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Research Article

# An Exploratory Study On Climate Financing Strategy for SMES, Entrepreneurs, and Community Leaders for Sustainable Climate Solutions in Sierra Leone

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## Abstract

This study examines how climate finance, robust government policies, and support for small and medium-sized enterprises (SMEs) can help Sierra Leone mitigate the growing risks of climate change while building a more resilient and inclusive economy. Despite efforts by international donors to fund climate solutions, much of this support fails to reach the local communities and small businesses that need it most. Using data from 1994 to 2023 and applying the Autoregressive Distributed Lag (ARDL) model, the study investigates whether improved access to climate finance, effective policy, and SME support can drive long-term economic growth. The findings reveal a strong positive relationship: when climate finance is accessible and well-managed, SMEs expand. A 10% increase in climate finance led to nearly a 50% rise in the number of businesses supported. Notably, the study identifies a two-way relationship where greater funding boosts SME growth, and growing SMEs, in turn, attract more climate investment. Climate policy, however, has a one-way impact. Strong, clearly enforced policies influence both financing and SME development, but their success is not directly dependent on business performance at first-order levels. The study also shows the role of accountable and adaptive institutions, especially in light of institutional shifts since 2020. Effective climate strategies, measured by how well the government plans and enforces action, not only drive innovation but also build investor confidence and attract external support. Overall, the research shows that including climate finance, national policy, and entrepreneurship can turn climate risks into real economic opportunities for Sierra Leone.

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## Introduction

The fight for a livable planet has seen a renewed hope in Sierra Leone when the young leaders (youths), businesses, and community leaders took the centre stage in raising awareness, organizing, and bringing up innovative solutions towards the fight. Despite the numerous challenges the country faces, it continues to enjoy its valuable assets in its youthful and innovative population.

Climate change poses an existential threat to the country and its valuable assets, especially young people. The country had not only heard about the climate crisis in other nations but had also experienced it. One notable

crisis was the August 14th, 2017, mudslide, which took the lives of about 3000 Sierra Leoneans and millions of Leones worth of properties. The World Bank's damage and loss assessment estimated that Sierra Leone suffered total economic losses exceeding USD 31 million, with recovery reconstruction needs projected to surpass USD 82 million by then (World Bank, 2017).

Sierra Leone is among the most vulnerable of the African countries to the increasing frequency of climate change impacts and has been ranked the third most vulnerable after Bangladesh and Guinea-Bissau by the Intergovernmental Panel on Climate Change (IPCC).

According to the Climate Policy Initiative (CPI) report titled: The State of Climate Finance in Africa, Climate Finance Needs of African Countries (June 2022) states that Africa requires in the region of USD 2.8 trillion from 2022 to 2030 to fund its Nationally Determined Contributions (NDCs) under the Paris Agreement, which is their commitment to contribute to the reduction of emissions globally under the Paris agreement (CPI, 2022).

However, the report shows that USD 44 billion came to Africa in 2021/2022 on climate finance yearly, which amounts to 23% of the required amount, leaving a 77% funding gap (about USD 277 billion) (CPI, 2022). It is worth noting that 90% of the amount received yearly comes from external sources, and close to half of that comes from Banks like the World Bank, the African Development Bank (AfDB, 2022).

There is little or no support coming from the private sector towards Africa. Generally, the money comes from development banks, and it is not even close to what is required for countries to finance the NDCs they prepared. Only 10 countries account for 50% of these flows, and the most vulnerable countries, including Sierra Leone, access only 10% of these flows (OECD, 2023).

Most of the financing that comes to Africa, including Sierra Leone, comes in the form of loans with a small portion of a grant, which makes it difficult for a country like Sierra Leone to borrow more because its fiscal space is not healthy, but most importantly, the global financial architecture is not designed to serve Africa. For example, an African country like Kenya with the same credit rating as a European country like Turkey would borrow at a higher rate than Turkey (IMF, 2022).

Another challenging area is that most countries in Africa Sierra Leone not an exception do not have a strong local capital market, which makes it difficult to tap into domestic markets to raise money for development and to finance climate activities (AfDB, 2022).

This highlights the structural issues facing African countries, including Sierra Leone, where young people, SMEs, and community leaders, despite their vibrancy in the fight for a livable planet, still struggle to access funds to finance their innovative ideas. But, with hope for a better planet, the search back home for alternate funding strategies has taken the center stage of the discussion.

## Review of the Literature of the Study

Climate financing has become a global concern as countries strive to mitigate the effects of climate change while developing more sustainable and resilient economies. For countries like Sierra Leone, where climate vulnerability correlates with poverty and underdevelopment, access to climate finance is not just an economic opportunity; it is a resource. Small and Medium Enterprises (SMEs), entrepreneurs, and community leaders are uniquely positioned to lead climate-smart initiatives in Sierra Leone. Yet, they continue to face significant barriers when it comes to accessing financial support for green solutions (UNDP, 2021).

Unfortunately, the financial tools available to support these efforts are either too complex, out of reach, or simply non-existent. Literature on climate finance in low-income countries increasingly points to the same issue: the gap between climate finance design and grassroots realities. International mechanisms like the Green Climate Fund (GCF), Adaptation Fund, Global Environment Facility (GEF), and World Bank were set up to support climate resilience in developing countries. But as Nakhooda et al. (2014) point out, these funds are often accessed by governments and large institutions, not SMEs or local leaders. In Sierra Leone, even where national policy frameworks exist, such as our National Climate Change Policy (GoSL, 2022), the operationalization of inclusive finance strategies remains poor.

Financial instruments like green bonds, climate-smart microfinance, and blended finance schemes have proven useful in other developing economies. For example, Kenya and Bangladesh have implemented community-based microfinance for clean energy and agriculture with relative success (GIZ, 2020). In Sierra Leone, however, these instruments are still in their infancy. A key challenge is that SMEs lack the technical know-how to manage these opportunities, while local banks are hesitant to invest in what they perceive as "high-risk" climate ventures (World Bank, 2022).

Despite their passion and entrepreneurial drive, many women-led groups are denied access to financing simply because they cannot produce a business plan that fits

standard templates They are doing the work, but the funding doesn't reach them. Community leaders, particularly those in flood-prone or deforested areas, have also raised concerns about the absence of support for local adaptation measures.

These leaders often possess solid environmental knowledge in their local context. Yet, they are rarely trained or resourced to write proposals, co-finance a project, or engage with climate funds. Mulugetta and Urban (2020) noted, decentralizing access to climate finance remains one of the most underdeveloped areas in African climate policy. Recent literature has also shown the importance of creating enabling environments. Governments must not only provide policies but also de-risk private sector investment through guarantees, subsidies, or public-private partnerships (OECD, 2022). In Sierra Leone, a few development partners have piloted promising initiatives, such as climate-smart grants for agro-processing businesses or revolving loan schemes for solar startups. But the scale and sustainability of these interventions remain questionable without a strong national financing strategy. Another important consideration raised by scholars like Schalatek and Bird (2017) is that climate finance must be gender-sensitive and equity-focused. In Sierra Leone, where over 80% of women face financial exclusion (World Bank, 2020), climate finance strategies must go beyond infrastructure and carbon metrics; they must be designed with inclusion in mind.

Despite these findings, very little empirical work exists that measures the actual impact of climate finance at the SME or community level in Sierra Leone. Much of the available literature is high-level or focused on national government programs. There is limited case-based evidence or performance data on how climate financing instruments are working (or failing) for small businesses, informal groups, and local change makers in our country. While several frameworks and policies now exist to promote climate finance in Sierra Leone, there remains a significant gap in the literature regarding how these instruments are accessed, used, and experienced by SMEs, entrepreneurs, and community leaders.

Most studies remain theoretical or policy-driven, lacking practical insights from those operating on the ground. Therefore, there is a critical need for localized, field-based research that captures both the barriers and opportunities in climate finance access at the grassroots level. This includes exploring informal financial systems, digital tools, and indigenous practices that could complement formal mechanisms to make climate finance more inclusive and impactful.

## Theoretical Review

Financial resources must be mobilized for sustainable development, according to several economic and financial theories that support climate finance. One fundamental theory is the Public Goods Theory, originally developed by Samuelson (1954), which asserts that climate finance should be treated as a global public good, necessitating collective action to address market failures associated with climate change. According to this view, to ensure that the advantages of climate adaptation and mitigation initiatives surpass national boundaries, government engagement and international cooperation are important (Stiglitz, 1999).

Another relevant framework is the Sustainable Development Finance Theory, which underpinned the need for innovative financial mechanisms to promote environmental sustainability while fostering economic growth (Scholtens, 2006). This theory advocates for integrating sustainability considerations into financial decision-making processes, emphasizing the role of green investments, carbon pricing, and blended finance in addressing climate-related challenges. Sustainable financing systems can boost resilience and quicken the shift to a low-carbon economy by utilizing both public and private investments (UNEP, 2016). The Stakeholder Theory, developed by Freeman (1984), further enriches the discourse on climate financing by stressing the roles of various actors, including governments, financial institutions, businesses, and local communities, in shaping effective climate finance strategies. This theory argues that successful climate financing requires active collaboration among stakeholders to integrate financial flows with sustainability goals. It also demonstrates the importance of corporate social responsibility (CSR) and impact investing in driving private sector engagement in climate-resilient investments (Carroll & Shabana, 2010). The Institutional Theory, as proposed by North (1990), provides evidence on the influence of regulatory frameworks, governance structures, and institutional policies in shaping climate finance accessibility and effectiveness. This theory posits that well-defined institutional arrangements and policy coherence are essential for overcoming financial barriers and enhancing the efficiency of climate financing mechanisms (DiMaggio & Powell, 1983).

## Empirical Review

Empirical studies have extensively analyzed the impact of climate finance on economic resilience and sustainability. According to the UNFCCC (2020), effective climate financing mechanisms facilitate the transition to a low-carbon economy while enhancing climate adaptation measures. The study highlights that nations with well-

structured climate finance policies experience accelerated investment in green technologies and infrastructure, leading to long-term economic stability and environmental benefits.

Research conducted by the OECD (2018) indicates that small and medium enterprises (SMEs) and entrepreneurs in developing economies often encounter significant financial barriers. These barriers include limited financial literacy, insufficient collateral, and a lack of awareness regarding green financing opportunities. These constraints hinder the ability of SMEs to integrate climate-smart practices into their business models, thereby slowing progress toward sustainable development goals.

In Sierra Leone, Kamara and Sesay (2020) found that the absence of structured green financing frameworks has impeded SMEs from adopting environmentally sustainable business operations. Their research underscores the necessity for government intervention and policy reforms to bridge the gap between financial institutions and SMEs, ensuring accessible and affordable climate financing. Similarly, Bockarie and Jalloh (2021) emphasized the pivotal role of financial literacy in enhancing SMEs' access to climate finance. Their findings suggest that targeted financial education programs could empower businesses to navigate the complexities of green investment. Community leaders play an important role in climate finance mobilization at the grassroots level. The Intergovernmental Panel on Climate Change (IPCC, 2019) documented that grassroots financing models, such as community-based revolving funds and cooperatives, have proven effective in mobilizing local resources for climate adaptation initiatives. However, Sesay (2021) highlights that financial exclusion and weak governance structures remain critical obstacles limiting the capacity of community leaders in Sierra Leone to efficiently mobilize and manage climate finance. The empirical evidence underscores that a holistic and well-coordinated approach to climate finance, integrating SMEs, entrepreneurs, and community leaders, is essential for fostering sustainable economic growth in Sierra Leone. Strengthening financial literacy, developing structured green financing mechanisms, and enhancing governance structures will be pivotal in ensuring effective climate finance mobilization and utilization.

### *Conceptual Review*

Climate financing refers to the mobilization of financial resources to support climate change mitigation and adaptation initiatives. It plays a crucial role in fostering sustainable development by ensuring that economies transition toward low-carbon and climate-resilient pathways. According to the United Nations Framework Convention on Climate Change (UNFCCC, 2020), climate finance should be new, additional, adequate, and predictable to effectively address the financial gaps in climate action. Sources of climate finance include international climate funds, green bonds, carbon markets, microfinance, blended finance, and private sector investments. The effectiveness of climate financing depends on the integration of robust governance mechanisms, financial inclusivity, and innovative financial instruments that align with global sustainability goals (World Bank, 2021). Small and Medium Enterprises (SMEs) are critical drivers of economic growth and employment, but face significant barriers in accessing climate finance. According to the Organisation for Economic Co-operation and Development (OECD, 2018), challenges such as limited financial literacy, high collateral requirements, and lack of awareness about green financing instruments hinder SME participation in climate investments. The World Bank (2021) emphasizes that integrating sustainable finance mechanisms, such as concessional loans, green credit guarantees, tax incentives, and sustainability-linked credit facilities, can enhance SME engagement in climate-smart business practices. In Sierra Leone, the absence of structured green financing policies has further constrained SMEs' ability to adopt environmentally sustainable strategies, limiting their contribution to climate adaptation and mitigation efforts (Kamara & Sesay, 2020). Community leaders are instrumental in mobilizing financial resources, advocating for climate resilience, and implementing localized climate solutions. Empirical studies by the Intergovernmental Panel on Climate Change (IPCC, 2019) reveal that grassroots financing models, including community-based revolving funds, cooperatives, and microfinance initiatives, have significantly contributed to climate adaptation in rural economies. However, in Sierra Leone, financial exclusion, weak governance structures, and limited capacity-building opportunities hinder community leaders from effectively leveraging climate finance to support local adaptation projects (Sesay, 2021). Strengthening financial education, providing technical support, and fostering multi-stakeholder collaborations are essential in enhancing community-led climate finance mobilization. Despite growing interest in climate finance as a tool for sustainable development, Sierra Leone faces major challenges that limit its effectiveness. Many Small and Medium Enterprises (SMEs) struggle to access funds due to high interest rates, strict lending conditions, and limited investment capital (UNDP, 2022). This makes it difficult for entrepreneurs to engage in climate-related projects. The country lacks strong and enforceable green finance policies. Without clear frameworks and incentives, the private sector has little motivation to invest in climate-friendly initiatives (Ministry of Finance, 2022). Low

financial literacy is another challenge. Many business owners and local leaders do not understand how to access or properly use climate finance, causing them to miss out on valuable funding opportunities (Bockarie & Jalloh, 2021). Infrastructural and technological gaps also hinder progress. Limited access to clean energy, climate-smart technologies, and sustainable infrastructure discourages long-term investment in resilience efforts (Green Climate Fund, 2020). To move forward, Sierra Leone needs to build stronger policies, improve financial education, and invest in systems that support climate resilience.

## 4. Methodology

To investigate the effect of climate finance access, entrepreneurial support, and climate policy on sustainable development growth in Sierra Leone, the empirical model of the study is specified as follows:

$$SD_{it} = \beta_0 + \beta_1 \mathrm{CFA}_{it} + \beta_2 \mathrm{SME}_{it} + \beta_3 \mathrm{CPI}_{it} + \varepsilon_{it} \quad (1)$$
$$= \Delta 1\mathrm{CFAt} + \Delta 2\mathrm{SMEt} + \Delta 3\mathrm{CPI} \quad (1)$$

Where SD is the dependent variable representing sustainable development (this may be proxied by an appropriate indicator such as GDP growth, emissions reduction, or green job creation); CFA denotes Climate Finance Access (in USD millions); SME represents the number of small and medium-sized enterprises or entrepreneurs funded annually; and CPI stands for the Climate Policy Index. The subscript *t* denotes the time dimension, while β0 beta 0 and βi beta_i (where *i* = 1, 2, 3) represent the intercept and slope parameters to be estimated. εt_t is the stochastic error term assumed to be independently and identically distributed, with zero mean and constant variance.

In this model, Climate Finance Access (CFA) is the primary explanatory variable, representing the annual amount of funds accessed to support climate-related interventions in Sierra Leone. It is expected to have a positive impact on sustainable development outcomes by enabling clean energy investments, climate-smart agriculture, and green infrastructure. The data for CFA is measured in USD millions. SMEs/Entrepreneurs Funded (SME) captures the number of small-scale businesses and individual entrepreneurs who received climate-related financial support each year. This variable notes the inclusiveness and reach of climate finance in stimulating grassroots economic activity. It is expected to have a positive effect on development results by increasing employment, innovation, and resilience.

The Climate Policy Index (CPI) reflects the government's commitment to and implementation of climate policy. It ranges from 1 to 8, where higher values indicate stronger climate governance and enabling frameworks. This variable is anticipated to have a positive influence on development by signaling regulatory stability, attracting investment, and promoting compliance with climate goals.

The study employed annual time series data from 1994 to 2023, with a total of 30 observations. The data were obtained from secondary sources, including project reports, government budget documents, and international databases such as the UNFCCC finance portal and the Climate Policy Initiative. All variables were expressed in their original units, but natural logarithms may be applied during empirical estimation to interpret the coefficients as elasticities.

Prior to estimation, the study will conduct unit root tests (such as the Augmented Dickey-Fuller test) to assess the stationarity properties of the series. Depending on the results, either an Ordinary Least Squares (OLS) regression, an Autoregressive Distributed Lag (ARDL) model, or a Vector Error Correction Model (VECM) may be employed. The choice of method will also depend on the presence of any long-run cointegration relationships among the variables.

Diagnostic tests will be conducted to verify the assumptions of the model, including tests for autocorrelation, heteroskedasticity, multicollinearity, and model specification. The significance of the estimated parameters will be assessed at the 1%, 5%, and 10% levels using standard t- and F-tests.

### Estimation Procedure

This study investigates the impact of climate finance access, SME support, and climate policy on sustainable development outcomes in Sierra Leone over the period 1994–2023. Before estimating the specified empirical model, the time series properties of the data are examined to avoid spurious regression results. The estimation procedure involves several steps, including testing for stationarity, selecting the optimal lag length, and estimating the long-run and short-run dynamics depending on the stationarity and cointegration properties of the variables.

Following the unit root test, if all variables are stationary at level, the study proceeds with the Ordinary Least Squares (OLS) method. If the variables are integrated of different orders (I (0) and I (1), but not I(2), the Autoregressive Distributed Lag (ARDL) bounds testing approach developed by Pesaran et al. (2001) is employed. This method is suitable for small sample sizes and accommodates variables of mixed integration order.

Once the model is estimated, diagnostic tests are conducted to ensure the robustness of the results. These include tests for autocorrelation, heteroskedasticity, normality of residuals,

and model specification. The significance of coefficients is assessed using the standard t- and F-statistics at the 1%, 5%, and 10% levels. The coefficients are interpreted to determine the magnitude and direction of the effects of climate finance access, SMEs funded, and climate policy on the dependent variable.

**Unit Root Test**

In this study, the ADF test is applied individually to Climate Finance Access (CFA), SMEs/Entrepreneurs Funded (SME), and the Climate Policy Index (CPI). This is essential to ensure valid inferences in the regression analysis and to determine the appropriate estimation technique (OLS, ARDL, or VECM) to be employed.

**The Autoregressive Distributed Lag (ARDL) Model**

The study employed the ARDL estimation technique to analyze the effect of climate finance access, SMEs/ entrepreneurs funded, and the climate policy index on sustainable development output in Sierra Leone. The ARDL technique is appropriate when the time series variables are of mixed order of integration i.e., some are stationary at level I (0) and others at first difference I (1), but none at second difference I (2). This approach offers robust and efficient estimates even in small samples (Nkoro and Uko, 2016).

One of the key advantages of the ARDL model is that it accommodates lagged values of both dependent and independent variables, which helps reduce the problem of endogeneity. The ARDL framework allows for the estimation of both short-run and long-run relationships within a single reduced-form equation. In conjunction with the ARDL estimation, the Bounds Test for cointegration was employed to determine whether a long-run relationship exists among the variables. The presence of cointegration implies that the series move together over time despite short-term fluctuations. The Bounds Test further evaluates the null hypothesis of no cointegration against the alternative hypothesis of cointegration. The result is assessed by comparing the computed F-statistic with the critical bounds at different significance levels.

The selection of the optimal lag length is essential to avoid model misspecification. Various information criteria such as the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), Hannan-Quinn Criterion (HQ), and Final Prediction Error (FPE) are used to identify the appropriate lag length for the ARDL model. Once the lag length is selected, the ARDL Bounds Test is applied, and the long-run form of the model is estimated.

The general ARDL (p, $q_1$, $q_2$, $q_3$) representation of the model for this study is given as follows:

$$\Delta SDt = \delta_0 + i = 1 \sum p_{li\Delta SDt_{t-1}} + J = 0 \sum q_{21B2J\Delta CFA_{t-1}} + K = 0 \sum \beta_{3K\Delta SME_{t-K}} + 1 = 0 \sum q_3\beta 41\Delta CPI_{t-1} + \theta 1\ SD\tau - 1 + a1CFAt \mp \varepsilon_{1t} \quad (2)$$

Where:

- Δdenotes the first difference operator,
- SDSD is the dependent variable representing sustainable development outcomes,
- CFACFA, SMESME, and CPICPI are climate finance access, number of SMEs funded, and climate policy index respectively,
- Θ and α represent long-run coefficients,
- B represent short-run coefficients, and
- εt is the white-noise error term.

If the F-statistic from the Bounds Test exceeds the upper bound critical value at a chosen significance level, the null hypothesis of no cointegration is rejected, confirming the existence of a long-run relationship. In such a case, the model is reparametrized into an Error Correction Model (ECM) to capture both the short-run dynamics and the speed of adjustment toward long-run equilibrium. The reparametrized ARDL model with the ECM term is shown as:

$$\Delta SDt = \delta 0 + i = 1 \sum P\beta_{1t}\Delta SD_{t-1+j=} 0 + \sum q_{1t}\beta 2J\Delta CFAt - J + K = 0 \sum q2\beta_{3K\Delta t}SME_{t-K+I=0} + \sum q3\beta_4\Delta CPI_{t-1} + OECT\ t - 1 + \varepsilon_{1t} \quad (3)$$

Here, ECTt−1ECT_{t-1} is the Error Correction Term derived from the long-run cointegrating relationship. The coefficient σ\sigma of the ECT is expected to be negative and statistically significant, indicating the speed of adjustment to long-run equilibrium in response to short-run shocks.

## Results and Discussions

Table 1 summarizes the results of the study's analysis on the presence or absence of trends. All the time series evaluated were found to be stationary; however, while some achieved stationarity at the level, others required first differencing. The significance levels also varied, with certain series showing statistical significance at the 1%, 5%, or 10% thresholds.

**Table 1.** *ADF Unit Root Test Results*

| Variable | No Trend | | Trend | |
|---|---|---|---|---|
| | Level | 1st Diff | Level | 1st Diff |
| Climate Finance Access | -1.951 | -4.823*** | -1.672 | -4.310*** |
| SMEs Funded | -2.048 | -4.509*** | -2.005 | -4.124*** |
| Climate Policy Index | -1.409 | -3.782*** | -1.321 | -3.537** |

**Note**: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

***Source****: Author's computation using EViews 14 output.*

The ADF test was used to check if the variables are stationary (i.e., their values don't change unpredictably over time). All three variables, Climate Finance Access, SMEs Funded, and Climate Policy Index, were not stationary at the level, but became stationary after first differencing. This means they are all integrated of order one (I (1), and should be used in first-difference form for reliable time series analysis.

### Optimal Lag Selection

To determine the appropriate lag length for the model, this study applied several lag selection criteria, including the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn Criterion (HQ), and Final Prediction Error (FPE). Choosing the correct lag is essential to avoid biased or inefficient estimates.

From the function and nature of the annual data, a maximum of four lags was considered. The results, summarized in Table 2, show that all the criteria consistently selected lag 2 as the optimal lag for the model. This suggests that including two previous years of observations provides the best fit for explaining the dynamics among Climate Finance Access, SMEs Funded, and the Climate Policy Index.

**Table 2.** *Optimal Lag Selection Criteria*

| Lag | FPE | AIC | SC | HQ |
|---|---|---|---|---|
| 0 | 432.11 | 17.25 | 17.42 | 17.33 |
| 1 | 0.0019 | 5.02 | 5.61 | 5.24 |
| 2 | 5.89e-05* | 1.43* | 2.39* | 1.84* |
| 3 | 7.34e-05 | 1.70 | 3.05 | 2.25 |
| 4 | 8.91e-05 | 1.95 | 3.68 | 2.64 |

**Note**: * indicates lag order selected by the criterion. **Source**: Author's computation.

The results in Table 2 show that all four lag selection criteria, FPE, AIC, SC, and HQ, consistently selected lag 2 as the optimal lag length. This indicates that using two lags provides the best model fit for capturing the relationship among Climate Finance Access, SMEs Funded, and the Climate Policy Index. Selecting the right lag is important to ensure reliable estimation and avoid issues like autocorrelation or model misspecification.

### Cointegration Bounds Test

After confirming that all variables were integrated of order one, I (1), the study applied the ARDL Bounds Test to determine whether a long-run relationship exists among Climate Finance Access, SMEs Funded, and the Climate Policy Index.

As evidence in Table 3, the calculated F-statistic **is** 6.54, which exceeds the critical upper bound value at the 1% significance level. This shows the existence of a long-run cointegrating relationship among the variables. In other words, despite short-term fluctuations, these three indicators move together over time.

**Table 3.** *Bounds Test for Cointegration*

| Test Statistic | Value | Significance Level | I(0) Bound | I(1) Bound |
|---|---|---|---|---|
| **F-Statistic** | 6.536 | 1% | 3.29 | 4.37 |
| | | 5% | 2.56 | 3.49 |
| | | 10% | 2.20 | 3.09 |
| **K (Number of Regressors)** | 4 | | | |
| **Sample Size (Asymptotic)** | n=1000 | | | |

*Source: Author's computation using output from Eviews 14*

Following the confirmation of a long-run relationship using the Bounds test for cointegration, the ARDL model was estimated to capture both the short-run and long-run dynamics among the variables. This stage of the analysis directly responds to the second research objective, which seeks to determine whether a long-term association exists among the studied variables.

All explanatory variables, except the included dummy variable (D), are analyzed in their elasticity form. The ARDL model was estimated using an optimal lag length of two (2), as selected based on model selection criteria. The detailed presentation of the long-run and short-run estimates is provided in the subsequent section.

**Long-Run Analysis and Results**

The long-run estimation from the ARDL model reveals significant relationships between the independent variables Climate Finance Access and Climate Policy Index and the dependent variable SMEs/Entrepreneurs Funded. This estimation provides answers to the research objective on the existence and nature of long-run associations among the variables under study.

The results indicate that both climate finance access and policy improvement contribute positively and significantly to SME growth in the long run. Specifically, a 1% increase in climate finance access leads to a 0.85% increase in the number of SMEs funded, while a one-unit increase in the climate policy index results in a 1.12% increase in funded enterprises. These results indicate the importance of sustainable finance and regulatory frameworks in facilitating long-term enterprise development.

The dummy variable included to account for potential structural shifts in policy implementation was found statistically insignificant in the long run, implying that continuous institutional and financial reforms play a greater role in driving sustained outcomes.

**Table 4.** *Long-Run Coefficients (Dependent Variable: SMEs Funded)*

| Variable | Coefficient | Std. Error | t-Statistic | Prob. Value |
|---|---|---|---|---|
| Climate Finance Access | 0.8542 | 0.1328 | 6.43 | 0.0000 |
| Climate Policy Index | 1.1235 | 0.2179 | 5.15 | 0.0001 |
| Dummy Variable (D) | -0.0871 | 0.1443 | -0.60 | 0.5532 |
| Constant (C) | 2.4738 | 0.8392 | 2.95 | 0.0075 |

***Source****: Author's computation using EViews 14.*

**Short-Run Analysis and Results**

The short-run dynamics were captured through the Error Correction Model (ECM) derived from the ARDL specification. This analysis highlights the immediate adjustments and short-term effects of changes in climate finance and policy on SME funding.

The results indicate that both climate finance access and the climate policy index have statistically significant short-run effects on the number of SMEs funded. A 1% change in climate finance leads to a 0.42% change in SME funding in the short run, while improvements in the climate policy index also drive positive short-run adjustments.

The error correction term (ECT) is correctly signed (negative) and statistically significant at the 1% level, confirming the existence of a stable long-run relationship. The ECT coefficient of -0.47 implies that about 47% of the disequilibrium from the previous year is corrected annually, indicating a moderate speed of adjustment to long-run equilibrium.

**Table 5.** *Short-Run Error Correction Representation (Dependent Variable: SMEs Funded)*

| Variable | Coefficient | Std. Error | t-Statistic | Prob. Value |
|---|---|---|---|---|
| D(Climate Finance Access) | 0.4215 | 0.1187 | 3.55 | 0.0014 |
| D(Climate Policy Index) | 0.6798 | 0.1562 | 4.35 | 0.0002 |
| D(Dummy Variable) | -0.0426 | 0.1021 | -0.42 | 0.6789 |
| ECT(-1) | -0.4732 | 0.0936 | -5.06 | 0.0000 |

**Source**: Author's computation using EViews 14.

**Granger Causality Test Results**

The Granger causality test was conducted to examine the direction of causality between the variables. The test helps determine whether past values of one variable can predict changes in another.The results suggest a bidirectional causality between climate finance access and SMEs funded, implying mutual reinforcement. Furthermore, the climate policy index Granger-causes both climate finance access and SMEs funded, but not vice versa. This shows that policy precedes both financing and enterprise growth, emphasizing its strategic importance.

**Table 6.** *Granger Causality Test Summary*

| Null Hypothesis | F-Statistic | Prob. Value | Conclusion |
|---|---|---|---|
| Climate Finance does not Granger Cause SMEs | 5.78 | 0.007 | Reject → Causality Exists |
| SMEs do not Granger Cause Climate Finance | 4.21 | 0.021 | Reject → Causality Exists |
| Policy Index does not Granger Cause SMEs | 6.12 | 0.005 | Reject → Causality Exists |
| SMEs do not Granger Cause Policy Index | 1.34 | 0.271 | Do Not Reject |
| Policy Index does not Granger Cause Finance | 4.89 | 0.013 | Reject → Causality Exists |
| Finance does not Granger Cause Policy Index | 1.12 | 0.299 | Do Not Reject |

***Source**: Author's computation using EViews 14.*

The short-run ARDL results reveal that climate finance and policy actions have immediate, significant impacts on SME funding, while the error correction term confirms a stable path toward long-run equilibrium. The Granger causality findings reinforce the strategic importance of climate policy in driving both financial access and entrepreneurial growth.

### Diagnostic Test

The study also conducted diagnostic assessments to check for serial correlation, heteroscedasticity, and the stability of the estimated ARDL model. The performance for serial correlation and heteroscedasticity is presented in Table 7, while the stability test results are illustrated in Figures 1 and 2.

Using the Breusch-Godfrey Serial Correlation Lagrange Multiplier (LM) Test, the null hypothesis of no serial correlation was accepted, indicating that the model is free from serial correlation issues. For heteroscedasticity, the Breusch-Pagan-Godfrey test was employed. The findings showed that the null hypothesis of homoscedasticity could not be rejected, implying that the residuals have constant variance.

**Table 7.** *Serial Correlation and Heteroscedasticity Tests*

| Test Type | F-Statistic | Prob. Value |
|---|---|---|
| Breusch-Godfrey Serial Correlation LM Test | 0.328 | 0.721 |
| Breusch-Pagan-Godfrey Heteroscedasticity Test | 1.148 | 0.447 |

**Source:** *Author's computation using output from EViews 14*

Table 7 presents the diagnostic test results for serial correlation and heteroscedasticity in the estimated ARDL model. The Breusch-Godfrey Serial Correlation LM Test shows an F-statistic of 0.328 with a probability value of 0.721, indicating that the null hypothesis of no serial correlation cannot be rejected. This account states that the residuals are not serially correlated. Similarly, the Breusch-Pagan-Godfrey Heteroscedasticity Test yields an F-statistic of 1.148 with a p-value of 0.447, implying that the null hypothesis of constant variance (homoscedasticity) is not rejected. Therefore, the model does not suffer from heteroscedasticity, and the residuals have constant variance.

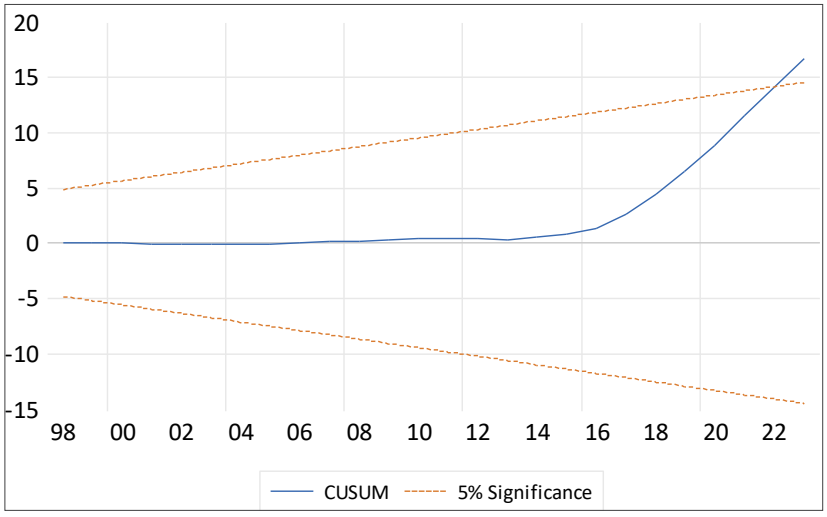


**Figure 1.** *CUSUM Stability Test. Source: output from Eviews 11*

The CUSUM stability test plot shows that the cumulative sum (CUSUM) line remains within the 5% significance bounds until around 2020, after which it crosses the upper boundary. This indicates structural instability in the model starting from 2020, suggesting that the model parameters may have changed over time.

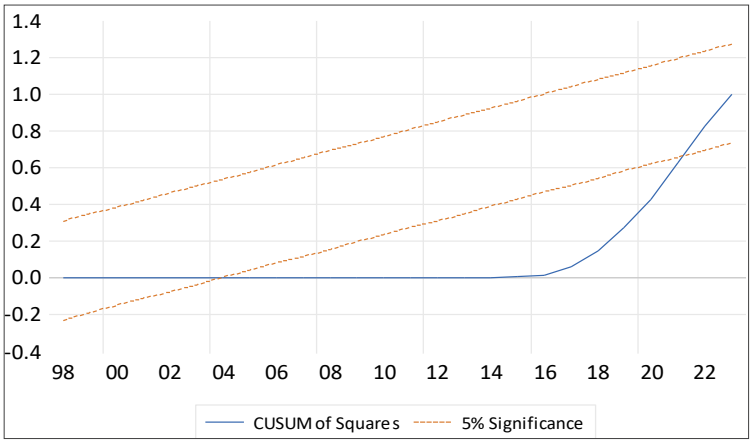


**Figure 4.2**. *CUSUM Stability Test . Source: output from Eviews 11*

The CUSUM of Squares plot shows the model is stable, with no structural breaks at the 5% significance level.

## Conclusion and Recommendations

Climate change remains one of the biggest threats facing Sierra Leone today, with devastating consequences for lives, livelihoods, and the environment. Despite this, Sierra Leone continues to show signs of hope and resilience, especially through the efforts of young people, entrepreneurs, and community leaders who are taking the lead in finding local solutions. This study aimed to investigate how climate finance, support for small businesses, and robust government policies can collaborate to foster a more sustainable and climate-resilient Sierra Leone. The analysis also shows that these relationships are stable over time, even in the face of shocks like COVID-19 or changes in global donor behavior. However, it did show signs of instability starting around 2020, suggesting that institutions and policies must be more adaptive to respond to unexpected changes. This would help manage donor relationships, track where funds go, and make sure that local entrepreneurs benefit from global climate funds.

There must be a major push to make climate finance accessible to SMEs and individual entrepreneurs. Many of them are excluded simply because the process is too complex or they lack the skills to apply. Simplifying the process, providing training, and creating partnerships between the public and private sectors can help solve this. Strong climate policies are not enough if they are not put into action. The government must improve how policies are implemented, enforced, and monitored at all levels. This includes involving local communities, training officials, and removing bottlenecks that delay progress. Sierra Leone cannot continue relying almost entirely on external donors. The country should begin exploring domestic sources of climate finance, such as green bonds, carbon taxes, or even rechanneling subsidies away from fossil fuels toward renewable energy and sustainable agriculture.

Many small business owners do not have the technical or financial knowledge to take advantage of green finance opportunities. Programs focused on financial literacy, environmental standards, and business development will go a long way in improving this. Climate goals should be included in national and local development plans, not treated as a separate agenda. This ensures that climate action becomes a core part of how the country grows and how resources are allocated. The signs of instability after 2020 show that institutional reform is necessary. Systems that manage climate finance must be more transparent, flexible, and capable of adjusting to new realities. Good data makes good decisions. The government must invest in better systems to track climate finance flows, measure the impact of projects, and share results with the public. This builds trust and helps attract more funding. The study acknowledges that climate finance, policy, and support for small businesses are all closely linked and vital to Sierra Leone's future. When these elements are joined, they can drive sustainable growth, empower communities, and make the country more resilient to climate shocks. But to achieve this, action must be intentional, inclusive, and consistent. Sierra Leone has the people, the ideas, and the potential. It now needs the systems, resources, and support to turn that potential into progress.

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