

CLIMATE CHANGE RISK: THREATS TO THE PERFORMANCE OF MICRO, SMALL AND MEDIUM SCALE ENTERPRISES IN NORTH EAST, NIGERIA

ORUGUN Johnson Juwon¹; Musa Noah Adujo² & SULEIMAN Olusegun³

^{1,2,&3} Department of Business Administration

Prince Abubakar Audu University, Anyigba

Corresponding Author's Email: musanoah@gmail.com

+2348039356405

Abstract

Climate change poses severe threats to Micro, Small, and Medium Enterprises (MSMEs) in North East Nigeria, compounding insecurity with environmental disruptions. Droughts, flooding, and rising temperatures are driving increased operational costs, supply chain breaks, and severe productivity declines. The general objective of this study was to investigate the impact of climate change on the performance of MSMEs in North East, Nigeria, while the specific objective was to assess the impact on specific areas namely micro, small and medium scale enterprises. The specific objectives are to: identify the impact of extreme weather on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria; and assess impact of rising sea level on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria. The research was of cross sectional survey type. Data collection from the respondents was done with the help of a structured questionnaire. Six (6) States from North East, Nigeria. The MSMEs operators were sampled using Krejcie and Morgan sample size determination formula with a sample size of 362 operators from 20,670 MSMEs operators in the population. Simple random sampling technique was used for the study. The data gathered was analysed descriptively and by multiple regression at 0.05% significant level. The findings of the study were that: Extreme weather event has significant effect on the performance of MSMEs: (Extreme Temperature) $\beta = 0.674$, $t = 13.615$, $p = 0.002$ (Heat Waves and Cold Waves Condition) $\beta = 0.711$, $t = 6.297$, $p = 0.000$. Rising sea level has a significant effect on the performance of MSMEs: (Extreme Rainfall) $\beta = 0.329$, $t = 3.166$, $p = 0.001$, (Overflowing River Banks) $\beta = 0.418$, $t = 3.510$, $p = 0.000$. The study has found that irregular rainfall and flooding directly disrupts supply chains and decrease customer traffic, impacting the trading and agro-processing sector the most. Accordingly, the study recommended that the Government should be involved in providing early maturing and drought resistant crop varieties to address the issues of irregular rainfall, high temperatures and rising sea level.

Keywords: Climate change, Weather event, rising sea level, MSMEs, North-East, Nigeria

1.0 Introduction

Micro, Small and medium enterprises (MSMEs) are key to fostering more inclusive and equitable development and they are the backbone of most countries' businesses. But with the increasing temperatures and extreme natural events, it is inevitable that MSMEs will lose their productivity and the worth of their assets, which will impact their business and financial performance. This means that MSMEs, as major contributors of eco-innovation, can be the ones to contribute to the fight against climate change, while enhancing resilience.

Generally, there are size related barriers, such as finance-ability issues, for MSMEs to embrace sustainable practices and to benefit from "green" business opportunities in the context of adaptation to climate change. MSMEs require access to mitigation finance to shift towards low carbon business models and access to adaptation finance to cope with natural disasters and other climate induced processes that are occurring over a longer timeframe (e.g., sea-level rise or droughts). However, the traditional market failures that constrict financing for MSMEs do not apply as easily because of negative externalities that compel them to invest in climate change mitigation and adaptation.

Therefore, climate change from this point of view of timing of activity or duration of measurement of impinging parameters refers to long lasting variations in the statistical properties or parameters of the weather when considered over few decades to millions of years (Gavin, 2010). According to Norrington and Underwood, (2008), climate change refers to a significant change in the climate variables such as temperature, pressure, relative humidity, wind storm, precipitation (rainfall, snowfall, mistfall, etc) which causes the current global warming, extreme temperatures referring to excessive rainfall, mistfall and snowfall or no rainfall at all in some parts of the world or drought, changed global ocean currents destructive wind and storms.

The global climate variability that has caused most of the recent global environmental disasters and degradations including massive flooding that has inundated farm-lands, factories, other businesses and livelihoods, homes resulting in huge losses in assets and lives, devastating gulley erosion sites or ecological sites that have disrupted, distorted and dislodged businesses, other forms of livelihoods, social and religious/cultural activities and not excluding the damage in the North East and Nigeria that has affected residential houses resulting in loss of lives, assets and other livelihoods. The study aims to draw inferences on how the risks of climate change can be a great challenge to the performance of the micro, small and medium scale enterprises in the study area of North East Nigeria, based on the background.

Nigeria today is facing a myriad of economic and social challenges which experts in these fields as well as public opinion analysts and commentators contend are not unconnected with the statistics of economic inequality in income distribution. It is no longer news that Nigeria is the world poverty headquarters.

Nigeria is still at the primitive stage of its industrialization effort, which has recently led to the realization that it could industrialise quickly and push its start-up activities in MSMEs sector of the economy to a much higher level, if it is able to strengthen its institutional and policy frameworks as well as the infrastructural base, as these are the key ways how the sector can be industrialised sustainably. The problems associated with climate change such as sea-level rise, extreme weather condition and droughts are creating serious challenges for MSMEs in North East and Nigeria. Anywhere and everywhere in the world without Nigeria being an exception, MSMEs constitute about 92% of numerical strength of all the business organizations and manufacturing.

The study focused on the following research questions;

- i. What is the effect of extreme weather events on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria?
- ii. What is the effect of rising sea level on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria?

The main objective of this study is to investigate the effect of climate change on the performance of micro, small and medium scale enterprises in North East, Nigeria. The specific objectives are to:

- i. determine the effect of extreme weather events on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria;
- ii. evaluate the rising sea level on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria;

The following will be formulated for the study:

- i. There is no significant and positive relationship between extreme weather events and the performance of Micro, Small and Medium Scale Enterprises in Kogi State;
- ii. Rising sea level does not have significant and positive effect on the performance of Micro, Small and Medium Scale Enterprises in Kogi State.

2.0 Review of Related Literature

Concept of Climate Change

Climate change refers to long term shifts in temperature, rainfall patterns and other atmospheric conditions, caused by a combination of natural factors and human activities. Historically, Earth's climate has undergone changes due to natural factors like volcanic eruptions, variations in solar energy, and oceanic circulation patterns. However, the current trend of global warming began in the 19th century, coinciding with the Industrial Revolution, when the burning of fossil fuels significantly increased green-house gas emissions. (Inter-Governmental Panel on Climate Change 2021).

Climate change refers to significant, long-term changes in the global climate. It is largely attributed to human activities that increase the concentration of greenhouse gases (GHGs) in the atmosphere, leading to global warming and a host of related environmental changes. This phenomenon has emerged as one of the most critical challenges of the 21st century, with widespread implications for natural ecosystems, human health, food security, water availability, and global economies (IPCC, 2021). This essay explores the concept of climate change, its causes, consequences, and responses, drawing from scientific, environmental, and policy perspectives. The Earth's climate system is influenced by the balance of incoming solar radiation and outgoing infrared radiation. Greenhouse gases such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) trap some of the heat in the atmosphere, maintaining a temperature that supports life.

Rising Sea Level and the Survival of MSMEs

Climate-related natural hazards are becoming more frequent and severe as global temperatures rise. Rising sea level is among the most damaging natural disasters in Europe, where their economic and social costs have already been material (European Environment Agency 2022). While the increase in flood risk at the European scale is substantial, its impact on firms' financial conditions is not fully understood. Beyond direct losses, rising sea level inflicts indirect financial costs: flood risk is capitalized into the value of real and financial assets (Giglio et al. 2021), and business disruptions may impede borrowers' ability to repay outstanding debt. This financial strain can spill over to the banking sector. Furthermore, natural hazards likely have a localized impact (Mamonov et al. 2024), thus making smaller firms especially vulnerable given their dependence on domestic credit and limited capacity to share risks through capital markets.

Concept of MSMEs

Micro, Small and Medium Enterprises (MSMEs) are enterprises with a small number of employees, turnover or assets, which play a key role in economies by generating employment, innovation and growth – although definitions of MSMEs differ across countries (e.g. Nigeria's MSMEs focus on employee numbers or assets). They come in different sizes from street vendors or small restaurants (micro), but are medium tech businesses that can be the difference in making things more inclusive and developmental, and can encounter obstacles like securing funding access.

Micro, Small and medium scale enterprises (MSMES) have been generally acknowledged as the bedrock of the industrial development of any country. Apart from the numerous goods and services produced by MSMES, they provide a veritable means of large scale employment, as they are usually labour intensive. They also provide training grounds, for entrepreneurs even as they generally rely on the use of local raw materials (Nnanna, 2020). If well managed, MSMES can gradually transform into the giant corporations of tomorrow. These contributions thus explain why government and international agencies mobilize efforts towards the realization of sustainable industrial growth and the creation of mass employment through the rapid growth and development of the small and medium enterprises (Nnanna,

2020). This fact underscores the essence, importance and relevance of this sub-sector in the development of any given economy. The experiences of developed economies in relation to the roles played by MSMEs buttresses the fact that the relevance of MSMEs cannot be overemphasized especially among the Less Developed Countries (LDCs) or rather developing countries.

Theoretical Review

Resource-Based Theory (RBT)

The Resource-Based Theory (RBT), also known as the resource-based view (RBV), was initially conceptualized by Edith Penrose in her seminal work, "The Theory of the Growth of the Firm" (1959). However, the theory gained prominence and became a dominant paradigm in strategic management following Jay Barney's influential article, "Firm Resources and Sustained Competitive Advantage," published in 1991. RBT is highly relevant to the research title "Climate change and the survival of SMEs in South East Nigeria" because it focuses on how firms utilize their unique resources and capabilities to achieve and sustain competitive advantage, especially in challenging environments. The theory posits that firms with valuable, rare, inimitable, and non substitutable (VRIN) resources are better equipped to adapt, innovate, and survive external shocks such as those caused by climate change.

Anthropogenic Global Warming (AGW) Theory

According to Bast (2010), this is the first theory of climate change. This theory explains that greenhouse gases emissions like carbon dioxide, nitrous oxide and methane by human beings have caused the astronomical rise in average global temperature leading to a mechanism known as greenhouse effect and that is why this theory is termed "anthropogenic global warming" or simply put "AGW."

According to him, due to the transparent nature of the atmosphere of the Earth, some of the energy from the sun that travels through the space are absorbed while the remaining are reflected back in the form of heat energy into the atmosphere. This theory further explains that water vapour majorly contributes to greenhouse effect and it causes about 36%-90% of the greenhouse effect and this is followed by carbon dioxide which is responsible for about 1%-26%, followed by methane (4%-9%) and ozone (3%-7%). The theory stated human activities such as cutting down of trees, burning wood, burning fossil fuels, burning forests in the past century had caused increase in the carbon dioxide concentration by approximately 50% in the atmosphere.

Adopted Theory

Resource Based View was adopted for this study. In the context of MSMEs facing climate change in developing regions, RBT provides a lens to examine how internal resources-such as innovation capacity, managerial skills, technological assets, and financial slack-enable SMEs to respond proactively to environmental threats and exploit new opportunities for survival and growth. Empirical studies have shown that SMEs with greater resource endowments are more likely to invest in climate adaptation and innovation, thereby enhancing their resilience and long-term sustainability.

Empirical Review

Moustafa et al. (2025) highlight the dual impact of climate change on labor supply and demand. Their work reveals that heat stress and environmental degradation disproportionately affect agriculture and outdoor sectors, leading to reduced productivity and altered work patterns. Simultaneously, climate-induced migration surges as rural livelihoods collapse,

particularly in regions reliant on climate-sensitive industries. Their call for adaptive policies such as green job creation and flexible labor regulations offers a roadmap for mitigating displacement.

Moreover, Michel et al (2021) meta-analysis identifies climate variability as a key driver of rural-to-urban migration. Their synthesis of global data emphasizes how droughts, floods, and soil erosion push populations toward cities, exacerbating urban labor market pressures. However, gaps remain in understanding how long-term climate trends, such as sea-level rise, will reshape cross-border migration in regions like South Asia and Sub-Saharan Africa.

Similarly, Eric et al (2015), focusing on Uganda, demonstrate how weather-induced internal migration disrupts local economies. Their findings show that sudden influxes of displaced workers depress wages in destination areas while creating labor shortages in origin regions, underscoring the need for adaptive social protection systems to stabilize vulnerable communities.

Olowu et al. (2023) carried out a study on Impact of Investment Climate Reforms on Business Operations in Nigeria. The main objective of the study was to examine whether these reforms in Nigerian investment climate have or otherwise improved the level of Foreign Direct Investment (FDI) that translate to economic growth and development, and reduces the cost of doing business in Nigeria. The study found that: Nigerian investment climate since the return of democratization in 1999 has gone through so many reforms with the sole aim of attracting local and foreign investors from every part of the globe in order for private investment to thrive in Nigeria; an unfavourable investment climate is one of the many hindrances faced by developing and underdeveloped nations including Nigeria. This may be largely due to some structural and administrative bottlenecks, corruption, inconsistency in policy making, lack of rule of law, lack of security and poor infrastructure among others. But over the years, a lot of reforms were introduced in order to make investment climate in Nigeria, Investor friendly. The study recommended that: regulatory reforms should be reviewed as they are the key component of removing the barriers to investment.

Gérard (2024) carried out a study to analyze how private capital and investment climate contribute to private sector growth in African countries: Cameroon, Côte d'Ivoire, Tunisia, South Africa and Zambia. The methodology adopted was use of time series, autoregressive distributed lags (ARDL)-bound test approach and error correction model (ECM). The study found that; in the short-run there is a significant relationship between private capital, economic freedom and private sector growth in Cameroon, in Côte d'Ivoire, in South Africa and in Zambia. However, in the long run, the study established that a long-term relationship exists between the variables. This implies that there is a long run co-integration relationship among the variables in some equations in Cameroon, Côte d'Ivoire, South Africa and Zambia. Employing the appropriate order of the ARDL specification and multidimensional economic freedom proxies to examine this linkage, the results obtained are not all significant. The gap in the study is that the findings are vaguely stated and the study has no recommendations.

Conceptual Model

The relationship between the dependent and independent variables is revealed in figure 1 below.

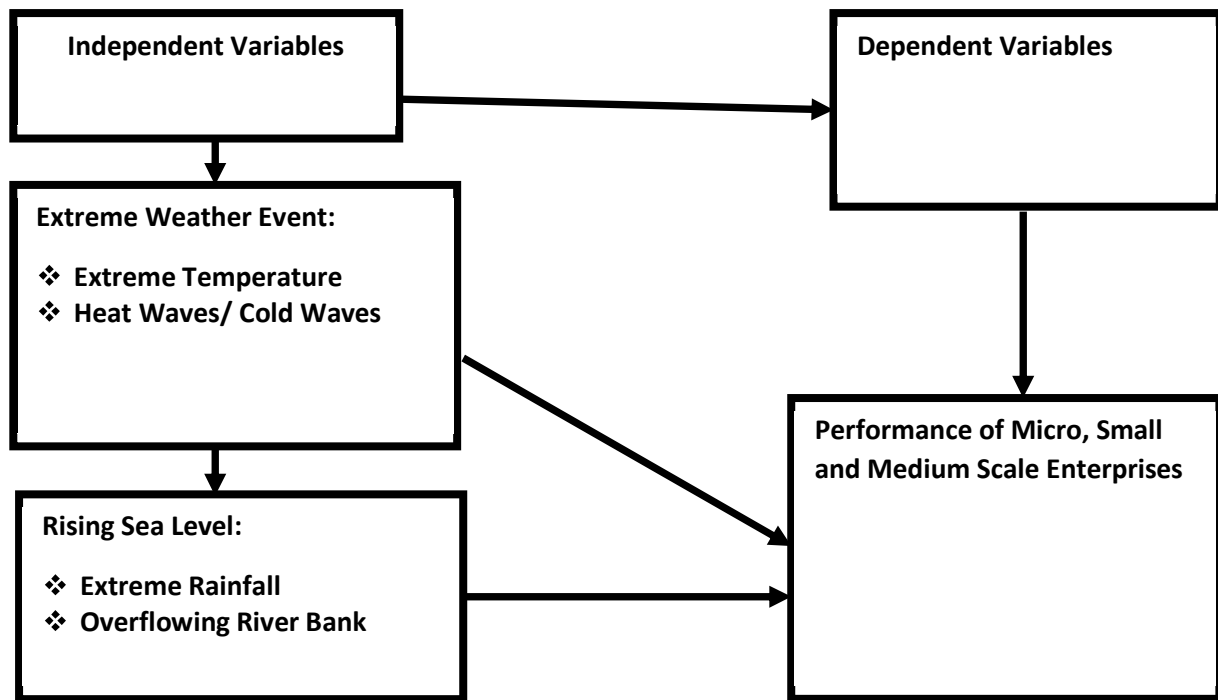


Figure 1. Source: Author's Conceptualization, (2026).

3.0 Methodology

This study adopted cross sectional survey research design. Cross sectional survey research design is a method in which a group of respondents is studied by collecting and analyzing sample data or data from the entire population by administering questionnaire to them. This method will help to achieve the objective of this study, which is, to examine the effect of climate change and the performance of micro, small and medium scale enterprises in North East, Nigeria. This will include the States like Yobe, Borno, Adamawa, Taraba, Gombe, Bauchi. The target population of this study consist of all registered micro, small and medium scale enterprises in North Eastern Nigeria. Yobe, Borno, Adamawa, Taraba, Gombe, Bauchi

Table 3.2.1 Distribution of Population of the Study

S/N	States	Number of Registered MSMEs
1	Borno State	2,343
2	Yobe State	3,266
3	Taraba State	4,234
4	Adamawa	5,234
5	Gombe	2,135

6	Bauchi	3,458
	Total	20,670

Source: SMEDAN, (2023)

In choosing the sample size and securing representative responses, this study adopted Krejcie and Morgan (1970) formula stated below:

$$S = \frac{X^2 NP (1 - P)}{d^2 (N - 1) + X^2 P (1 - P)}$$

S = Required sample size

X^2 = The table value of chi-square for 1 degree of freedom at the desired confidence level (3.841)

N = The population size

P = The population proportion (assume to be .50 since this would provide the maximum sample size)

D = the degree of accuracy expressed as a proportion (.05)

Thus, a population of 20,670 as a sample size of

$$S = \frac{X^2 NP (1 - P)}{d^2 (N - 1) + X^2 P (1 - P)}$$

$$S = \frac{3.841 \times 20,670 \times 0.50 (1 - 0.50)}{0.0025 (20,670 - 1) + 3.841 \times 0.50 (1 - 0.50)}$$

$$S = \frac{79393.47 \times 0.25}{51.6725 + 0.96025}$$

$$S = \frac{19848.3675}{49.618518125}$$

$$S = 400$$

$$S = 19848.3675$$

$$S = 400$$

Thus, a total four hundred (400) micro, small and medium scale enterprises in North East, Nigeria.

Table 3.2: Allocation of Copies of Questionnaire to various States in North East, Nigeria

S/N	States	Number of Registered MSMEs	Allocation of Questionnaire
1	Borno State	2,343	2,343/20,670 X 400 = 45
2	Yobe State	3,266	3,266/20,670 X 400 = 63

3	Taraba State	4,234	4,234/20,670 X 400 = 82
4	Adamawa	5,234	5,234/20,670 X 400 = 101
5	Gombe	2,135	2,135/20,670 X 400 = 42
6	Bauchi	3,458	3,458/20,670 X 400 = 67
Total		20,670	400

Source: Author's Computation, (2025)

The study employed the use of multi-stage sampling technique as sampling technique which involves deliberate sampling, stratified random sampling and simple random techniques.

The instrument used to collect data for the study is questionnaire.

The multiple regression analysis was used because the study examines the effect climate change on the performance of micro, small and medium scale enterprises in North East, Nigeria.

Model Specifications

Model for Hypothesis 1

Regression Analysis

The mathematical model that describes how extreme weather event affects the performance of micro, small and medium scale enterprises in North East, Nigeria is given in equation 1 below:

$$\text{PMSMs} = f(\text{EWE}) \dots\dots\dots$$

Given that $\text{EWE} = \text{ET} + \text{EH}$

Therefore,

$$\text{EO} = \beta_0 + \beta_1 \text{ET}_i + \beta_2 \text{HWCW}_i + \mu_i \dots\dots\dots (1)$$

Where:

EWE is Extreme Weather Event

PMSMEs is Performance of Micro, Small and Medium Scale Enterprises

ET is Extreme Temperature

EHC is Heat Waves and Cold Waves Condition

μ is the stochastic error term of the model

β_0 is the constant term and intercept of the model

$\beta_1 - \beta_2$ are the coefficient values of extreme temperature and Heat Waves and Cold Waves Condition respectively.

Model for Hypothesis 2

Regression Analysis

The mathematical model that describes the effect of rising sea level on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria is given in equation 2 below:

PMSMEs = f (RSL)

Given that RSL = ER + ORB

Therefore,

$$RSL = \beta_0 + \beta_1 ER_i + \beta_2 ORB + \mu_i \dots\dots\dots (2)$$

Where:

RSL is Rising Sea Level

APP is Performance of Micro, Small and Medium Scale Enterprises

ER is Extreme Rainfall

ORB is Overflowing River Bank

μ is the stochastic error term of the model

β_0 is the constant term and intercept of the model

$\beta_1 - \beta_3$ are the coefficient values of extreme rainfall and overflowing river bank respectively

4.0 Data Analysis and Discussion of Findings

The study showed that out of 400 copies of questionnaire given to the respondents, 362 copies were duly filled and returned.

The Effect of determine the effect of extreme weather events on the performance of Micro, Small and Medium Scale Enterprises in North East, Nigeria.

Table 1

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.743 ^a	.649	.612	.45322

a. Predictors: (Constant), ET, HWCW

The R-square value of .649 in table 1 indicates that the components of independent variable have a combined effect of 65% on the dependent variable while the adjusted r square value of .612 also indicates the accurate influence of the combined effect of extreme temperature and heat waves and cold wave conditions of 61.2% on the performance of Micro, Small and Medium Scale Enterprises in Kogi State. The remaining 38.8% was not captured by variables in this model.

Table 2:

ANOVA Result

ANOVA^a

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	2649.447	2	883.149	4205.348	.001 ^b
Residual	64.515	359	.187		
Total	2713.962	362			

a. Dependent Variable: MSMEs Performance

b. Predictors: (Constant), ET, HWCW

The F-Statistics value of 4205.348 and the sig. level of .001 in table 2 signifies that the model is good and fit and significant at (0.05) 5% level. This means that the result is good and admissible for decision making concerning extreme weather events and MSMEs performance.

Table 3:

Coefficients

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		

	(Constant)	.516	.117		5.311	.000
1	ET	.674	.061	2.319	13.615	.001
	HWCW	.711	.045	.129	6.297	.000

a. Dependent Variable: MSMEs Performance

Again table 3 presents the coefficients of the effect of extreme weather events have significant effect with B (0.674 and 0.711). and the variables have p-values of 0.001 and 0.000 which are lower than 0.05 significance level.

Extreme weather event and heat wave and cold waves conditions all have positive coefficients, signifying that they all have positive effect on MSMEs performance. This implies that an increase in each of these variables of extreme temperature will affect the MSMEs performance.

Specifically, a point increase in extreme weather event will lead to 0.674 points will affect MSMEs performance. Similarly, a point increase in heat wave and cold waves conditions will lead to 0.711 points will affect MSMEs performance.

The Effect of rising sea level on the performance of Micro, Small and Medium Scale Enterprises in Kogi State.

As for the first objective, the dependent variable is MSMEs Performance and the independent variables are the items used to measure of Rising Sea Level are, extreme rainfall and overflowing river bank.

Table 4:

Model Summary

Model	R	R square	Adjusted square	Standardized error of the estimate
1	.821 ⁹	.754	.713	234.307

i. Predictor: (Constant), ER, ORB

Source: SPSS Result, 2026

The R-square value of .754 in table 4.1.28 indicates that the components of independent variable have a combined effect of 75.4% on the dependent variable while the adjusted r square value of .713 also indicates the accurate influence of the combined effect of extreme rainfall and overflowing river bank of 71.3% on MSMEs performance. The remaining 28.7% was not captured by variables in this model.

Also, table 4.1.28 presents the analysis of variance (ANOVA) for the model. F-statistic is shown with value 381.123 and probability value 0.000 indicating that the reported F-statistic is significant, which implies that the model is fit.

Table 5:**ANOVA^a**

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	223.658	2	74.553	381.123	.000 ^b
Residual	2415.337	361	13.127		
Total	2638.995	362			

c. Dependent Variable: MSMEs Performance

d. Predictors: (Constant), ER, ORB

Table 6 Coefficient Table

Model	Unstandardized co-efficient	Standardized co-efficient error	Standardized co-efficient beta	t	Sig.
Constant	21.971	3.635		6.044	.000
ER	.329	.104	.250	3.166	.001
ORB	.418	.122	.117	3.510	.000

a. Dependent Variable: MSMEs Performance

b. Independent Variables: ER, ORB

Source: SPSS Result, 2026

Table 6 presents the coefficients of the effect of 0.754

level on MSMEs performance, the result revealed that extreme rainfall and overflowing river bank have significant coefficients (0.329 and 0.418). All variables have significant coefficients because they have p-values of 0.001 and 0.000 which are lower than 0.05 significance level. Extreme rainfall and overflowing river bank all have positive coefficients, signifying that they all have positive effect on MSMEs performance. This implies that an increase in each of these variables of rising sea level will affect MSMEs performance.

Specifically, a point increase in extreme rainfall will lead to 0.329 points and affect MSMEs performance in North East Nigeria. Similarly, a point increase in overflowing river bank will lead to 0.291 points and affect MSMEs performance in North East Nigeria.

Discussion of Findings

The study investigated the effect of climate change on micro, small and medium scale enterprises in North East, Nigeria. Discussion was presented in line with the objectives and the hypotheses of the study.

The first finding established the significance of extreme weather events on the performance of micro, small and medium scale enterprises in North East, Nigeria. The hypothesis proved that there is a significant effect between extreme weather events and MSMEs performance. The independent variables (extreme temperature, heat waves and cold waves condition which represent extreme weather condition variables were all found to affect MSMEs performance in North East, Nigeria. The study showed that extreme weather events, particularly severe heatwaves and flooding, are causing significant disruption to Micro, Small, and Medium Enterprises (MSMEs) in North East Nigeria, compounding existing challenges from inflation and insecurity. The region has experienced temperatures rising to 44°C, leading to reduced business hours, lower customer turnout, and decreased sales, especially during Ramadan and Lent periods. The finding is in line with Moustafa *et al* (2025) which investigated the dual impact of climate change on labour supply and demand. Their work reveals that heat stress and environmental degradation disproportionately affect agriculture and outdoor sectors, leading to reduced productivity and altered work patterns. Simultaneously, climate-induced migration surges as rural livelihoods collapse, particularly in regions reliant on climate-sensitive industries. Their call for adaptive policies such as green job creation and flexible labor regulations offers a roadmap for mitigating displacement. The study applied the anthropogenic global warming (AGW) theory. This theory explains that greenhouse gases emissions like carbon dioxide, nitrous oxide and methane by human beings have caused the astronomical rise in average global temperature leading to a mechanism known as greenhouse effect and that is why this theory is termed “anthropogenic global warming” or simply put “AGW.”

The second finding established the significance of rising sea level on the performance of MSMEs in North East, Nigeria. The hypothesis proved that there is a significant effect between rising sea level and MSMEs performance in North East, Nigeria. In particular, the study showed that rising sea levels and related climate stressors significantly threaten Micro, Small, and Medium Enterprises (MSMEs) in North East Nigeria, primarily through intensified flooding, environmental degradation, and supply chain disruptions. While the region is inland, it faces severe indirect impacts from climate change, including erratic rainfall, drought, and increased flooding of river basins that devastate MSMEs in the selected region. The study is in consonance with the study of Runyan (2016) carried out a study on firm growth and investment climate in developing countries. The study showed how investment climate matters for firm growth through the quality of infrastructure, the experience and education of the labor force, the cost and access to financing, and different dimensions of the government-business relationship. This findings justifies the Contingency theory. Contingency theory discussed that firms can continue strategic matching which correspond with the external environment and uncertainties to gain the appropriate competitiveness, business growth performance and sustainability

5.0 Conclusion and Recommendations

Based on the findings highlighted above, this study makes the following conclusion:

Extreme weather events, driven by climate change, present a critical, structural risk to Micro, Small, and Medium Enterprises (MSMEs) in North East Nigeria, with significant implications for local employment and economic stability. The study indicates that rising temperatures, erratic rainfall, and flooding are directly reducing productivity, disrupting supply chains, and increasing operational.

The study was motivated by growing concerns over the increasing vulnerability of businesses in the region to changing environmental conditions, which threaten their ability to sustain operations, maintain productivity, and remain profitable over time.

The study showed to evaluate how extreme weather event affects the performance of MSMEs in North East, The Findings from the study revealed that MSMEs in North-East Nigeria are significantly affected by irregular weather patterns such as prolonged dry spells, intense rainfall, frequent flooding, and excessive heat. These environmental disturbances disrupt logistics, damage infrastructure, reduce customer turnout, and lead to higher input costs. Most business owners indicated that these disruptions affect their ability to operate consistently, often resulting in loss of revenue and, in severe cases, temporary closure of businesses.

The study also revealed the influence of rising sea level on the performance of MSMEs North East, Nigeria. Respondents expressed concern over the long-term changes in climate conditions, including rising sea level, average temperatures, increasing desertification, and unpredictable rainfall patterns. These trends have contributed to a gradual but steady increase in the cost of doing business. Entrepreneurs noted that they are compelled to spend more on utilities such as electricity and water, experience difficulty in sourcing raw materials, and are forced to constantly adapt to a shifting business environment that lacks predictability or stability.

In conclusion, the study found that MSMEs in North-East Nigeria are highly vulnerable to both short-term climate variability and long-term climate change. These climatic factors negatively affect their capacity to remain competitive and sustainable. Additionally, the limited accessibility and effectiveness of existing climate policies further compound the challenges faced by MSMEs in the region. The findings emphasize the need for a more inclusive, supportive, and accessible climate adaptation framework tailored to the unique needs of small and medium enterprises.

The following recommendations were made based on the findings of the study:

- i. The study revealed that Extreme weather conditions which are ranging from flooding and storms to prolonged heat waves have significantly disrupted micro, small, and medium-sized enterprises (MSMEs). These events frequently cause asset damage, supply chain interruptions, and reduced customer demand, often hitting small businesses hardest due to limited resources. The study therefore, recommended that government should implement conservation agriculture, rainwater harvesting, and agroforestry to maintain soil fertility and water availability to mitigate the effect of climate change on the performance of MSMEs in North East, Nigeria.
- ii. The study showed that rising sea levels pose a critical threat to Micro, Small, and Medium Enterprises (MSMEs), particularly those in North East region, by disrupting supply chains, damaging inventory, and reducing customer traffic. The study recommended that MSMEs in North East Nigeria should prioritize climate-smart agriculture, adopting flood-resilient infrastructure, and enhancing financial inclusion to build resilience against shrinking resources, desertification, and intermittent flooding.

References

- Adamu, Y., & Sani, A. (2021). Role of SMEs in economic development: Evidence from developing economies. *Journal of Development Studies*, 14(2), 101–115.
- Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. R., & Wreford, A. (2009). *Are there social limits to adaptation to climate change?* *Climatic Change*, 93(3), 335–354. <https://doi.org/10.1007/s10584-008-9520-z>
- Ajufo, B. I. (2021). Climate change and small businesses in Nigeria: Challenges and adaptation strategies. *African Journal of Business Management*, 15(4), 112–123.

- Akinbami, J.-F. K., & Fadare, S. (2018). Assessment of energy use and energy conservation potential in Nigerian SMEs. *Journal of Sustainable Development*, 11(2), 12–24. <https://doi.org/10.5539/jsd.v11n2p12>
- Altavilla, C, M Boucinha, M Pagano and A Polo (2023), "Climate risk, bank lending, and monetary policy", VoxEU.org, 2 November.
- Audu, S., & Tijjani, A. (2020). The impact of SMEs on socio-economic development in Nigeria. *International Journal of Business and Management Review*, 8(3), 45–60.
- Ayodele, O. (2020). Bureaucracy and access to climate change funding in developing countries: A Nigerian experience. *Global Journal of Human-Social Science: Political Science*, 20(1), 14–22.
- Basil, O. (2019). SMEs as engines of economic growth in developing countries. *Economic Development Journal*, 6(1), 15–27.
- Bast, J. (2022). Understanding weather and climate: Concepts and misconceptions. *Climate Science Quarterly*, 28(1), 34–47.
- Barbaglia, L, S Fatica and C Rho (2024), "Flooded credit markets: physical climate risk and small business lending", Mo.Fi.R. Working Papers 186.
- Bilal, A and E Rossi-Hansberg (2023), "The importance of anticipating climate change", VoxEU.org, 24 July.
- Carbon Disclosure Project. (2019). *SMEs and climate change: How to build resilience*. <https://www.cdp.net>
- Cline, W. R. (2007). *Global warming and agriculture: Impact estimates by country*. Peterson Institute for International Economics.
- Correa, R, A He, C Herpfer, U LeI (2022), "The rising tide lifts some interest rates: Climate change, natural disasters and loan pricing," International Finance Discussion Papers 1345.
- Edeh, H. C., & Eboh, E. C. (2019). Climate variability and implications for smallholder farmers and SMEs in Nigeria. *Nigerian Journal of Environmental Economics and Management*, 3(2), 56–68.
- Eze, C., & Okafor, L. (2021). Strategies for enhancing SME performance in Nigeria. *African Journal of Entrepreneurship and Business Innovation*, 9(2), 77–93.
- European Environment Agency (2022), "Economic losses from weather and climate-related extremes in Europe reached around half a trillion euros over past 40 years," Publications Office of the European Union.
- FAO. (2020). *The state of food and agriculture 2020: Overcoming water challenges in agriculture*. Food and Agriculture Organization of the United Nations. <https://www.fao.org/publications>
- Faiella, A, T E Antofie, S Luoni, F Rios Diaz, M M Ferrer (2020), "The risk data hub loss datasets-the risk data hub historical event catalogue," JRC Technical Report JRC116366.
- Fatica, S, G Katay and M Rancan (2023), "Floods and firms in Europe: Destruction and reallocation," VoxEU.org, 7 May.
- Ferrando, A, J Groß and J Rariga (2023), "Climate change and euro area firms' green investment and financing — results from the SAFE," ECB Economic Bulletin, Issue 6.
- Gavin, S. (2021). Climate vs weather: A guide for researchers. *Environmental Science and Policy*, 12(4), 213–228.
- Giglio, S, B Kelly and J StroebeI (2021), "Climate finance," Annual Review of Financial Economics 13: 15–36.
- IPCC. (2021). *Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg1/>
- Leichenko, R., O'Brien, K., & Solecki, W. (2019). Climate change and human systems: Impacts, vulnerability, and adaptation. *Annual Review of Environment and Resources*, 44, 319–349. <https://doi.org/10.1146/annurev-environ-101718-033330>

- NASA. (2023). *Global climate change: Vital signs of the planet*. National Aeronautics and Space Administration. <https://climate.nasa.gov>
- National Bureau of Statistics. (2021). *SME statistics and economic growth trends in Nigeria*. <https://nigerianstat.gov.ng>
- NBS (National Bureau of Statistics). (2020). *MSME Survey Report 2020*. Retrieved from <https://nigerianstat.gov.ng>
- NIMET. (2022). *Climate variability and impact on small-scale industries*. Nigerian Meteorological Agency Publications. <https://www.nimet.gov.ng>
- Nnanna, O. J. (2020). Entrepreneurial development and industrialization in Nigeria: The role of SMEs. *Journal of African Economic Studies*, 3(2), 89–104.
- Norrington, H., & Underwood, C. (2018). Climate change simplified: An introduction to causes and impacts. *Global Environmental Review*, 21(2), 140–158.
- Nwankwo, O. U., & Onuigbo, C. (2020). Climate change adaptation strategies and their implications on small business sustainability in Nigeria. *International Journal of Management and Sustainability*, 9(1), 1–11.
- Okonkwo, J. (2021). Industrial development and SMEs in Nigeria: Challenges and prospects. *Nigerian Journal of Economic Development*, 5(1), 25–42.
- Olayemi, A. O. (2019). Infrastructural challenges in Nigeria's SMEs: A study of climate-induced vulnerabilities. *Journal of African Business*, 20(2), 198–210. <https://doi.org/10.1080/15228916.2019.1599755>
- Onuoha, B. C. (2018). Weather risk management and business continuity in SMEs: Evidence from North-East Nigeria. *International Journal of Entrepreneurial Studies*, 5(1), 27–35.
- Sada, S. O., & Ogunlade, I. (2021). Climate policy and governance: Effects on economic activities in Sub-Saharan Africa. *African Journal of Environmental Economics and Policy*, 6(2), 79–97.
- UNDP. (2020). *Strengthening SME resilience to climate change in Africa: Policy brief*. United Nations Development Programme.
- UNHCR. (2021). *Climate change and displacement: Key issues and challenges*. United Nations High Commissioner for Refugees. <https://www.unhcr.org>
- WHO. (2022). *Climate change and health*. World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>
- World Bank. (2021). *Climate-smart development for small enterprises*. Retrieved from <https://www.worldbank.org/en/topic/climatechange/publication/climate-smart-smes>
- World Meteorological Organization. (2022). *State of the global climate 2022*. <https://public.wmo.int/en/resources/library>
- WWF. (2021). *Living planet report: Climate change impacts on biodiversity and ecosystems*. World Wildlife Fund. <https://www.worldwildlife.org>