the issue of short-term gains but widen the long-term protection of the interests of the future by way of assuring and developing sustainable finance disclosures and regulations (Chiu, 2021) and avoiding greenwashing (Gregory, 2021). In achieving the sustainable development goals, it has been argued by Ozili (2021) that the mainstreaming of sustainable financing can be a solution to climate change risk and the mobilization of institutional capacity for sustainable financing. The identification of a financial model that considers the issue of responsibility and the promotion of social equity is a good conversation starter for incorporating the losing story of Africa within the narrative of climate change's consequences (Liang & Renneboog, 2020). The use of the theory can be useful towards ensuring that there is adequate capital investment to empower African societies to catch up with an advancing net-zero global economy that has hope for reducing greenhouse gas emissions. This is in line with the study of Štreimikienė et al. (2023), which found that countries that have and implement sustainable financing frameworks have high success rates in the implementation of the SDGs. Also, the degree of vulnerability of African states will be addressed by incorporating climate-smart financing frameworks that expand the degree of resilience and close the gap between African society's vulnerabilities (Newell et al., 2019). The concept of sustainable financing has, however, been identified by Migliorelli (2021) as a heterogeneous and complex framework that hinders the conceptualization of sustainable finance. This observation does not pull down the vibrant and positive outlook of climate financing for vulnerable and less developed states but rather calls for an expansion of academic theorization of sustainable financing theories. The relevance of the theory to the research can be inferred from the responsibility that the theory seeks to give agents within the framework of climate financing to contribute to the social wellbeing of the world and the environment. This therefore draws on climate financing frameworks from the Paris Agreement and the Copenhagen Convention, which have advocated for climate funds for least-developed countries as part of their financial commitment to climate change adaptation and mitigation within the broader picture of reducing GHG emissions. The theory further assumes that governmental structures and private entities should consider the societal implications of their financial frameworks to benefit the interests

of a larger society and not only maximize profit margins. The need for environmental financial governance has been highlighted by the theory, therefore advocating that institutions may have to consider the social and environmental implications of their expenditure. The relevance of the theory to the study advances the theoretical needs for climate financing in Africa. Additionally, the theory is relevant in advocating the imbalance of climate consequences that has the potential to disrupt the entire continent, therefore the need for ESGs as the surest way towards resolving the problem. The theory further advances the ethical and ecological dimensions of climate financing, thereby making a case for climate financing in Africa. Without the infusion of such mechanisms for climate change, the optimization of financial frameworks may be weak to deal with adaptation and mitigation efforts in Africa. The relevance of the theory also identifies and addresses market failures and other externalities that may hinder the achievement of the broad goal that climate finance seeks to achieve in Africa. The theory notes the possibility of market failure in the delivery of financial capital for climate adaptation and mitigation.

A major limitation of sustainable finance theory is that it is an evolving and novel field that lacks a concrete, clearly defined methodology. The evolving nature of the theory makes it difficult to optimally operationalize the theory within the field of practice due to the highly unexplored nature of the theory. As an emerging theory that seeks to align itself with resolving the financial malfunctions of contemporary finance mechanisms through the inclusion of socially protective regulation, it may fall short of answering several unanswered practical questions as to the operational value of the theory to the practice of finance institutions and corporate bodies. Inclusive of the limitations, the sustainable finance theory faces trade-offs and conflict between different social and environmental objectives. The existence of a multiplicity of social and environmental problems makes it difficult to operationalize a specific objective, as all objectives may be equally important in resolving similar problems. The duration of the applicability of the theory is also not clear. There are usually long-term and short-term plans and goals of corporate institutions, and the infusion of a sustainable finance framework may conflict with such goals and objectives, thereby posing a challenge to the theory.

The identified challenges are reduced within the study by way of operationalizing the theory within the framework of international institutions and states that have committed themselves to rolling out the theory in order to solve a global environmental challenge that is climate change. As a result, the theory falls short of limiting the study to the challenges of the theory. Moreover, the theory is applied within the context of states in Africa who, as part of their financial obligation to access funds for projects, may have to show commitment to the application of the sustainable finance framework. As a result, the limitations of the theory may be reduced so as not to affect the outcome of the study.

MATERIALS AND METHODOLOGY

A mixed research methodology is the most comprehensive method for answering the research questions and addressing research objectives.

The field of climate finance flows and state vulnerability is complex and multifaceted, necessitating an in-depth understanding that integrates both quantitative and qualitative methodologies. By combining quantitative data analysis and qualitative research methodologies, a mixed-method approach enables a more thorough investigation of this research (Dawadi et al., 2021). This research allows for the examination of both the quantitative trends and patterns in climate finance flows and state vulnerability, as well as the underlying variables, views, and experiences that impact them from a qualitative perspective.

In this study, quantitative data from the Climate Policy Initiative (CPI) data set and the ND-GAIN vulnerability index are triangulated with qualitative insights gathered from expert interviews. This integration of multiple data sources strengthens the overall credibility of the study. The quantitative data were analyzed using SPSS version 22.

The suitable population for the study is African states, specifically those within the five regions of Africa. We selected the African states for this study based on their economic performance, using the HDI as the inclusion criterion to identify the states with the highest and lowest scores. The rationale behind this is to establish the various variations in terms of economic performance and human wellbeing among sharply different states within the same subregion, the amounts they need and what they actually receive, and some relations among the two

states from each subregion, considering their vulnerability and their exposure to climate risk. The study further selected countries based on the availability of their Nationally Determined Contributions (NDC) documents, which were delivered to the UNFCCC as action plans for climate action, and also quantified their climate finance needs for the period between 2020 and 2030.

To establish the qualitative part of the study, we selected industry experts for interviews using a non-probability sampling technique. This strategy effectively gathers data for analysis by interviewing the appropriate individuals. The study utilised a combination of purposive and snowball sampling strategies. Purposive sampling was suitable for selecting the initial group of participants who have specific experience and knowledge regarding climate financing and state vulnerability in Africa, while the snowball technique was used to draw in more participants for the study (Campbell et al., 2020). A semi-structured interview guide was designed with direct reference with the research questions. The interview guide was further deployed in collecting meaningful data from the respondents of the study. The first stage as outlined by Braun and Clarke (2020) is the familiarization stage where the transcribed interviews from the various respondents is read and reread till there is a comprehensive understanding of the data in line with the research questions. The data as comprehended was further deduced into potential themes for easy understanding and interpretation. Secondly, themed codes are generated from the data, this includes labelling and the identification of key phrases and key words in the data in order to gain key ideas and the most appropriate themes. This then called for a systematic coding specifically tailored towards answering the research questions. The third process includes the search for further themes that underpin the study. The themes within this stage highlights a broad scope of this research. The recurring ideas and relationships are identified and compared. The fourth stage of the analysis of the data involves the review of the identified themes this involve the further breaking down of the identified themes into coherent and relatable understanding of the research findings. The fifth stage includes the definition of the various identified themes where the patterns and the various salient findings of the study was further advanced. The final stage of the data analysis and interpretation in accordance with the six processes in thematic analysis as established by Braun and Clarke (2020) is the reporting of the findings of the research. This includes the various themes that were identified that addressed the research questions and further interpretation for easy comprehension by all readers. This stage also includes the recommendations that the research came up with and the various institutions that ought to act in accordance with the findings of this research.

Table 1 (Source: UNHDI 2022 Index)

Country	Sub-Region	HDI Score	HDI Rank
Cabo Verde	West Africa	0.662	128th
Mali	West Africa	0.428	186th
South Africa	Southern Africa	0.713	109th
Lesotho	Southern Africa	0.514	168th
Kenya	East Africa	0.575	152nd
Egypt	North Africa	0.731	97th
Morocco	North Africa	0.683	123rd
Angola	Central Africa	0.586	148th
Central African Republic	Central Africa	0.404	188th

RESULTS AND DISCUSSION OF FINDINGS

The study employed a mixed method approach that is the combination of quantitative data analysis and the use of qualitative approach. The quantitative aspect of this research made use of two data sets from the Climate

Policy Initiative (CPI) and the ND-Gain index. The data set gained from the CPI helped the study establish the climate needs and the flow of funds of the various African states based on the sub-regions and country specific needs and flows as indicated by their NDCs. The ND-GAIN index was used to assess the degree of vulnerability of African states based on two metrics that is vulnerability and readiness to adapt. The qualitative aspect included the use of an unstructured interview to illicit data from the respondents of the study who were largely experts in the field of climate financing and climate risk analysis.

Research Question 1: What degree of risk do the consequences of climate change pose to African states?

Table 1: ND-GAIN Index of Sampled States (2021)

Country	Cape Verde	Mali	Lesotho	South Africa	South Sudan	Kenya	Egypt	Morocco	Central African Republic	Angola
Rank	77	176	135	95	179	159	104	70	184	159
Score	51.2	34.6	41.8	48.3	32.8	39.6	46.6	52.5	27.7	37.9
Vulnerability	0.455	0.596	0.471	0.390	0.604	0.510	0.420	0.379	0.584	0.510
Food	0.541	0.638	0.500	0.437	0.717	0.593	0.508	0.436	0.578	0.578
Water	0.268	0.475	0.280	0.336	0.720	0.516	0.515	0.233	0.342	0.333
Health	0.596	0.759	0.614	0.432	0.705	0.694	0.436	0.509	0.793	0.696
Ecosystem Services	0.455	0.514	0.431	0.489	0.661	0.470	0.394	0.374	0.500	0.543
Human Habitat	0.359	0.594	0.531	0.529	0.557	0.571	0.338	0.393	0.709	0.696
Infrastructure	0.345	-	-	0.123	0.263	0.218	0.329	0.330	-	0.290
Readiness	0.459	0.288	0.307	0.356	0.261	0.302	0.353	0.428	0.138	0.268
Economic	0.459	0.264	0.338	0.382	0.330	0.337	0.306	0.515	0.053	0.248
Governance	0.631	0.276	0.418	0.476	0.213	0.373	0.382	0.442	0.186	0.354
Social Readiness	0.265	0.325	0.164	0.210	0.240	0.197	0.371	0.328	0.175	0.202

Source: ND-GAIN Index (2021)

Research Question 1: What degree of risk do the consequences of climate change pose to African states?

Null Hypothesis (H₀): There is no significance in the degree of risk posed by the consequences of climate change to African states.

Alternative Hypothesis (H₁ or H_a): There is a significant degree of risk posed by the consequences of climate change to African states.

Table 2: Descriptive Statistics

	Mean	Std. Deviation	N
Vulnerability	.49190	.083426	10
Readiness	.31600	.090699	10

The descriptive statistics show that the mean vulnerability is 0.49190 while the mean readiness score is 0.31600. This implies that a higher vulnerability level changes the readiness of African states to adapt to climate variability.

Table 3: Correlations

		Vulnerability	Readiness
Vulnerability	Pearson Correlation	1	-.750*
	Sig. (2-tailed)		.013
	Sum of Squares and Cross-products	.063	-.051
	Covariance	.007	-.006
	N	10	10
Readiness	Pearson Correlation	-.750*	1
	Sig. (2-tailed)	.013	
	Sum of Squares and Cross-products	-.051	.074
	Covariance	-.006	.008
	N	10	10
*. Correlation is significant at the 0.05 level (2-tailed).			

The Pearson correlation suggests that ‘Vulnerability’ is negatively correlated with “Readiness” at -0.750 while the p-value which is 0.013 is less than the significance level of 0.05 indicating that the correlation is statistically significant. The negative correlation here indicates that as the level of vulnerability increases the level of readiness for states to adapt decreases.

Nonparametric Correlations

Table 4: Correlations 2

		Vulnerability	Readiness
Spearman's rho	Vulnerability	Correlation Coefficient	1.000
		Sig. (2-tailed)	.
		N	10
	Readiness	Correlation Coefficient	-.857**
		Sig. (2-tailed)	.002
		N	10
**. Correlation is significant at the 0.01 level (2-tailed).			

The Spearman’s rho indicates a strong and statistically significant negative correlation between Vulnerability scores and Readiness. As the readiness scores with a sample size of N (10) is -0.857 with a p-value of 0.02 which is less than the 0.05 level of acceptance, it should however be noted that due to the 2-tailed test, the correlation significance level is pegged at 0.01.

The study findings therefore conclude that there is a strong and statistically significant negative correlation between climate vulnerability and the readiness for adaptation through the governance, economic, and social architecture available in Africa per the sub-regional assessment of the selected states. The study through the Spearman and Pearson correlation analysis has without doubt rejected the null hypothesis. The null hypothesis (H_0) posits that “There is no significance in the degree of risk posed by the consequences of climate change to African states”. In other words, the alternative hypothesis (H_a) is accepted, the study, therefore, finds that “There is a significant degree of risk posed by the consequences of climate change to African states”. The strength of the negative correlation in both tests that is Pearson and Spearman reinforces the finding that the high risks of climate change amount to weakening the readiness for states to adapt.

Research Question 2: What is the relationship between climate finance need and climate finance flows in Africa?

Null Hypothesis (H_0): There is a significant difference between the amount of money received by African countries for climate change mitigation and adaptation in 2020 compared to the estimated amount needed.

Alternative Hypothesis (H_1 or H_a): There is no significant difference between the amount of money received by African countries for climate change mitigation and adaptation in 2020 compared to the estimated amount needed.

Sample T-Test

Table 5: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Climate Finance Needs	48660000000.00000	5	40647915075.683770	18178300250.573483
	Climate Finance Flow	50400000000.00000	5	3243917384.891298	1450723957.202059

The sample T-Test conducted indicates that the average variation in Climate Finance Needs in Africa is USD 48,660,000,000.00000. The approximate standard deviation of Climate Finance Needs is USD 40,647,915,075.683770. The mean standard error for Climate Finance needs is USD 18,178,300,250.573483. The average amount of Climate Finance Flow is USD 5,040,000,000.00000. The standard deviation of the amounts received is approximately USD 3,243,917,384.891298. The standard error for Climate Finance Flow is approximately USD 1,450,723,957.202059. The difference in the amount of the average Finance Needs and the Finance Flows indicates a huge gap in the average amounts of monies disbursed for climate financing as against the amount of funds needed by African states to implement their NDCs.

Table 6: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Climate Finance Needs & Climate Finance Flow	5	-.027	.966

The Paired Sample Correlation indicates that there are 5 paired observations with a correlation coefficient of -0.027 which indicates a weak negative linear relationship between Climate Finance Needs and Climate Finance Flows within the observations paired. The observed p-value of 0.966 is higher than the significance level of 0.05. There is therefore no evidence to suggest that there is no significant relationship between Climate Finance Needs and Climate Finance Flows in Africa as held in the H_1 .

Table 7: Paired Sample Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Climate Finance Needs - Climate Finance Flow	4362000000.000000	40863944988.216690	18274911764.492870	-7119289316.447792	94359289316.447780	2.387	4	.075

The above is a Paired Sample Test that compares the means of the two groups. The mean difference between Climate Finance Needs and Climate Finance Flows is USD 4362,000,000. The standard deviation of the difference is USD 40,863,944,988.216690. The standard error of the mean is USD 18,274,911,764.492870. The Confidence Interval of the Difference was pegged at a 95% confidence level from USD -7,119,289,316.447792 to USD 94,359,289,316.447780. The t-value of 2.387 with 4 degrees of freedom results in a p-value of 0.075 which is marginally above the acceptable level of significance of 0.050.

With the combined effect of the significant level in the Paired Sample Correlation that had a p-value of 0.966 and the Paired Sample Test also produced a p-value of 0.075 all of which are all above the significant level of 0.05, there is no evidence to reject the H_0 , so there is a significant difference between the amount of money received by African countries for climate change mitigation and adaptation in 2020 compared to the estimated amount needed. This is to suggest that the average amount of funds received by Africa is inadequate in sponsoring the NDCs of African states.

To assess the level of risk climate change consequences, have on African states

The consequence of climate change in Africa is widespread. It has been identified by the study that the consequence of climate change in Africa is multifaceted and affects facets of meaningful living in Africa. The findings of the study identified that climate change has had profound influence on the ability of Africa to be able to meet its SDGs thereby threatening the overall development efforts of Africa from the individual level, to household and nationally. Climate change consequence influence key areas including agriculture, health, economy, human security and governance network.

Agriculture

The findings of the study reveal that climate change has had a negative impact on the agricultural sector in Africa. Respondents to the study have identified that Africa is the most vulnerable region in the world and the majority of productive activities are hinged on the agricultural sector, mainly livestock rearing, pastoralism, fishing and mainstream crop farming. Climate change poses a risk due to the reliance of most agricultural activities on nature and weather patterns, which could have a long-term impact on Africa's ability to adapt effectively. Climate variability has had a negative impact on the growth of these productive sectors, thereby threatening other periphery economic activities that are hinged on the performance of the agricultural sector. LECIAD therefore stated that:

the productive force of Africa is hinged on the back of the agricultural sector which is highly threatened and is at a high risk of climate change adversity because most agricultural activities in Africa are climate or weather dependent like rainfall agricultural practices including crop farming, animal husbandry and fishing in most parts of Africa, as a result when it comes to the agricultural sector Africa is at high risk of climate change consequence (2/11/ 2023).

This makes the impact of climate change on agriculture have cascading impacts on all facets of human survival in Africa, as has been established in the study of Baptista et al. (2022) that climate change has had an adverse impact on agriculture in Africa, leading to negative macroeconomic performance in Africa that has affected the

living standards of Africans. The findings of the study also reveal that climate change has led to the rampant occurrence of climate-induced disasters that have had damaging effects on the growth of the agricultural sector in Africa, particularly flooding, cyclones, erratic rainfalls, droughts, desertification and unbearable heatwaves from extreme sunshine. These disasters, as identified, cannot be said to have been non-existent, but the severity of these disasters has become unbearable for agricultural growth, leading to crop failure and the extinction of some vital wild life and aquatic species in some societies in Africa. The net effect is that these risks that have become frequent and extreme have a negative impact on the growth of the sector, which should be of profound concern as Giller (2020) estimates that the agricultural sector in Africa is a major source of employment for more than 50% of the continent's population. This implies that climate risk in the agricultural sector has a negative impact on job creation within the broader scheme of things in Africa since the estimates from Statista (2024) suggest that unemployment rates in Africa are 7.11% of the population. The risk posed by climate change has also affected food security in Africa; most farmlands have been lost as a result of flooding; arable lands have become barren with no potential for crop yield as a result of desertification; and drought has also made it impossible for plant cultivation. Also, the decreasing nature of water bodies in Africa has led to the extinction of some aquatic species that formed part of the catch of fisherfolk, leading to a direct threat to their livelihoods. Climate change further exacerbates the already vulnerable state of Africa as it has made it close to impossible for Africa to meet SDG 2, which is zero hunger. It has affected the availability and accessibility of food and has also crippled the nutritional needs of most African states. UJ therefore muted that:

the severity of climate change has led to the devastation of the agricultural systems ability to secure the food requirements of the African population, not only in the amounts of food available but also in the quality and nutritional needs of most African states and considering the population increase in Africa, this is very serious, and if we may not see this as a risk, then what else can it be (3/11/2023).

This finding is in line with the study of Otekunrin et al. (2020) which suggests that the ability of Africa to meet SDG 2 that is Zero Hunger is hampered by challenges including climate change leading to food insecurity on the continent since there is a high record of hunger and undernourishment on the continent. GR also added that:

growing level of food insecurity on the continent is on the high and is as a result of the growing populations and also the disruption of the agricultural sector as a result of climate change thereby exacerbating the already worsened case of Africa to meet it food needs in terms of its adequacy and its quality in terms of meeting the nutritional needs of Africans (28/10/ 2023).

The finding of this study that climate change poses food insecurity as a risk is affirmed by the study of Atukunda et al. (2021), who established that climate change has been a contributory factor in the increasing prevalence of hunger and found that, as of 2019, 29.1% of the general population of Africa suffered undernourishment and that this number is expected to increase to 25.7% by 2030. The study also found that climate change impact on the agricultural sector has led to an increase in poverty, thereby threatening the ability of Africa to meet requirements towards fulfilling SDG 1, which is no poverty, as climate variability leads to job losses as most of these jobs are interlinked with the progress of the agricultural sector.

Health

Health has been a major sector that has been identified as an area where climate change poses lethal consequences that expose most African populations to the risk of death. Climate change variability has led to several instances where human lives have been threatened, especially in Africa. This is as a result of the already weak health infrastructure available in Africa and its inability to rapidly catch up with the increasingly changing climatic changes that bring in new cases and uncommon health conditions. Climate change-related consequences pose health risks to most Africans, as the continued change in environmental conditions has led to the spread of VBDs and WBDs. The findings of the study do not mean that climate change directly causes these diseases, but rather that it provides enabling conditions for the exacerbation of these health conditions. The spread of VBDs has been largely caused by the destruction of the ecosystems of insects that cause VBDS, including a variety of mosquitoes that can cause malaria, dengue and tsetse flies that can cause Human African trypanosomiasis (HAT), also known as sleeping sickness. The study of Fouque and Reeder (2020) affirms the findings of this

study, as their research found that climate change was responsible for the spread of diseases including malaria and dengue fever, Rift Valley Fever, Japanese encephalitis, human African trypanosomiasis, and leishmaniasis in Africa as a result of erratic rainfalls and flooding. C3SS2 therefore stated that:

climate change has also led importantly to the spread of several diseases in Africa as a result of the destruction and the extremity of weather conditions of disease-causing insects including a variety of mosquitoes and sometimes other insects from the wild that may come to settle with domestic dwellers” (15/10/2023).

GAYO 2 further affirmed that “*climate variability within the health sector is quite widespread as it has undoubtedly led to the increase in water borne diseases and other non-communicable diseases in affected communities of floods who suffer from cholera, elephantiasis among several other diseases (2/10/2023).*

GR also affirmed that:

“In terms of health, there are climate related illnesses that because of climate change that are coming out of excessive heat and the habitat conditions that were supported by a certain level of climate but has changed” (28/10/2023).

Climate change has therefore also contributed to the spread of non-communicable diseases (NCDs), including worsening respiratory diseases like asthma and chronic obstructive pulmonary disease (COPD), as a result of air pollution, extreme heat and, in some cases, bushfires. Extreme heat leads to exhaustion and heat strokes that have direct health consequences. The study further found that climate change has led to an increase in mental health cases. The devastation that comes with climate-related disasters, including cyclones, floods, erratic rainfall, desertification and drought, poses direct mental health stress on victims. The thought of the amount of property and the loss of loved ones by climate change poses serious mental health risks; without proper counselling, such victims may develop mental health disorders. GR therefore stated that:

climate change can even cause mental health issues, imagine yourself losing all that you have worked for, just one flood can unmake your destiny, and considering the weak nature of mental health infrastructure in our part of the world, this is a serious risk that we ought not to joke with (28/10/ 2023).

The study by Cianconi et al. (2020) supports this finding that climate change-related disasters may lead to unplanned migration, loss of livelihood, property and human life, which may also lead to PTSD among victims in Africa. This suggests that climate change may also have damaging consequences for mental health cases in Africa. Climate change-related heat extremes can lead to dermatological diseases, particularly skin cancer, due to direct exposure to UV radiation. Antimicrobial resistance (AMR) is also on the rise as a result of climate change, where some disease-causing microorganisms, including bacteria, fungi and viruses, have developed resistance to drugs, especially antibiotics and antiparasitic medicines. The study by Anjani et al. (2023) confirms that as a result of climate change, AMR is on the rise, which may destabilize global public health and lead to the investment of huge sums of capital by pharmaceutical companies globally to find a solution for them. Climate change-related consequences may also put the whole health system of Africa at risk, as the research mechanisms for ensuring robust measures to find proactive solutions to our health needs have not been adequately addressed. There is a huge gap in health infrastructure and personnel, and a climate health emergency in Africa may lead to the loss of several lives and resources. This therefore suggests that climate change in Africa negatively affects the ability of African states to achieve SDG 3, which is “good health and wellbeing.” The study also found that the impact of climate change on health is not equitably distributed in Africa; the most affected and vulnerable groups to climate-related health risks are predominantly women, children and the elderly. ND-GAIN therefore stated that:

Generally speaking, sensitive populations (children under 5, elderly, people with disabilities, etc.) can face increased health risks with the onset of more climate hazards, i.e., increasing temperatures and increasing rainfall (7/11/2023).

This finding is held in a similar study by Rao et al. (2019), which suggests that climate vulnerability is gendered and that climate change adversely affects women more than men in terms of access to adaptive capacities, of which health is no exception. The study by Salm et al. (2021) also suggests that women and children are nutritionally challenged as a result of climate change impacts in terms of access to food sources, both in quality and quantity.

Economy

Climate change has also had a huge impact on the economies of most African states. As identified earlier, most agricultural systems are dependent on nature-based assisted development; climate change consequences therefore directly affect economic structures in Africa. As the majority of the workforce in Africa is into agriculture and its related economic activities, climate change poses a direct economic threat to most Africans. Long droughts, desertification, floods, cyclones and erratic rainfall imply a decrease in economic activities, resulting in the loss of livelihoods. Climate change-related impacts pose a threat to the ability of economic activities to flourish sustainably. It has had an impact on the sustainability of agricultural-based economic activities. GAYO 1 therefore mentioned that:

the risk of climate can also be cited in the disruption it has for food systems and agricultural activities, this leads to the erosion of livelihoods and therefore serves as a bottle neck for the creation of new jobs therefore leaving many without jobs (2/10/2023).

This finding is in line with the study of Raihan (2023), which suggests that climate change may have a direct negative impact on the economies of developing states, leading to a decrease in economic productive output from about 20 to 40%. The study further reveals that climate change has had an impact on the food value chain of most African states as floods and erratic rainfalls lead to disruptions in the mobility of food from farming communities to main towns for sale, thereby leading to post-harvest losses. Climate change has also had a direct impact on the ecotourism industry in Africa. Most African economies benefit economically from the tourism sector, and climate change has posed a direct risk to this industry. As a result of the reliability of the industry on the ecosystem, climate change has resulted in the destruction of faunal and floral systems that tourists may patronize, but climate change has disrupted this productive aspect of some economies in Africa. LECIAD therefore stated that:

climate change has also destructed eco-tourism in Africa as exotic species and wildlife animals are getting extinct as a result of climate change (2/11/ 2023).

CPI also added that:

most African societies are reliant on tourism of which climate change poses a risk therefore reducing the economic output and revenue generation of these societies (2/11/2023).

Abbass et al. (2022) affirm the findings of this study that climate change has accelerated biodiversity loss in Africa, thereby leading to economic losses in societies that are heavily dependent on the ecotourism sector as their means of livelihood and leading to a loss in revenue generation for those states.

Climate change has also impacted the economic system of Africa by way of posing a challenge to the growth of Small and Medium Sized Enterprises (SMEs) in Africa. Most of these enterprises are reliant on weather-based activities as a means towards scaling up their businesses, and climate change may disrupt their progress. It is estimated by Forbes Africa (2023) that SMEs are responsible for more than 80% of employment in Africa and form more than 50% of the GDP of Africa. This implies that any disruption that may arise as a result of climate change may directly influence economic activities in Africa. Skouloudis et al. (2020), whose research aligns with this finding, suggest that most SMEs in Africa do not have the capacity to withstand climate variability, therefore leading to a weak resilience level, thereby accounting for their obvious fold-up when hit by the consequences of climate change. This risk posed by climate change directly undermines the efforts of African states to achieve SDG 8, which is “decent work and economic growth.”

Governance

Climate change has also posed a direct threat to the operations of governments across Africa. Most states in Africa have faced serious governmental challenges in the form of climate change, which has the potential to challenge and undermine the efforts put in place by governments to provide basic necessities for the survival of their citizens. Climate change as a result of rising sea levels in low-lying areas has made efforts by the government in some cases, which have created good economic structures in these societies, to be eroded by the impact of climate change. The interventions that governments put in place in the agricultural sector may also be eroded by climate change by virtue of floods, cyclones, desertification, erratic rainfall, rising sea level and extreme temperatures. The long-term efforts of governments to address the socioeconomic needs of their population are usually short-lived by climate change, thereby posing a challenge to sustainable and accelerated development in most of the productive sectors of the economy. GMI therefore mentioned that;

most governments in Africa are at direct risk of climate change consequences, they now have a huge responsibility as most their efforts in securing and funding agricultural projects may be washed away as a result of the climate induced disasters that I mentioned earlier (3/11/2023).

Climate change has had a huge impact on revenue losses to the government as a result of the humanitarian aid and support it may have to provide for communities who become directly hit by climate change adversities. These communities would have to be supported by the government through the purchase of relief items and also provide social infrastructure to ensure that they are able to assimilate into a broader society. According to the International Labour Organisation (ILO), Cyclone Idai that occurred in 2029 in Mozambique caused a total damage of USD 1.4 billion with a USD 1.3 billion in losses. The total needs recovery is estimated at USD 2.9 billion in four provinces, including Tete, Manica and Sofala.

Security

Climate change has had a profound impact on the security architecture of various states in Africa. Climate change has diversified the understanding of security in Africa, putting more emphasis on human-centred security in Africa. The Westphalian understanding of security diminishes as a result of climate change. Human security has taken centre stage since climate variability has led to a multifaceted impact that affects all aspects of Africans, from community security, food security, political security, economic security, environmental security, personal security and health security. As a result of the pervasive nature of climate change in Africa, it has threatened all aspects of the meaningful lives of Africans. The increasing sea levels pose a personal security vulnerability to most people who live in lowland areas around the coast and, in some cases, deprive them of their health security. LECIAD therefore stated that:

climate change has a direct impact on the who architecture of security, especially in Africa, the movement of pastoralist farmers have caused several community tensions across West Africa (2/11/ 2023).

The findings of the study by Von Uexkull and Buhaug (2021) also underscore the patterns of agricultural production in Africa and its relations with conflict, establish the linkage of climate-induced migration to conflicts, and assess the risks climate impact has on urban social unrest across Africa. Climate change has, on several occasions, been a fuel for community clashes over arable land. The study also finds that climate change has also led to climate-induced migrations that pose security vulnerabilities and usually turn violent in several communities in Africa. Drought, desertification and shrinking water levels have also posed serious security implications. LECIAD therefore passionately muted that:

the severity of climate change has been underestimated in terms of its security focus, most water bodies within the Sahel and the Northern part of Africa are shrinking and it is leading to serious security stand offs not only limited to communities but among states, there is currently a bitter rivalry between Egypt and Ethiopia over the Nile river, the next phase of wars in Africa will be fueled predominantly by climate change (2/11/ 2023).

Climate change therefore has direct implications for the pervasive and widespread nature of violent conflicts in the Sahelian part of Africa as a result of the extremely vulnerable nature of that part of Africa.

How uniqueness is the climate vulnerability of Africa?

The findings of this study reveal that climate change vulnerability and risk in Africa are quite unique compared to other parts of the world. In terms of anthropogenic GHG emissions, Africa has contributed less to climate change in terms of anthropogenic emissions of GHG as compared to other parts of the world. According to the 2020 Emissions Gap Report by the United Nations Environment Program (UNEP, 2019), the G20 countries accounted for approximately 78% of global GHG emissions in 2017. On the other hand, Africa as a whole accounted for approximately 4% of global GHG emissions in 2017. UJ therefore stated that:

Africa has been the less emitter and contributor to GHG yet bears the brunt of climate risk consequence (2/11/2023).

The study further notes that climate change consequences, risk and impacts are quite hard to measure in Africa as a result of the lack of adaptive capacities and the ability to effectively mitigate climate change risks. Many societies and communities across Africa have hardly been hit by climate change, and as a result of unavailable adaptive measures, they are unable to infuse themselves into the current situation due to its pervasive nature. Climate change resilience levels are therefore not equally shared among continents and even among states and communities across Africa. The study by Chapman and Ahmed (2021) suggests that climate change consequences and risks are deep-seated and extreme in low-income countries, despite the fact that they contribute less to the human-related activities that cause climate change. The study also found that climate change is more pervasive in Africa as a result of its geographic location. Speaking to that GMI averse that:

the geographic location of the region also contributes to the differentiated impact of climate change, I mean Africa spans a large range of latitudes, from the tropics to the subtropics, and has diverse topography and climatic zones, which implies that different parts experience different climate change impacts including droughts, heatwaves rising sea levels and the likes that are not similar to other parts of the world as a result of the pervasive nature of climate risk in Africa (3/11/2023).

The multifaceted impact of climate change was also identified as factors that have made the case of Africa in terms of climate change impact quite different from the rest of the world since climate change impacts are interlinked to all facets of meaningful living in Africa, from food systems to the economy to health and security, among several others. The study further found that the vegetative cover of Africa also contributes to the pervasive nature of climate consequences. As a result of the massive vegetative cover, the study reveals that Africa has become a global carbon sink that immerses all the GHG emitted elsewhere in the world, thereby creating huge room for the variability of climate consequences. LECIAD is therefore notes that:

due to the massive vegetative cover of Africa, it attracts a lot of GHG that is emitted from the West and other parts of the world thereby placing huge burden on the ecological system here in Africa that leads to climate risk (2/11/ 2023).

This therefore speaks to the assertion that the vegetative cover of Africa, which is comparatively huge as compared to the rest of the world, also contributes to the unique nature of Africa's risk of climate variability.

How Africa can reduce climate risk?

The study has identified some key strategies that ought to be used as instruments to ensure that Africa can reduce its current risk. Among the obvious topics that were identified in this study is climate finance, which was mentioned by all the experts who contributed to this study and has been analyzed in the next section. Apart from climate financing, the study found that climate risks in Africa can be reduced through adaptation capacity building in Africa. The focus should be directed towards afforestation and agroforestry to increase the vegetative cover, thereby increasing the carbon sinks in Africa. These processes will ensure that the adversity of climate

change is addressed, but not entirely. This approach has the potential to safeguard crucial resources such as fresh water bodies, stimulate tourism, and ensure seasonal rainfall, which can effectively combat desertification and droughts in many parts of Africa. Afforestation and agroforestry may also open up Africa for opportunities available in the carbon market framework, where the vegetative cover of Africa may be used as collateral and the basis for accessing climate funds to fuel the NDCs of African states. LECIAD therefore mentioned that:

afforestation that is already in abundance in Africa can be used in ensuring access to climate funds, it can also serve as carbon sinks and the emerging carbon market can also be a big deal that Africa can venture into (2/11/2023).

DR also added that:

Africa is surrounded by oceans right from the Atlantic Ocean, Indian Ocean to the East of it. Africa still possess the largest forest field cover together because even though there is Amazon the Congo basin is the second to Amazon. In fact, the statistics I came across recently that the climate mitigation potential of the Congo basin is higher than the Amazon (28/10/2023).

The study of Oyewole et al. (2019) aligns with this current finding, as their research found that afforestation has a huge impact on ensuring development in Africa and also added that an adequate concentration on forestry can catalyze the development of the economic capacities of most African states and can fuel industrialization. The study further finds that afforestation and agroforestry should be practiced with technical and research advice since unsustainable afforestation may lead to an increase in GHG, thereby defeating the purpose of the whole activity towards climate resilience. This finding is affirmed by the study of Di Sacco et al. (2021), who stated that tree planting may serve as best practices in compensating for human-induced CO₂ emissions, yet poorly planned and executed afforestation programs may lead to an increase in CO₂, thereby having a long-term harmful impact on biodiversity and diminishing the potentials that the activity may present.

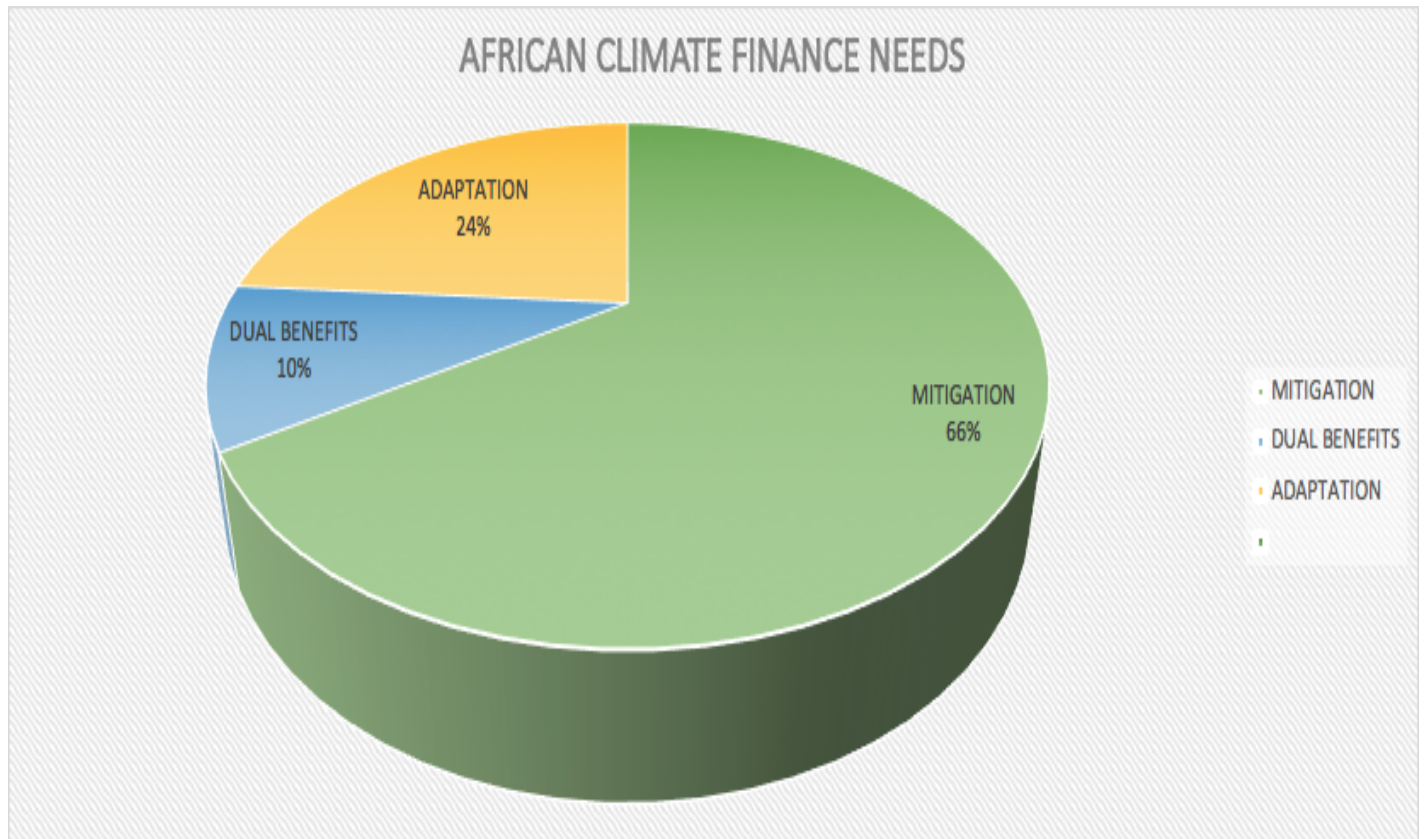
The study further found that climate vulnerability and risks in Africa can be reduced through research. The study found that Africa is a continent impregnated with lots of research opportunities, and when problems are identified through research, solutions are readily available. Research has also proven to be useful in providing solutions to agricultural activities through the development of advanced agricultural practices that can be leveraged to ensure food security. The use of drought friendly seeds and seedlings can be cited as an example of what research can provide in terms of ensuring adaptation mechanisms in African. As part of the solutions to reducing the risk of climate change is the enormous potential of Africa's ecosystem for a just energy transition system that can be supported by the abundant solar energy potential, wind generated power, waterbodies for hydro-energy and geothermal energy. The study of Steve et al. (2022) affirms this finding; their study established that renewable energy had a rich potential for increasing the macroeconomic growth of African states by way of the availability of resources to drive other sectors of the economy while also ensuring a reduction in GHG. The study therefore advocated for an increase in the infusion of renewable energy sources into the energy mix of African states. The study further finds that there should be an improvement in localized adaptive measures to ensure a reduction in the risk of climate change in Africa. Local and indigenous knowledge can be improved through progressive research and the infusion of contemporary technology to ensure the scaling up of adaptive measures at the community level. The study also found that the application of early warning systems including flood warning systems, drought warning systems and other warning systems with inclusive community sensitization and education on the potential risks of climate change may also be a game changer in fostering the reduction of climate change risks and vulnerabilities in Africa.

Sub-regional climate needs overview

The findings of the study reveal that the total cost for the execution of the NDCs in Africa, per the data provided by the CPI (2022) report, is pegged at USD 2.8 trillion between 2020 and 2030. The local governments of the various African countries, per their NDCs presented, are expected to foot USD 264 billion, which is an average of 10%, with the remaining USD 2.5 trillion earmarked for climate finance needs. The World Bank (2022) estimates that the total GDP of Africa is USD 2.38 trillion, and per the DCs presented by the various African

countries, Africa may need an annual USD 250 billion to meet the 2030 climate sustainability targets, which is obviously more than the 10% local commitment targets set by African governments. Despite the calls by many authorities in the field of climate financing for a balanced share of climate allocation and needs for both mitigation and adaptation, the findings of this study suggest that there has, however, been a greater focus and allocation for mitigation by most economies in Africa than adaptation. As a result, mitigation accounted for 66% of the total climate needs of USD 1,607 billion, while an estimated need of USD 579 billion was allocated for adaptation, which is 24% of the total. The rest of the 10% is allocated for overlapping needs, that is, needs that are for both mitigation and adaptation concurrently.

Figure 1: Pie-chart of Climate needs aggregation



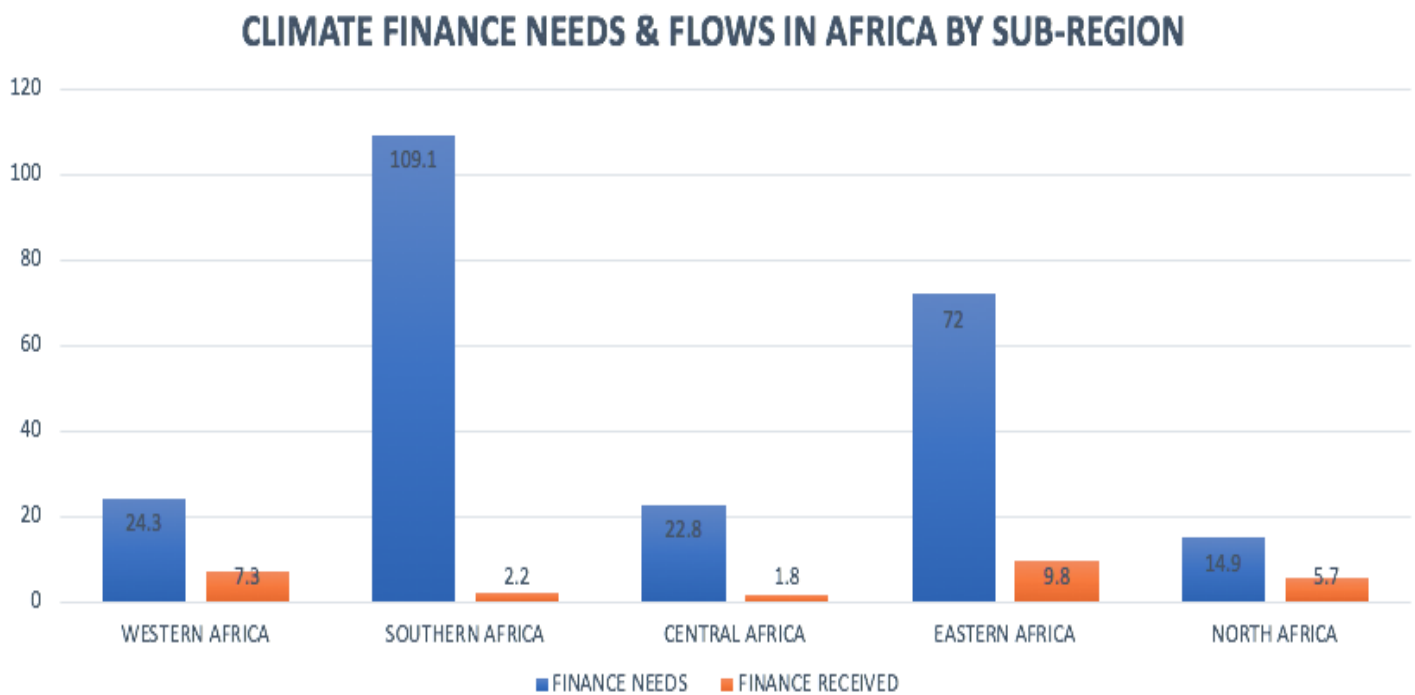
Source: Climate Policy Initiative (2022)

The total average climate finance needs of Africa are estimated by data from the CPI (2022) at USD 277 billion, which is close to the amount estimated by the World Bank (2022) report of USD 250 billion annually. The study estimates the total climate finance needs (2020–2030) of Western African countries at USD 222.7 billion, allocating USD 34.6 billion for adaptation needs, accounting for 15.54% of the total, and USD 188.1 billion for mitigation needs, accounting for 84.46% of the total. In the southern part of Africa, their climate needs are estimated at USD 1.089 trillion, with adaptation financing pegged at USD 271.6 billion, while mitigation is estimated at USD 818.2 billion. In the East of Africa, their total climate needs are estimated at USD 565.7 billion, with USD 156.5 billion for adaptation and USD 409.2 billion for mitigation. Central African countries estimated USD 69.3 billion for adaptation and USD 158.9 billion for mitigation, bringing their total climate needs to USD 228.2 billion. Northern African countries totaled an amount of USD 75.7 billion for their climate needs, with USD 43.1 billion for adaptation and USD 32.6 billion for mitigation. The climate needs of Southern African countries are estimated to be higher than all the sub-regions of Africa, while Northern Africa presented the least climate finance needs of USD 75.7 billion.

Differently, the total annual average climate finance needs of African countries out of their NDCs require an annual funding of USD 277 billion. On the other hand, the climate finance flows recorded between 2020 and 2021 in Africa are a mere USD 29.5 billion, which is just 11% of the total amount needed for African states to be able to meet their climate needs both for adaptation and mitigation.

The annual climate finance needs of Western African states are estimated at USD 24.3 billion, but the actual climate funds received are USD 7.3 billion. In the southern part of Africa, the annual climate finance needs are USD 109.1 billion, yet the actual climate funds received are USD 2.2 billion. In central Africa, their climate needs presented on a year-on-year basis is USD 22.8 billion, but they received USD 1.8 billion. In the East of Africa, their annual climate needs are pegged at USD 72 billion, but they received USD 9.8 billion. In the northern part of Africa, their climate flows are USD 5.7 billion, yet their climate finance needs are estimated at USD 14.9 billion annually.

Figure 2: Annual Climate Finance Flows and Needs by Sub-region



Climate financing and risk reduction mechanisms

The study found that sustainable climate financing in Africa had high prospects of reducing the vulnerability of African states. The study reveals that climate funds can be used to build adaptive mechanisms for resilient societies, as most participants in the study related positively to the ability of climate change to reduce the risks of climate change.

UJ therefore notes that:

climate funds are the most probable instruments that can be used to reduce the risks that climate change pose to most African states through mostly adaptation planning and policy action (2/11/2023).

ND-GAIN further affirmed that:

Increasing access to funding for major infrastructure projects can help reduce certain vulnerabilities like food & water security, health outcomes and limiting damage from climate hazards like flooding, droughts, typhoons (7/11/2023).

Climate financing provides frameworks and the infrastructure for African societies to build strong and resilient institutional capacity to withstand the shocks of climate change. All adaptive mechanisms that can be used to reduce the vulnerability of African states and reduce the risk of climate change are capital-intensive, thereby creating the need for funds for the support of African states. The building of dams for water storage for irrigation purposes in drought-stricken communities would need capital injection for construction. Societies displaced as a result may also need resettlement plans, and communities may also require the use of climate funds to achieve

this. Garschagen and Doshi (2022) have also stated in their research that climate change financing is geared towards aiding developing countries reduce climate risks by way of the principle of common but differentiated responsibility outlined in the UNFCCC and the Paris Agreement. The findings of Lee et al. (2022) affirm the findings of this study, which analysed climate finance flow from 2000 to 2018, shows that climate change has increasingly reduced the emission of GHG and that mitigation financing has had a profound impact on the reduction, which may translate into reducing the climate risks of states. The study therefore found that for effective climate mitigation and adaptation in Africa, there is a need for Africa to have access to climate funds in order to embark on such projects towards building a sustainable future in terms of securing all aspects of the 17 SDGs.

The study further found that for Africa to be able to attract climate funds, there is a need for a creative understanding of the ecosystem capacity of Africa in terms of forest cover and renewable energy potential that can be harnessed and used as the basis for attracting green funds in terms of grants and interest-free funds that have a long-term impact on all aspects of development in Africa.

To assess whether the current state of climate financial flows decreases or exacerbates the vulnerability of African states to climate change consequences.

The findings of this study suggest that the current financial flows, at an average of 11% annually across Africa, are not adequate to address the climate needs of African states.

The study therefore advocates for a properly regulated African domestic revenue generation module supervised by the AU. The study also identifies that the internal generation regime, no matter how rigorous and ambitious, may not be able to fund the needs of African states to reduce their climate risks and vulnerability.

Impact of current climate finance flows to Africa

The study findings establish that climate finance has the potential to reduce climate vulnerability. The study further establishes that current climate finance flows, despite their meagre nature, have made some marginal progress in attending to some mitigation and adaptation projects and climate action activities. Participants in the study mentioned how small and unacceptable the amounts of money received were and how such amounts of money may not be able to meet the direct needs of most African states. CPI averse that;

there is a huge gap in climate finance inflows in Africa as against it needs but what should be noted is that Africa has an enormous opportunity to explore within this period as the money sent has made some gains in some communities but I cannot say it is universal in all parts of Africa (2/11/2023).

Bilateral and multilateral donors primarily receive these climate finance flows through concessional financial frameworks; they typically provide assistance at rates below current rates, with some offering a prolonged grace period. The study also revealed the existence of special funds, such as the Green Climate Fund (GCF), the Special Climate Change Fund (SCCF), and the Adaptation Fund, under the management of the Global Environmental Facility (GEF). There are also private investments from various sources, such as banks, corporations and foundations. These sources have been identified as having helped support adaptation and mitigation programs in various parts of Africa, yet the impact has been reactive and marginal.

Implication of financial gap

The vulnerability of most African states to climate change is alarming, and an unsustainable climate financial regime may worsen and exacerbate the degree of risk and vulnerability. The identification of the huge finance gap in climate fund flows in Africa implies that Africa may not be able to pursue NDCs. The findings of the study therefore establish that this may create a continental crisis that may spill over to other parts of the world. In the case of drought and desertification, millions of affected Africans may join the illegal route into other parts of the world. The growing alarm over water insecurity in many parts of Africa has led to inter-communal conflicts that may get worse if there are no proper adaptive and mitigative mechanisms, which climate financing

has, through this study, established to have the potential to reduce but not eradicate climate risks in Africa. Cao et al.'s (2022) research confirms this finding and suggests that even a small investment in water, along with improvements to its quality and infrastructure, could boost community resilience, preventing violent conflict due to unpredictable rainfall patterns. The study further finds that climate funds ought to be sustainable and targeted towards some key areas that will spill over as benefits into other sectors, including agriculture, forestry, land use and renewable energy transition. This is in line with the sustainable finance theory used in this study. These areas, per this study, have the potential to scale up other sectors of African society in building climate resilience and also ensuring the ability for African states to develop sustainably. Climate finance regimes also have to ensure streamlined regulatory frameworks for ensuring climate equity in terms of prioritizing vulnerable communities and groups and channeling such funds into both adaptive and mitigation projects that build their resilience. This is to say that the current climate finance pathway is not sustainable enough to cater for the climate needs of African states.

RECOMMENDATIONS

Domestic climate finance mobilization framework

The findings of the study suggest that at the national level, African states should establish a national climate or green fund that will ensure the mobilisation of funds through taxing of various institutions, both public and private, that are into environmentally impactful economic activities. These institutions include Oil Marketing Companies (OMCs), mineral extraction and refinery companies, and any other institution whose activities have direct or indirect environmental implications. There is also the opportunity for African states to allocate a percentage of the local budget for financing climate action programs in their respective states. There is the need for African states to de-risk their climate finance mobilization pathways by creating some form of insurance for climate finance mobilization. Pension funds have been identified as a sustainable pathway of collateral for the mobilization and guarantee of climate finance mobilization regimes in Africa. We further found that as a result of the enormous SMEs that exist in Africa, there is the need for domestic governments to ensure investible pipelines that empower and grant these businesses the technical capacity to venture into climate-friendly programs and projects that are bankable and can be able to elicit private and international climate finance grants for a scale-up in their business while propelling climate action. The study concluded that in order to establish a sustainable climate financing framework in Africa, African states must concentrate on retooling their adaptation mechanisms, particularly in the agricultural and energy sectors. While the agricultural sector needs some scale-up in terms of mobilization of structural, infrastructural and technical capacity to reduce the shocks of climate variability. The energy sector, however, requires inward and creative transition pathways that make use of renewable sources in reducing the price of energy and also facilitate access to energy sources, especially electricity.

Sub-regional climate finance mobilization framework

The study further finds that there has been progress in terms of integration in Africa. The various sub-regional bodies that are the Regional Economic Communities (RECs), including the Arab Maghreb Union (UMA), Common Market for Eastern and Southern Africa (COMESA), Community of Sahel–Saharan States (CEN–SAD), East African Community (EAC), Economic Community of Central African States (ECCAS), Economic Community of West African States (ECOWAS), Intergovernmental Authority on Development (IGAD), and the Southern African Development Community (SADC), can serve as pathways towards leveraging local opportunities of some of the states towards building a sustainable financial framework for climate fund mobilization. This can be done by identifying comparatively advantageous climate-friendly projects and opportunities that can be explored by the RECs in mobilising funds; this includes the area of renewable energy transition processes. The RECs can make an ambitious contribution in the creation of renewable energy plants that can be used to power and serve the energy needs of the various member states. This can involve an identification of a comparatively advantageous renewable energy source from several member states where the RECs can fund it and reap the economic benefits within the long term. Also, RECs can also implement regulatory frameworks in sustainable climate mobilization frameworks that will commit states to commit a percentage of their annual budget to raising climate funds in meeting their climate finance needs. The various RECs can also

implement sustainable finance mobilization by creating regulatory frameworks that commit institutions whose activities have environmental implications to pay a percentage tax towards raising climate funds.

Continental climate finance mobilization framework

On the continental level, there should be more radical measures towards ensuring a sustainable climate financial system. The AU must also commit member states to a high degree of annual financial commitment that will be targeted in specific areas of member states, most importantly for drought management, water protection, the elimination of hunger, and also fighting poverty on the continent. Climate finance can facilitate the achievement of these crosscutting benefits and ensure resilience. The AU framework can also strengthen the stance of African states by setting an example for climate action. This could begin with boycotts and other extreme actions that show Africa's displeasure with the promises made and the deliberate partial fulfilment of those promises, along with the continued contribution of anthropogenic GHG by developed states. There should also be advocacy for more regulatory punitive measures for states that are unable to meet their commitments in accordance with the Paris Agreement to ensure that the path is towards net zero. It should, however, be noted that the path to net-zero does not imply the total elimination of fossil fuel but the drastic reduction since coal is still used despite long years of transition from coal to oil and gas.

CONCLUSION

The study utilized the ND-GAIN Index data to establish a significant risk of climate change vulnerability in Africa, demonstrating an inverse correlation between vulnerability and the degree of readiness for African states to adapt to climate variability. An increase in vulnerability leads to a decrease in adaptive capacity in terms of economy, governance and social readiness. The study further establishes quantitatively through a sample T-test that there is a significant disparity in the climate fund needs of African states as against the amounts of money received to satisfy those needs. This was done with the use of the CPI data set on climate finance flows and the climate finance needs data set. Qualitatively, the study affirmed that climate change has a high impact on worsening the vulnerability of African states and that climate variability disables the ability of African states to meet their SDGs. Climate change, therefore, is a risk multiplier and threatens the development of Africa. The qualitative findings and analysis align with the quantitative findings, revealing a significant financing gap between climate finance needs and flows in Africa. This suggests that states within Africa may struggle to meet their Nationally Determined Contributions (NDCs), potentially exacerbating their already vulnerable state. Further, the study found that the current financial framework marginally and negligibly decreases the vulnerability levels of African states, which implies an increase and the establishment of a sustainable financial framework for the mobilization of climate funds. The study further found that to ensure a sustainable climate financing regime, there should be a national budgetary commitment, a sub-regional financial regulatory framework, and a continental climate financing action plan that is more pragmatic towards a net-zero path for Africa. The study further recommends that future research can make use of longitudinal research methods to assess climate finance and climate vulnerability in Africa.

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