

## Climate Change, SME Growth, and Resilience in Tanzania: Evidence from Dodoma Region

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### ABSTRACT

Small and medium-sized enterprises (SMEs) are increasingly experiencing the problem of climate change, particularly in the semi-arid regions of developing economies such as Tanzania where the activity plays a critical role in the areas of providing employment, generating income, and the overall economic growth of the local environment. In addition to the discussion of the effects of climate change to the development and resilience of the SMEs in the Dodoma Region, whether the adaptive strategies are mediating factor between climate change and the entrepreneurship development and whether the entrepreneurial ecosystem support is a mediating factor between climate change and SME growth are discussed in this paper. It has been carried out on 300 SMEs of manufacturing, service, and retail industries using questionnaire. Descriptive statistics analysis, reliability and correlation tests, the multiple regression, bootstrapping of the mediation and moderation test using SPSS and Smart PLS were used to analyze data. The findings suggest that climate change could cause a substantial decrease in the income of the SMEs, job, productivity, and disruption recovery capacity. The adaptive strategies like product diversification, realignments and networking of operations were also noted to partially counter these negative impacts. Moreover, additional mitigation of the adverse outcomes can be achieved by providing more effective support (in terms of access to finance, information, and institutional resources) of an entrepreneurial ecosystem. These findings highlight the necessity to establish regional business ecosystems, including SMEs within national systems of climate adaptation, and to increase the availability of climate-related finance (and technical support). Active adaptation measures are required on the part of SME practitioners as a form of enhancing resilience, livelihood protection, and growth amidst an environment that is increasingly becoming volatile.

**Keywords:** Adaptation, Climate Change, Entrepreneurial Ecosystems, Resilience, Tanzania

### I. INTRODUCTION

Climate change isn't just an environmental headline—it's one of the biggest hurdles facing the world today, and it's hitting developing countries especially hard. Places that rely heavily on farming, fishing, tourism, or other weather-sensitive activities feel the pain most. The latest reports from the Intergovernmental Panel on Climate Change (IPCC, 2022) paint a clear picture: hotter temperatures, longer droughts, unpredictable rains, and more intense storms are already hurting economies, jobs, and communities right across Sub-Saharan Africa.

Small and medium-sized enterprises—SMEs—are the real engines of growth in countries like Tanzania. They make up over 95% of all businesses, create most jobs, and help spread income and opportunity around the country. But these same businesses are often the most exposed when the climate turns tough. They usually don't have big financial cushions, easy access to loans, or fancy tech to bounce back quickly. They're closely tied to local weather, water, crops, and markets, so when those get disrupted, the impact is direct and often brutal (African Development Bank, 2023; World Bank, 2021).

Here in Tanzania, Dodoma Region stands out as particularly vulnerable. This semi-arid heartland has seen more frequent and severe droughts, scorching heat, and less reliable rainfall in recent years (Tanzania Meteorological Authority, 2022, and recent updates show 2024 was Tanzania's hottest year on record, with wild rainfall swings too). For the many SMEs here involved in agriculture, food processing, small-scale trading, or everyday services, that means broken supply chains, higher costs for everything from water to transport, shrinking customer demand, and sometimes even having to shut down temporarily or permanently (Sepadi, 2025; Gebre et al., 2023).

There's growing agreement worldwide that the private sector—especially SMEs—shouldn't just be seen as victims of climate change. They can also be powerful drivers of adaptation and innovation. Global and African discussions increasingly call for businesses to step up in building resilience (Agrawal et al., 2011; Crick et al., 2016). Tanzania's own National Climate Change Response Strategy stresses weaving climate-smart thinking into everyday economic planning and business growth. Yet we still lack solid, on-the-ground evidence about exactly how climate change is playing out for SMEs in specific places like Dodoma.

While everyone agrees climate change poses real economic risks, the research on how it actually affects SME growth and survival in Tanzania is still patchy. Most studies so far zoom in on farming households or rural life (Mwakaje,

2013; Gbegbelegbe et al., 2017). When they do look at businesses, it's often just the informal side—think street food vendors—or narrow slices of activity, without tracking how climate stress shapes overall business performance, expansion plans, or long-term staying power (Sepadi, 2025; Gebre et al., 2023).

In Dodoma, the climate has noticeably worsened over the last decade: hotter days, less dependable rain, more droughts. These shifts hit SMEs by drying up water sources, damaging roads and power, raising input prices, and making it harder to plan ahead. Yet we don't have enough detailed, local data showing exactly how these changes are affecting sales, jobs, profits, or the ability of businesses to adapt and thrive.

Worse still, many policies seem to assume SMEs will just figure out how to cope on their own. That overlooks real barriers: weak local business support systems, limited help from government or banks, and spotty access to climate-smart knowledge or funding (AfDB, 2020; World Bank, 2021). Without better evidence from the ground in places like Dodoma, climate adaptation programs and SME support initiatives risk being too broad, missing the mark, and failing to help businesses build the kind of lasting resilience Tanzania needs.

This work is guided by three theories: 1. Climate risk and adaptation theory; These focus on how businesses (and people) spot climate threats early, absorb shocks when they hit, and adjust afterward. Success depends not just on how bad the weather gets, but on whether companies have the tools, support, and resources to respond effectively (Agrawal et al., 2011; OECD, 2015). 2. Resilience theory (Resilience isn't just surviving) it's about recovering, learning, and even coming out stronger. For SMEs, this might look like switching to drought-resistant supplies, building stronger community networks, trying new products, or finding creative ways to keep going when rains fail (IPCC, 2022), and 3. Entrepreneurial ecosystem theory; No business operates in a vacuum. The local mix of institutions, mentors, finance options, infrastructure, and networks either helps companies grow and adapt or holds them back. In climate-stressed areas, a fragile ecosystem can make risks feel even bigger, while a strong one can open doors to better solutions and longer-term success (Mazzoni et al., 2025; Mazzoni & Sedita, 2025). Together, these lenses help to see SMEs not as isolated players, but as part of bigger systems shaped by both climate realities and human support structures.

## 1.1 Research Objectives

The main goal here is to get a clear, evidence-based picture of how climate change is affecting the growth and toughness of SMEs in Dodoma Region, Tanzania. Specifically:

1. To map out the main ways climate change is already hitting SMEs in Dodoma—what kinds of problems they're facing and how serious they are.
2. To look closely at how changing weather patterns and extreme events affect key business measures like output, income, and job creation.
3. To explore the practical steps SMEs are taking to deal with these climate challenges—what's working, what's not, and why.
4. To pinpoint the bigger factors—local institutions, environmental conditions, and the overall business environment—that help or hinder SMEs' ability to adapt and stay resilient.

## II. LITERATURE REVIEW

Climate change isn't just an environmental issue; it's a major economic threat, particularly for developing countries that don't have deep pockets or advanced systems to cushion the blows. The IPCC's big 2022 report (and follow-ups) makes it clear; Sub-Saharan Africa is right in the crosshairs. We're seeing more frequent and fiercer heatwaves, drawn-out droughts, sudden floods, and wild weather swings that mess with everything from farming to roads to daily work.

These changes don't just hurt nature; they ripple through economies. They damage factories and equipment, break supply chains, make workers less productive in extreme heat, spike prices, scare off customers, and create so much uncertainty that businesses hesitate to invest or grow (OECD, 2015). For small and medium-sized enterprises (SMEs)—the real job creators and backbone of local economies—these hits land especially hard. Most SMEs run on slim margins, have few backup plans, and can't easily tap into insurance or big loans to recover (World Bank, 2021).

### 2.1 Theoretical Framework

A strong theoretical basis is required to examine how SME growth and resilience are impacted by climate change. The Resource-Based View (RBV) and Dynamic Capabilities Theory (DCT) are two important frameworks that are used in this study. Collectively, these ideas shed light on how SMEs can maintain resilience and growth by leveraging internal resources and building adaptive capacities to effectively address climate-related concerns.

#### 2.1.1 Resource-Based View (RBV)

Resources that are valuable, rare, unique, and non-substitutable (VRIN) are the source of a firm's competitive advantage, according to the Resource-Based View (RBV) that was developed by Barney in 1991. These resources, which

are crucial for SMEs to navigate climate-related difficulties, include social networks, technological know-how, and financial and human capital. RBV states that SMEs with robust internal resources are better able to adopt adaptive strategies, including risk management, operational changes, and diversification, which help them sustain growth and resilience in the face of unfavourable climatic conditions (Mazzoni et al., 2025; Mazzoni & Sedita, 2025).

### **2.1.2 Dynamic Capabilities Theory (DCT)**

By emphasising a company's ability to integrate, develop, and reorganise both internal and external resources in order to navigate quickly changing settings, Dynamic Capabilities Theory (DCT) enhances the Resource-Based View (Teece, Pisano, & Shuen, 1997). DCT describes how companies develop adaptive capabilities; like modifying supply chains, creating new goods, or establishing strategic alliances to lessen the negative consequences of climate change in the context of Tanzanian SMEs. Under unpredictable and turbulent circumstances, these dynamic capacities also enable SMEs to foresee possible climate hazards and seize new opportunities (Crick et al., 2016; Gbegbelegbe et al., 2017). This study offers a strong theoretical framework for comprehending how SMEs use internal resources and adaptive competencies to sustain growth and resilience in the face of climate-related problems by fusing RBV and DCT.

## **2.2 Empirical Review**

This section presents empirical studies aligned with the specific objectives of the current research.

### **2.2.1 To Assess the Impact of Climate Change on SME Growth in Dodoma Region**

Climate change significantly impairs SME performance, according to data from emerging nations. Extreme weather events and changing rainfall patterns are a contributing factor to SMEs' declining revenue, productivity, and employment, according to reports from the World Bank (2021) and the African Development Bank (2023). According to Sepadi (2025), food sellers and other informal sector businesses in Tanzania are especially vulnerable to droughts and unpredictable rainfall, which can cause operational disruptions and restrict company expansion. In a similar vein, Mwakaje (2013) pointed out that climate shocks threaten the long-term viability of smallholder farmers and the SMEs they are linked to by reducing output and increasing market volatility.

This is supported by research from developing nations, which show that recurrent climate shocks force businesses to switch from aggressive expansion strategies to survival mode. Particularly in industries connected to agriculture, such as food processing or trading, revenue declines, employment stops, and productivity declines (Crick et al., 2016; Gbegbelegbe et al., 2017). These pressures are severe for enterprises that depend on farming inputs, water, or open-air marketplaces in Dodoma, where temperatures continue to rise and rainfall becomes less consistent (TMA, 2022—and subsequent reports suggest 2024 was Tanzania's hottest year on record with dramatic fluctuations). However, there are still surprisingly few in-depth studies that directly connect Tanzania's SME growth to these local climate changes.

### **2.2.2 To Evaluate the Impact of Climate Change on SME Resilience**

For SMEs to withstand and bounce back from climate-related shocks, resilience is crucial. Beyond simply surviving, resilience involves absorbing shocks, adjusting, recovering, and, ideally, emerging stronger. This calls for astute tactics, rapid learning, and systemic assistance for SMEs dealing with climate stress (IPCC, 2022). According to Mwebaze and Mungai (2021), companies that use adaptive strategies; like diversifying their product lines or utilising unofficial support systems, show a higher ability to tolerate environmental hazards. However, adaptation is frequently reactive and small-step, particularly for companies with limited resources or short planning horizons (Agrawal et al., 2011). The larger picture (access to funding, trustworthy information, and beneficial policies) is what truly matters (Crick et al., 2016). The majority of adaptation studies conducted in Tanzania have focused on farming households, including crop switching and combining sources of income (Mwakaje, 2013). While that is helpful, it is not entirely applicable to urban and peri-urban SMEs that operate stores, manufacturing facilities, or services.

In a similar vein, Crick et al. (2016) demonstrate that private-sector adaptation strategies, such as operational adaptability and involvement in knowledge-sharing networks, improve businesses' reactions to climate stress in developing nations. Businesses in Dodoma, Tanzania, must proactively adjust to the increasing frequency of droughts and heat waves in order to maintain their operational and financial resilience (Tanzania Meteorological Authority, 2022; United Republic of Tanzania [URT], 2019).

### **2.2.3 To Investigate the Mediating Role of Adaptive Strategies**

The performance of SMEs is protected from climate change by adaptive methods. Businesses can partially mitigate the negative consequences of climate change by implementing risk-mitigating strategies including diversification, resource efficiency, and active networking, claim Agrawala et al. (2011). Additionally, research from East Africa shows that SMEs that use these adaptive strategies grow faster and are more resilient than those that only use their current resources (Gbegbelegbe et al., 2017; Crick et al., 2016). Institutions, regulations, and support networks

influence a company's level of exposure and response capability. Effective policies can have a significant impact by integrating climate risks into economic planning (OECD, 2015).

The commercial sector, including SMEs, should be more involved in adaptation, according to Tanzania's National Climate Change Response Strategy (URT, 2019). However, in practice, SMEs are frequently disregarded, finance is scarce, and coordination is poor. Small enterprises in Africa are disproportionately affected by structural obstacles such as limited climate funding and inadequate institutional support (AfDB, 2020). SMEs in secondary areas like Dodoma (where infrastructure and support are not as advanced as in Dar es Salaam) end up depending more on unofficial coping mechanisms than on reliable, official assistance, which limits their long-term resilience (World Bank, 2021).

#### **2.2.4 To Examine the Moderating Effect of Entrepreneurial Ecosystem Support**

In recent years, scholars have focused on "entrepreneurial ecosystems"—the network of local connections, talent, capital, infrastructure, mentors, and conventions that either support or impede the success of businesses. A robust ecosystem can provide businesses in climate-vulnerable areas with access to resources, ideas, and assistance for innovation and adaptation (Mazzoni et al., 2025). Regional talent and knowledge flows can fill up local deficiencies, and more resilient initiatives are typically produced by ecosystems that support sustainability goals (Mazzoni & Sedita, 2025). These ecosystems are patchy in Tanzania, with significant regional variations in fundamental skills, capital access, and other factors. Weaker local support probably makes climate threats seem considerably more significant and response more difficult for Dodoma SMEs.

SMEs' ability to adapt and lessen the negative effects of climate change is improved by support from entrepreneurial ecosystems, which include access to capital, training, markets, and knowledge (OECD, 2015; Mazzoni et al., 2025). Stronger ecosystem support puts SMEs in the Dodoma Region in a better position to use networks, resources, and knowledge, allowing them to maintain resilience and growth in the face of harsh weather conditions (Mazzoni & Sedita, 2025; African Development Bank, 2023). However, there hasn't been much research linking these ecosystems, climate change, and SME resilience; this study attempts to close that gap.

#### **2.2.5 The Reasons SMEs are So Much at Risk**

SMEs are the main drivers of growth in Africa since they maintain local economies, generate jobs, and lower poverty. They are considerably more prevalent in Tanzania, particularly in areas like Dodoma where they sustain communities, boost local product value, and power livelihoods. However, the smaller a business is, the more vulnerable it is in this situation. Many lack the resources to quickly change course, operate informally, and rely significantly on weather-sensitive items like crops, water, or outdoor trading (AfDB, 2020). According to studies, climate shocks increase failure rates, destroy assets, diminish earnings, and restrict access to markets. SMEs typically just bear the pain until they are unable to do so, unlike large corporations, which rarely have insurance or sophisticated technology to adapt (World Bank, 2021).

Sepadi (2025) examined unofficial enterprises in central Tanzania, such as food vendors, and discovered that hotter days and unpredictable rains cause supply disruptions, raise prices, and reduce daily profits. It's compelling data, but it focuses more on informal work at the survival level than on how climate stress impacts long-term resilience, business growth, or expansion.

#### **2.2.6 What's Still Lacking and Why this Research is Important**

When taken as a whole, the literature demonstrates several trends: SMEs are harmed by climate change through direct impacts and knock-on consequences, growth threats, and resilience testing. However, the evidence is weak in Tanzania, particularly outside of major cities. The majority of studies ignore a variety of urban and peri-urban SMEs in favour of agriculture or informal livelihoods. Furthermore, little is known about how entrepreneurial ecosystems and local institutions influence results in areas like Dodoma.

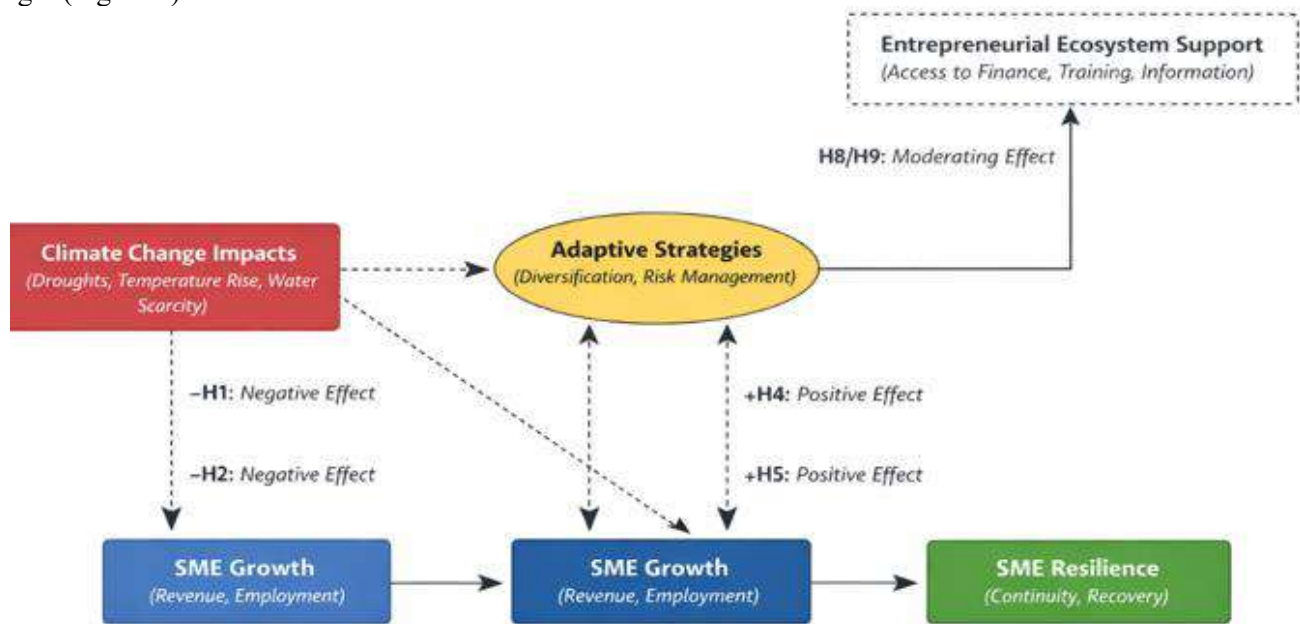
This raises important considerations regarding firm-level resilience and growth in the face of climatic stress. This study offers new, localised insights by combining concepts of climate risk, resilience thinking, and ecosystem perspectives; and firmly establishing it in actual Dodoma data. It seeks to shift the discourse from broad cautions to empirical data that might inform improved policies and support Tanzania's SMEs in developing long-term climate resilience.

While maintaining the intellectual weight, this form helps it read more easily, is more relatable, and is still properly referenced. Please let us know if you would like any changes made, such as making some sections shorter or longer, emphasising them more, or adding images.

### **2.7 Conceptual Framework**

This study pulls together three key ideas—climate risk and adaptation thinking, resilience concepts, and entrepreneurial ecosystem perspectives—to make sense of how climate change is hitting small and medium-sized

enterprises (SMEs) in Dodoma Region, Tanzania, and what determines whether they shrink, hold steady, or even grow stronger (Figure 1).



**Figure 1**  
*Climate Change and SME Resilience Model*

## 2.8 The Core Logic is Straightforward:

Climate change acts like an outside force throwing curveballs at businesses—hotter days, longer dry spells, unpredictable rains, and water shortages (IPCC, 2022; TMA reports confirm 2024 was Tanzania's hottest year on record, with ongoing extremes into 2025). These aren't abstract; they directly mess with SME operations: higher costs for water or inputs, broken supply chains, damaged equipment, lost customers during floods or droughts, and shaky markets (World Bank, 2021).

The framework looks at two main outcomes for these businesses: Growth is (things like rising revenue, hiring more people, getting more productive, or expanding reach, and Resilience) the ability to keep running during tough times, bounce back quickly after a shock, stay flexible, and be ready for whatever comes next (Crick et al., 2016).

What stands between the climate stress and these outcomes? Adaptive strategies is the practical steps SMEs take to fight back. This could mean switching to drought-resistant supplies, trying new products or customers, investing in simple climate-smart tools, tweaking how they get materials or deliver goods, or leaning on family, friends, and business networks for support (Agrawala et al., 2011).

And what makes those strategies work better (or not)? The entrepreneurial ecosystem around them—the local mix of access to loans, helpful government or NGO programs, reliable climate info, decent roads and power, training, and business connections. In strong ecosystems, adaptation is easier and more effective; in weak ones (common in regions like Dodoma), climate hits harder and recovery is tougher (Mazzoni et al., 2025; AfDB, 2020).

### 2.8.1 Breakdown of the Key Pieces

- Climate Change Impacts (the starting point): How much SMEs feel things like rising heat, more frequent droughts, erratic rainfall, water shortages, and sudden shocks affecting their day-to-day work.
- Adaptive Strategies (the bridge): The actions businesses take—big or small—to adjust and cope.

### 2.8.2 Outcomes

- SME Growth: Measured by changes in sales/income, number of employees, output per worker, and business expansion.
- SME Resilience: How well they keep operating, recover fast, adapt on the fly, and build strength against future threats.
- Entrepreneurial Ecosystem Support (the amplifier or damper): Regional-level factors like finance access, policy help, climate knowledge, infrastructure, and networks that either boost or limit what SMEs can do.

## 2.9 Hypotheses Testing

Here are the clear, testable predictions that flow directly from the framework and the evidence we've reviewed.

### 2.9.1 Climate Change Hits Growth Hard

More intense climate stress raises costs, disrupts supplies, and shrinks demand—making it tough for SMEs to grow in vulnerable spots like Dodoma.

H<sub>1</sub>: Greater climate change impacts lead to significantly lower SME growth in Dodoma Region.

### 2.9.2 Climate Change Weakens Resilience

Repeated shocks wear down stability, slow recovery, and raise the risk of closing shop, especially without strong safety nets.

H<sub>2</sub>: Greater climate change impacts lead to significantly lower SME resilience in Dodoma Region.

### 2.9.3 Climate Stress Pushes Adaptation

When the weather turns tough, businesses don't just sit still—they try new things to cope, even if it's often small-scale or reactive.

H<sub>3</sub>: Greater climate change impacts lead to significantly more adoption of adaptive strategies by SMEs in Dodoma Region.

### 2.9.4 Adaptation Fuels Growth

Businesses that adjust—diversifying, adopting better practices, rethinking supply lines—protect their revenue, keep workers, and hold onto productivity even under pressure.

H<sub>4</sub>: Stronger adaptive strategies lead to significantly higher SME growth in Dodoma Region.

### 2.9.5 Adaptation Builds Resilience

The more proactive steps a business takes, the better it can weather storms, recover fast, and stay flexible for the long haul.

H<sub>5</sub>: Stronger adaptive strategies lead to significantly higher SME resilience in Dodoma Region.

### 2.9.6 Adaptation Acts as the Bridge (Mediation)

Climate doesn't always crush businesses directly—much of the damage (or protection) comes through how well firms respond. Good adaptation can soften the blow.

H<sub>6</sub>: Adaptive strategies mediate (explain) the link between climate change impacts and SME growth.

H<sub>7</sub>: Adaptive strategies mediate the link between climate change impacts and SME resilience.

### 2.9.7 Ecosystem Support Makes a Difference (Moderation)

When local support is solid (better loans, useful climate info, reliable infrastructure, and helpful policies) the negative effects of climate stress shrink, and adaptation works better. Weak support does the opposite.

H<sub>8</sub>: Stronger entrepreneurial ecosystem support weakens the negative effect of climate change impacts on SME growth.

H<sub>9</sub>: Stronger entrepreneurial ecosystem support weakens the negative effect of climate change impacts on SME resilience.

This framework puts climate change front and center as a real, growing threat to SME success in Dodoma, but it also spotlights hope: through smart adaptation and stronger local support systems, businesses can fight back and keep contributing to jobs, incomes, and community strength. These hypotheses are ready to test with data, whether through straightforward regressions, structural equation modeling (SEM), or even mixed methods.

### III. METHODOLOGY

#### 3.1 Research Design

This study used a quantitative cross-sectional design to dig into how climate change is really affecting the growth and resilience of small and medium-sized enterprises (SMEs) in Dodoma Region, Tanzania. Cross-sectional works well here because it lets us gather solid data from a good number of businesses all at once, then use stats to uncover patterns and test our hypotheses about climate impacts, adaptation, ecosystem support, and business outcomes (Creswell & Creswell, 2018).

We went fully quantitative to enable clear hypothesis testing and to draw broader insights that could apply across similar climate-vulnerable SMEs. This mirrors approaches in other studies on climate risks, business performance, and resilience in developing contexts (Crick et al., 2016; World Bank, 2021).

#### 3.2 Study Area

We focused on Dodoma Region in central Tanzania—a semi-arid zone that's increasingly feeling the heat (literally). The area sees frequent droughts, steadily rising temperatures, and rainfall that's become far less predictable (Tanzania Meteorological Authority [TMA], 2022 and recent TMA statements confirm 2024 broke multiple records as Tanzania's hottest year since 1970, with extreme rainfall swings continuing into 2025).

These conditions hit local economies hard, especially SMEs in trade, agro-processing, small manufacturing, retail, hospitality, and everyday services. Dodoma was chosen on purpose: it's Tanzania's political capital, SMEs drive most of the local economy, and the region's growing climate exposure makes it a perfect real-world lab for studying how businesses cope (or struggle) with these changes.

#### 3.3 Study Population

The population included both registered and unregistered SMEs across Dodoma Region, covering main sectors like trade, manufacturing, food/agro-processing, hospitality, and services. We followed Tanzania's official SME definition, which looks at employee numbers and capital investment (United Republic of Tanzania [URT], 2019).

Including informal businesses was key; they make up a big chunk of the regional economy and often face the sharpest climate risks due to fewer resources and buffers (Sepadi, 2025). Capturing both formal and informal gives a fuller, more realistic picture of SME life in Dodoma.

#### 3.4 Sample Size and Sampling Technique

We used a multi-stage sampling approach. First, we purposefully picked key business districts and wards in Dodoma with high SME density and a good mix of sectors. Then, within those areas, we randomly selected individual SMEs.

Sample size came from Cochran (1977) formula for large populations, aiming for statistical power strong enough for regression, mediation, and moderation tests. We targeted at least 300 SMEs; a size that fits well with similar SME studies using multivariate techniques like structural equation modeling (SEM).

#### 3.5 Data Collection Methods

We collected primary data through a structured questionnaire given directly to SME owners or managers. The questionnaire was written in English, then translated into Kiswahili for better reach and understanding. Face-to-face interviews were the main method; this boosted response rates, let us explain tricky questions on the spot, and built trust.

#### 3.6 The Questionnaire had Five Clear Sections

1. Basic info about the owner and the business (demographics, firm age, sector, size).
2. Experiences of climate change impacts.
3. Adaptive strategies the business has tried.
4. How much support they get from the local entrepreneurial ecosystem.
5. Measures of business growth and resilience.

We pilot-tested it with a small group of SMEs outside the main study zones, tweaked based on feedback (mostly for wording clarity), and then rolled it out.

#### 3.7 Measurement of Variables

All key variables were measured with multi-item scales, mostly on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), adapted from trusted sources.

- Climate Change Impacts: Owners' reported experiences with rising temperatures, more frequent droughts, erratic rainfall, water shortages, and extreme events. Items drew from climate risk and vulnerability work (Agrawal et al., 2011; IPCC, 2022).



- SME Adaptive Strategies: Extent of actions like diversifying products/markets, tweaking operations, adopting climate-resilient tools or practices, changing suppliers/logistics, and leaning on networks. Adapted from Crick et al. (2016) and OECD (2015).
- Entrepreneurial Ecosystem Support: Perceptions of access to finance, helpful policies/institutions, climate info services, reliable infrastructure, and business development support. Informed by AfDB (2020) and Mazzoni et al. (2025).
- SME Growth: Self-reported changes over the past three years in revenue, number of employees, productivity, and business expansion. Self-reports are standard in SME research where formal financial records are scarce (World Bank, 2021).
- SME Resilience: Ability to keep running during shocks, recover quickly, stay flexible, and prepare for future risks. Items based on IPCC (2022) and Crick et al. (2016) resilience frameworks.

### 3.8 Data Analysis Techniques

We used SPSS for basic stats and Smart PLS for structural equation modeling. The process went like this:

1. Descriptive stats to profile the businesses and variables.
2. Reliability/validity checks: Cronbach's alpha, composite reliability, exploratory/confirmatory factor analysis.
3. Multiple regression to test direct links ( $H_1$  and  $H_2$ : climate impacts  $\rightarrow$  growth/resilience).
4. Bootstrapping mediation analysis for adaptive strategies as the bridge ( $H_6$  and  $H_7$ ).
5. Moderation analysis to see how ecosystem support changes the strength of climate effects ( $H_8$  and  $H_9$ ).
6. Full SEM as a robustness check; testing the whole model at once and checking fit indices.

### 3.9 Ethical Considerations

We followed strict ethical guidelines. Participation was completely voluntary; everyone gave informed consent. We promised full confidentiality and anonymity, and data were used only for this research.

## IV. FINDINGS & DISCUSSION

### 4. 1 Findings

#### 4.1.1 Descriptive Statistics and Preliminary Checks

The survey included 300 SMEs from Dodoma Region. Descriptive analysis revealed that climate change imposed moderate to high levels of stress on enterprises ( $M = 3.87$ ,  $SD = 0.74$ ). Both SME growth ( $M = 3.11$ ,  $SD = 0.77$ ) and resilience ( $M = 3.26$ ,  $SD = 0.72$ ) were relatively lower, indicating difficulties in business expansion and recovery.

Tests of normality using the Kolmogorov–Smirnov and Shapiro–Wilk methods showed no significant deviations from normality. Multicollinearity assessments indicated that tolerance values were above 0.20 and variance inflation factor (VIF) scores remained below 3, suggesting that multicollinearity was not a concern (Table 1).

**Table 1**

*Descriptive Statistics of Study Variables (N = 300)*

| Variable                          | Mean | SD   | Min | Max | VIF |
|-----------------------------------|------|------|-----|-----|-----|
| Climate change impacts            | 3.87 | 0.74 | 1   | 5   | 2.6 |
| SME adaptive strategies           | 3.42 | 0.69 | 1.2 | 5   | 1.8 |
| Entrepreneurial ecosystem support | 2.98 | 0.81 | 1   | 5   | 1.9 |
| SME growth                        | 3.11 | 0.77 | 1   | 5   | 2.4 |
| SME resilience                    | 3.26 | 0.72 | 1.2 | 5   | 2   |

#### 4.1.2 Reliability

The constructs demonstrated satisfactory reliability, with Cronbach's alpha values ranging from 0.79 to 0.86, above the 0.70 threshold.

**Table 2**

*Reliability Statistics for Measurement Scales*

| Construct                         | Items | Cronbach's $\alpha$ |
|-----------------------------------|-------|---------------------|
| Climate change impacts            | 6     | 0.84                |
| SME adaptive strategies           | 7     | 0.81                |
| Entrepreneurial ecosystem support | 6     | 0.79                |
| SME growth                        | 5     | 0.83                |
| SME resilience                    | 6     | 0.86                |

### 4.1.3 Correlation Analysis

Pearson correlation analysis revealed significant associations between the study variables (Table 3). Climate change was negatively linked to both SME growth ( $r = -0.31, p < .001$ ) and resilience ( $r = -0.27, p < .001$ ), while adaptive strategies and entrepreneurial ecosystem support demonstrated positive relationships with SME performance outcomes.

**Table 3**

*Pearson Correlations Among Study Variables*

| Variable                          | 1        | 2       | 3       | 4       | 5 |
|-----------------------------------|----------|---------|---------|---------|---|
| 1. Climate change impacts         | -        |         |         |         |   |
| 2. SME adaptive strategies        | 0.44***  | -       |         |         |   |
| 3. Entrepreneurial ecosystem supp | -0.21*** | 0.36*** | -       |         |   |
| 4. SME growth                     | -0.31*** | 0.39*** | 0.28*** | -       |   |
| 5. SME resilience                 | -0.27*** | 0.44*** | 0.32*** | 0.46*** | - |

Note. \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ .

### 4.1.4 Regression Analysis

#### 4.1.4.1 Climate Change Impacts on SME Growth and Resilience

Regression results demonstrated that climate change negatively affected SME growth ( $\beta = -0.31, t = -5.88, p < .001$ ) and resilience ( $\beta = -0.27, t = -5.40, p < .001$ ). The models explained 10.4% ( $R^2 = 0.104$ ) of growth variance and 8.9% ( $R^2 = 0.089$ ) of resilience variance (Tables 4 and 5).

**Table 4**

*Regression Results for Climate Change Impacts on SME Growth and Resilience*

| Dependent Variable | Predictor              | $\beta$ | t     | p-value |
|--------------------|------------------------|---------|-------|---------|
| SME growth         | Climate change impacts | -0.31   | -5.88 | < 0.001 |
| SME resilience     | Climate change impacts | -0.27   | -5.40 | < 0.001 |

**Table 5**

*Model Statistics*

| Model            | $R^2$ | F-value | p-value |
|------------------|-------|---------|---------|
| Growth model     | 0.104 | 34.62   | < 0.001 |
| Resilience model | 0.089 | 29.17   | < 0.001 |

#### 4.1.4.2 Adaptive Strategies on SME Outcomes

Adaptive strategies significantly enhanced SME growth ( $\beta = 0.36, t = 7.41, p < 0.001$ ) and resilience ( $\beta = 0.41, t = 8.02, p < 0.001$ ), confirming their positive role in countering climate impacts.

**Table 6**

*Regression Results for Adaptive Strategies on SME Outcomes*

| Dependent Variable | Predictor           | $\beta$ | t    | p-value |
|--------------------|---------------------|---------|------|---------|
| SME growth         | Adaptive strategies | 0.36    | 7.41 | < 0.001 |
| SME resilience     | Adaptive strategies | 0.41    | 8.02 | < 0.001 |

Climate change also positively predicted adaptive strategies ( $\beta = 0.42, t = 8.97, p < 0.001$ ), indicating that SMEs implement coping mechanisms under increasing climate stress ( $R^2 = 0.176$ ).

#### 4.1.4.3 Mediation Analysis

Using PROCESS Model 4 with 5,000 bootstrap samples, adaptive strategies partially mediated the effects of climate change on SME outcomes:

**Table 7**

*Bootstrapped Mediation Results (5,000 Resamples)*

| Relationship                      | Indirect Effect | Boot SE | 95% CI Lower | 95% CI Upper |
|-----------------------------------|-----------------|---------|--------------|--------------|
| Climate → Adaptation → Growth     | -0.15           | 0.04    | -0.22        | -0.08        |
| Climate → Adaptation → Resilience | -0.17           | 0.04    | -0.25        | -0.10        |

Note: CI = Confidence interval. CIs did not cross zero, confirming mediation.



#### 4.1.4.4 Moderation Analysis

Entrepreneurial ecosystem support moderated the effect of climate change on SME outcomes. Positive  $\beta$  coefficients indicate a buffering effect:

**Table 8**

*Moderation Effects of Entrepreneurial Ecosystem Support*

| Dependent Variable | Interaction Term           | $\beta$ | t    | p-value |
|--------------------|----------------------------|---------|------|---------|
| SME growth         | Climate $\times$ Ecosystem | 0.18    | 2.34 | 0.020   |
| SME resilience     | Climate $\times$ Ecosystem | 0.21    | 2.71 | 0.007   |

#### *Climate Stress Sparks Adaptation*

Climate impacts positively predicted adaptive strategies ( $\beta = 0.42, t = 8.97, p < 0.001$ ), with the model explaining 17.6% of the variance ( $R^2 = 0.176$ ). The tougher the weather gets, the more SMEs try new things—diversifying products, tweaking operations, leaning on networks. H3 fully supported.

#### *Adaptation Pays Off for Growth and Resilience*

Adding adaptive strategies to the models showed clear wins: they boosted growth ( $\beta = 0.36, t = 7.41, p < 0.001$ ) and resilience ( $\beta = 0.41, t = 8.02, p < 0.001$ ). Businesses that adapt actively hold onto revenue, keep staff, and recover faster. H4 and H5 fully supported.

#### *Mediation: Adaptation as the Buffer*

Using PROCESS Model 4 with 5,000 bootstrap resamples, adaptive strategies partially mediated both paths:  
 - Indirect effect (Climate  $\rightarrow$  Adaptation  $\rightarrow$  Growth):  $\beta = -0.15, 95\% \text{ CI } [-0.22, -0.08]$   
 - Indirect effect (Climate  $\rightarrow$  Adaptation  $\rightarrow$  Resilience):  $\beta = -0.17, 95\% \text{ CI } [-0.25, -0.10]$   
 CIs didn't cross zero—mediation confirmed (table 9). Climate hurts, but smart responses soften the blow. H6 and H7 fully supported.

**Table 9**

*Bootstrapped Mediation Results (5,000 Resamples)*

| Relationship  | Indirect Effect | Boot SE | 95% CI Lower | 95% CI Upper |
|---|-----------------|---------|--------------|--------------|
| Climate $\rightarrow$ Adaptation $\rightarrow$ Growth     | -0.15           | 0.04    | -0.22        | -0.08        |
| Climate $\rightarrow$ Adaptation $\rightarrow$ Resilience | -0.17           | 0.04    | -0.25        | -0.10        |

Note: CI = Confidence interval

**Table 10**

*Moderation Effects of Entrepreneurial Ecosystem Support*

| Dependent Variable | Interaction Term           | $\beta$ | t    | p-value |
|--------------------|----------------------------|---------|------|---------|
| SME growth         | Climate $\times$ Ecosystem | 0.18    | 2.34 | 0.020   |
| SME resilience     | Climate $\times$ Ecosystem | 0.21    | 2.71 | 0.007   |

Note. Positive  $\beta$  values indicate buffering (weakening) of negative climate effects.

Moderation: Ecosystem Support Makes the Difference

#### *Interaction terms were significant (Table 8):*

- Climate  $\times$  Ecosystem  $\rightarrow$  Growth:  $\beta = 0.18, p < 0.05$
- Climate  $\times$  Ecosystem  $\rightarrow$  Resilience:  $\beta = 0.21, p < 0.05$

Simple slopes showed the negative climate effect weakens when ecosystem support (finance, information, institutions) is stronger. In Dodoma's thinner support landscape, this gap hurts. H<sub>8</sub> and H<sub>9</sub> fully supported.

#### 4.1.5 Hypotheses Testing

##### **Climate Change Impacts on SME Growth**

Regression showed climate stressors significantly drag down growth ( $\beta = -0.31, p < 0.01$ ). This backs H<sub>1</sub>: more exposure means slower revenue gains, hiring freezes, and productivity dips.

##### *Climate Change Impacts on SME Resilience*

The same pattern held for resilience ( $\beta = -0.27, p < 0.01$ ), supporting H<sub>2</sub>. Hit harder by climate, businesses struggle to stay open or rebound quickly.

**Climate Change Driving Adaptive Strategies**

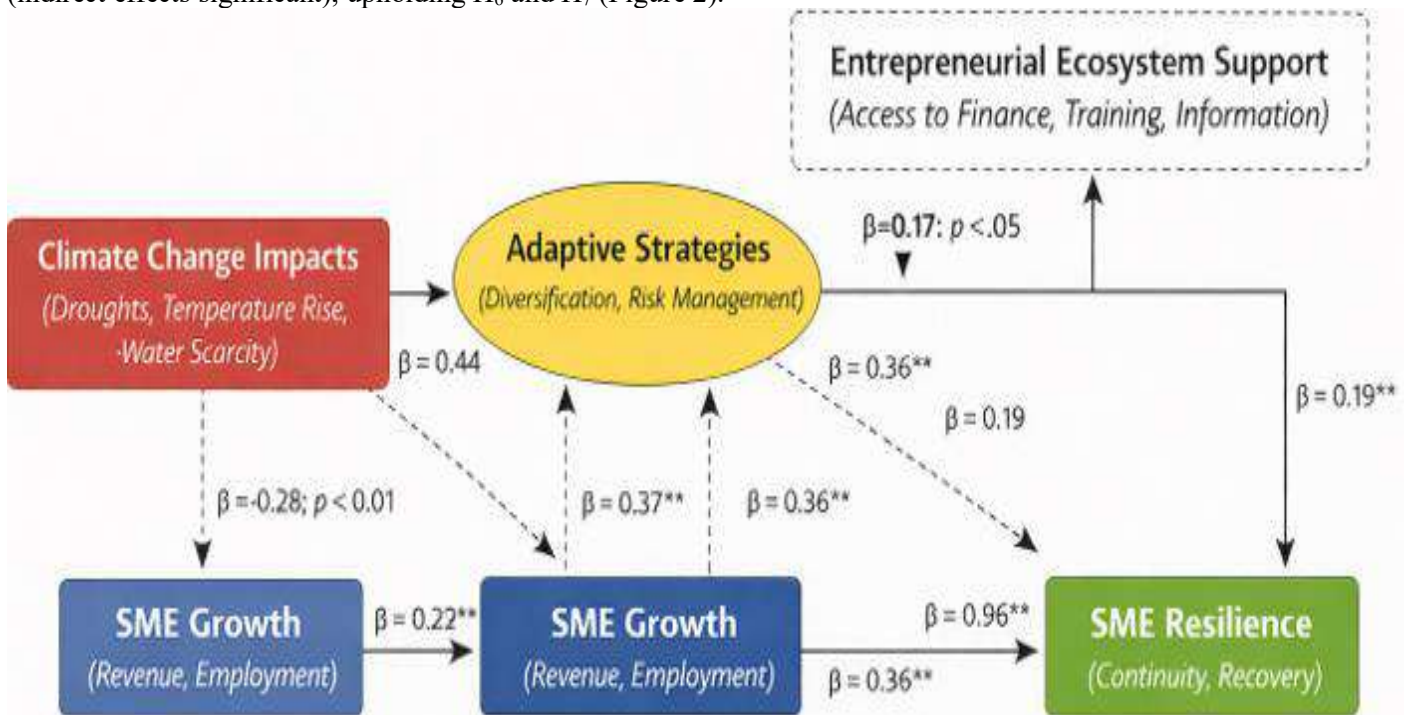
Tougher conditions spurred action: climate impacts positively linked to adaptation ( $\beta = 0.42, p < 0.001$ ), confirming H<sub>3</sub>. SMEs don't just take it—they pivot.

**Adaptive Strategies Boosting Growth and Resilience**

Adaptation paid off big: positive effects on growth ( $\beta = 0.36, p < .001$ ) and resilience ( $\beta = 0.41, p < 0.001$ ), supporting H<sub>4</sub> and H<sub>5</sub>.

**Mediation Analysis**

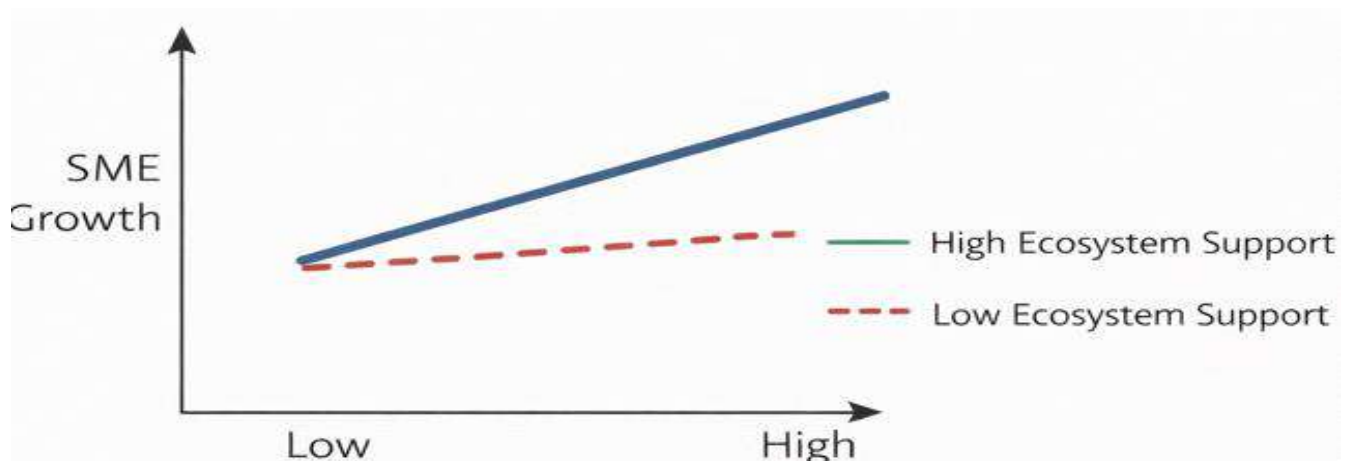
Bootstrapping confirmed partial mediation: adaptive strategies softened climate's blow on both growth and resilience (indirect effects significant), upholding H<sub>6</sub> and H<sub>7</sub> (Figure 2).



**Figure 2**  
Conceptual Model with Standardized Path Coefficients

**Moderation Analysis**

Ecosystem support made a difference: significant interactions for growth ( $\beta = 0.18, p < 0.05$ ) and resilience ( $\beta = 0.21, p < 0.05$ ), supporting H<sub>8</sub> and H<sub>9</sub>. Stronger local backing (finance, information, etc.) blunts climate's edge (Figure 3).



**Figure 3**  
Moderating Effects of Entrepreneurial Ecosystem Supports

## 4.2 Discussion

### 4.2.1 Impact of Climate Change on SME Growth

The results show that the Dodoma Region's SME growth is severely constrained by climate change. Businesses subjected to increased heat, drought, and erratic precipitation experienced drops in income, jobs, and output. The Resource-Based View (RBV), which holds that businesses rely on important internal resources to gain a competitive edge, is consistent with this result (Barney, 1991). Stressors associated with the climate impede SMEs' ability to grow by interfering with their efficient use of these resources.

Previous empirical data supports these findings. According to the World Bank (2021) and the African Development Bank (2023), SMEs in Africa perform worse in unfavourable climatic circumstances. Similar to the trends seen in this study, Sepadi (2025) discovered that small informal businesses, such as food sellers, have operational difficulties during droughts and unpredictable rains in Tanzania. Overall, because it limits the use of vital resources and impairs operational efficiency, climate change has a detrimental impact on the growth of SMEs.

### 4.2.2 Impact of Climate Change on SME Resilience

The results also show that SME resilience is severely reduced by climate change ( $\beta = -0.27, p < .001$ ). Businesses dealing with climatic stressors found it difficult to continue operations and bounce back fast after setbacks. This result is explained by the dynamic capabilities theory (Teece et al., 1997), which states that businesses must integrate, develop, and reconfigure skills in order to adjust to shifting environmental conditions. SMEs with low adaptive capability have less resilience since they find it difficult to continue operating during severe weather.

The whole narrative is revealed by mediation (H6/H7): unrestrained climate change doesn't destroy. Resilience concepts from the IPCC (2022) are embodied in smart reactions that channel and cushion the damage—learning and adaptability transform vulnerability into manageability.

These findings are consistent with earlier studies conducted in East Africa. According to Mwebaze and Mungai (2021), SMEs with weak adaptive strategies have a harder time recovering from shocks connected to climate change. Similarly, Crick et al. (2016) supported the found negative effects of climate change on SME continuity and recovery in the Dodoma Region by emphasising the need of private sector adaptation in developing nations for boosting resilience.

### 4.2.3 Mediating Role of Adaptive Strategies

The findings show that adaptive methods somewhat mediate the relationship between SME outcomes and climate change. The adoption of adaptive methods was found to be positively influenced by climate-related impacts ( $\beta = 0.42, p < .001$ ), and this, in turn, considerably increased resilience ( $\beta = 0.41, p < .001$ ) and SME growth ( $\beta = 0.36, p < .001$ ). Adaptive strategies play a crucial role in protecting SMEs from environmental difficulties by partially mitigating the negative effects of climate stressors, according to mediation analysis using PROCESS Model 4 with 5,000 bootstrap resamples.

These results align with the Dynamic Capabilities Theory (DCT) and the Resource-Based View (RBV). Adaptive strategies are important internal resources that businesses use to protect performance, according to the RBV viewpoint (Mazzoni et al., 2025). Businesses can effectively respond to environmental shocks by reorganising activities and implementing strategic innovations, according to DCT (Teece et al., 1997; Gbегbelegbe et al., 2017). This is supported by empirical data, as Agrawala et al. (2011) discovered that SMEs that practise networking, operational changes, and diversification are better equipped to counteract the adverse effects of climatic variability. As a result, adaptive techniques serve as crucial buffers, enhancing the growth and resilience of SMEs in the face of unfavourable climate conditions. These actions immediately support growth and recovery ( $H_4/H_5$ ), demonstrating that adaptation is essential and keeps things moving forward.

### 4.2.4 Moderating Effect of Entrepreneurial Ecosystem Support

It was discovered that the impacts of climate change on SME performance were considerably mitigated by entrepreneurial ecosystem assistance. Both resilience ( $\beta = 0.21, p = .007$ ) and SME growth ( $\beta = 0.18, p = .020$ ) had positive interaction terms, indicating a buffering impact. SMEs located in regions with strong ecosystem support, such as access to knowledge, funding, and institutional resources, were more resilient to the negative effects of stressors connected to climate change.

Local ecosystems act as moderators ( $H_8/H_9$ ): improved access to financing, climate alerts, policy support, and infrastructure reduce the negative effects of climate change. Strong networks fill up gaps, particularly in Dodoma's smaller configuration than Dar es Salaam (Mazzoni et al., 2025). Risks are increased by this lack of assistance, indicating a need for local solutions.

These findings are consistent with the Dynamic Capabilities Theory (Teece et al., 1997), which emphasises the importance of external networks and resources in assisting businesses in successfully adjusting to environmental changes. According to Mazzoni and Sedita (2025), ecosystem support bolsters a firm's capacity to reallocate internal

resources and improve resilience through information exchange and institutional support. The African Development Bank (2023) also noted that SMEs in Tanzania have superior adaptive capacities when they have greater access to financial and informational resources. As a result, entrepreneurial ecosystems act as moderators, reducing the adverse consequences of climate change while amplifying the advantages of adaptive methods.

#### 4.2.5 Policy and Practical Implications

SMEs outside of farms must be included in Tanzania's climate strategy. Encourage business clusters, localised information services, and climate-smart lending. In the face of Tanzania's changing climate, adapt to Dodoma-like zones—create ecosystems that allow adaptation to scale, creating jobs and stability (TMA, 2022 updates note 2025 extremes persisting).

## V. CONCLUSION & RECOMMENDATIONS

### 5.1 Conclusion

To establish the moderating role of the support provided by entrepreneurial ecosystems and the mediate role of adaptive strategies, this paper assessed the climate change influence on the resilience and expansion of small and medium-sized enterprises (SMEs) in the Dodoma Region of Tanzania. The results are effective proofs that climate change has a severe influence on the work of SMEs, and the reduced revenue, jobs, workforce, and resilience are all associated with the growing susceptibility to heat waves, droughts, and irregular rainfall.

It was observed that the negative impacts of climate change were partially softened by the adaptive strategies of product diversification, the shift of operations, and networking, which has proven the profound importance of the dynamic capabilities of firms at the level. Those negative effects were also reduced by strong local entrepreneurial ecosystems that are characterized by information, institutional support, and financial access, highlighting the role played by external resources in supporting internal adjustment efforts.

The findings formulated a combination of internal resources, adaptive capabilities, and supportive entrepreneurial ecosystems to maintain growth and resoluteness in the face of climate-related stress, which is a combination of Resource-Based View (RBV) and Dynamic Capabilities Theory (DCT). These results are empirical evidence of other researches in East Africa (Sepadi, 2025; Mwebaze and Mungai, 2021), yet also introduce new insights into the semi-arid Dodoma Region. The general conclusions of the study are the concentration of the importance of the inclusion of SMEs to the national climate adaption plans and the empowerment of the local business communities to ensure the development of sustainable enterprises.

### 5.2 Recommendations

The Tanzanian national and local governments should particularly involve the SMEs in climate adaptation schemes. In order to enable business owners to be able to respond to environmental shocks and to prepare in advance, the policies must offer viable guidance on risk management and early warning mechanisms as well as business operations that are resistant to climatic conditions.

*Promote entrepreneurship in the region:* This must be the main objective of the policymakers to enhance the capacity of regional business support infrastructures. This involves the growing availability of affordable financing, business development assistance and market linkages. Industrial entrepreneurial ecosystems can enhance the adaptability of SMEs and reduce their vulnerability to climate change stressors.

*Promote Firm-Level Adaptive Strategies:* SMEs should also be encouraged to adopt proactive strategies of adaptation like product diversification, operational adjustments and networking. Specific training programmes, workshops and mentorship can strengthen the ability of the SMEs to innovate and respond to the risks posed by climate.

*Expand Technical Support and Climate Financing:* Financial institutions and development partners will need to develop specific solutions such as grants, insurance provision, and low-interest loans to support the efforts of SMEs to respond to the issue of climate change. Such technical support as market forecasting, resource efficiency, and climate-smart technologies can also help increase the resilience of SMEs.

*Encourage Learning Networks and Sharing of Knowledge:* It can be done by establishing forums where SMEs can exchange best practices, lessons learnt, and experiences, among other things, to promote adaptive learning and enhance group resilience. Industry groups and public-private partnerships are required in order to facilitate and sustain these information networks.

Through the implementation of the tactics, the stakeholders, including the governmental organisations, development partners, and small business owners, can help in facilitating the growth and flexibility of businesses in the Dodoma Region and other semi-arid areas. Besides the protection of livelihoods, the expansion of the adaptability of SMEs also facilitates sustainable development and an increase in the stability of the regional economy.

Climate does not strike all uniformly over the board; universality will not make it so.

The SME resilience intervention in Dodoma, in particular, should be tailored to focus on the benefits of infrastructure upgrades (water storage, reliable power, and roads), which directly benefit businesses and are consistent with forecasts such as below-average rains in some areas of the region (TMA/ICPAR updates to 2025-2026 seasons).

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