Climate Change and Organizational Performance: The Mediating Role of Supply Chain Engagement

Clement NANGPIIRE
Simon Diedong Dombo University of Business and Integrated Development Studies
cnangpiire@ubids.edu.gh

Théophile Bindeouè NASSÈ
Simon Diedong Dombo University of Business and Integrated Development Studies
nassetheophile2009@gmail.com

Samuel Koffi SOGAH
Simon Diedong Dombo University of Business and Integrated Development Studies
sksogah@gmail.com

Article history
Received 12 November 2024 | Accepted 07 March 2025 | Published online 11 April 2025.

Abstract
The main purpose of this research is to evaluate the moderation role of supply chain engagement on the relationship between climate change risk and organizational performance. The study used a quantitative research approach and an explanatory research design to conduct its investigation. The target population consisted of 704 procurement officers, operations managers, and officers of manufacturing firms in the four main manufacturing hubs in Ghana. The results showed that climate chain risk significantly and positively enhances organizational performance. The results showed that supply chain engagement significantly and positively enhances organizational performance. With the inclusion of the mediation variable in supply chain engagement, the effect of climate chain risk on organizational performance was found to be significant. This shows that the relationship between climate chain risk and organizational performance is partially mediated by supply chain engagement. It was recommended that organizations should foster collaboration among their supply chain partners to build a shared understanding of climate change risks and opportunities.

Keywords: Climate Change, Organizational Performance, Supply Chain Engagement.

JEL classification: L6, L9 M31, M11, M14, R4.

Introduction

Recent years have seen a rise in the complexity of supply chains, both in terms of their geographic reach and the range of activities they encompass. Participating in a supply chain is now crucial to the development and competitiveness of many businesses (Hsu et al., 2013) to reduce operational exposure to climate change hazards. Managers and investors are searching for solutions to reduce the risks associated with climate change by changing their operations (Lin, et al., 2020). Climate change concerns have significantly shifted to top decision-making, both governmental and private, compared to widespread belief just a few years ago (Blanco, 2021).

Human activities contribute to this expanding global problem, which has impacted patterns of temperature and precipitation throughout the world (Rafindadi & Usman, 2019). The average temperature increase in Ghana during the past ten years has been 0.21°C. By 2030, this is anticipated to increase by 1.7°C to around 2.04°C (Tetteh et al., 2022). Manufacturing, despite producing essential goods, providing employment, and fostering innovation, significantly impacts the environment and is under scrutiny from various stakeholders, including consumers, workers, authorities, and communities (Pankratz & Schiller, 2021).

As a result of their excessive use, climatic change has been hastened. This risk has significantly influenced organizations' operational and financial successes (Villena & Dhanorkar, 2020). Current climate models predict that the future effects of climate change and its ripple effects will continue to have an impact on global supply chains (Pankratz & Schiller, 2021; OECD, 2015). Collaborating with supply chain partners is crucial for creating climate-resilient networks, requiring a thorough understanding of mutually-influencing interactions and their impacts. Companies are increasingly requesting suppliers to disclose climate change strategies, but mere collection of information is unlikely to significantly impact the issue (Yawar & Seuring, 2018). Promoting information exchange among supply chain partners is crucial for engagement (Sarkis, 2012).

Some few studies assessed the factors influencing the organizational performance of enterprises, (Dung et al., 2020). In Ghana, there is currently no study that assessed the effect of climate change on organizational performance. In light of the above, this research investigated the effect of climate change risk on organizational performance by examining the role of supply chain engagement. Thus, it assessed the effect of climate change risk on organizational performance; evaluated the effect of supply chain engagement on organizational performance; and examined the mediating role of supply chain engagement on the relationship between climate change risk and organizational performance.

1. Literature Review

1.1. Theoretical Review – Organizational Information Theory

Organizational information theory is a communication theory that provides a systematic approach to understanding and exchanging information within and among organizational participants. It provides a prism for fresh perceptions of the procedures included in handling information asymmetries (Busse et al., 2017); and its implementation to supply chain management issues, however, has received very little attention (Busse et al., 2017). According to Sarkis (2012), information is crucial for managing supply networks. Information barriers in supply chain hinder information flow, but it offers opportunities for organizational learning and performance enhancement, making business handling crucial for partners. For instance, Solér et al. (2010), and Oelze et al. (2016), offer insights into the features, contingencies, and changes in information management for the establishment of sustainable supply chain. Some impediments to companies developing collective reactions inside their supply chains include economic reasoning, poor actor relationships, and divergent interpretations of the game rules (Busse et al., 2017). Sustainability challenges in supply chain management add uncertainty, hindering collaboration and improving performance. Addressing environmental and ethical issues increases uncertainty in managing supply networks (Schulz et al., 2022). It is crucial to note that academic research topics are incorporating the new and significant informational asymmetries that climate change imposes (Zhao et al., 2018). The information on the impact of materials and goods on climate change and the vulnerability of business practices to legal and physical risks throughout the supply chain is highly ambiguous (Plambeck, 2012).

Organizational information theory emphasizes the importance of information in addressing information asymmetry, which can lead to uncertainty and ambiguity in shared data. Lack of sufficient and high-quality information is what uncertainty means when doing activities (Galbraith, 1974). To achieve a particular performance level, a corporation must acquire and interpret more data the more uncertainty it faces (Bode et al., 2011). For Simanjuntak et al. (2024) information accuracy is important to avoid equivocality or situations where information is ambiguous and messy, leading to competing interpretations and a lack of comprehension (Daft & Lengel, 1986).

1.2. Conceptual Review – Climate Change Risk

Climate change risk refers to long-term changes in temperature and weather patterns, primarily caused by human activity since the 1800s. Hence, climate change risk is a long-term shift in the climate's mean and variability that can be measured using statistical tests (Ching et al., 2018). Climate change risk is an abnormal change in weather. Climate change risks can lead to physical asset loss, increased expenses, business interruptions, and reduced operating income, negatively impacting the financial performance of businesses reliant on environmental conditions. Natural catastrophes made worse by climate change can interfere with businesses' manufacturing processes and seriously hurt their earnings (Hong et al., 2019). Climate change impacts manufacturing firms' value chain, affecting raw material availability, workforce, and market demand. It can reduce production capacity, alter capital structures, increase costs, and decrease profitability. Businesses must adapt strategies. For Sussman and Freed (2008) value chain, operational risks and infrastructural changes are the three primary risks associated with climate change that impact organizations.

1.3. Organizational Performance

Organizational performance refers to the evaluation of an organization's effectiveness and efficiency in achieving its goals and objectives. It includes several facets of a company's operation, such as financial performance, operational effectiveness, customer happiness, staff productivity, and overall success in providing goods or services. Financial performance, product performance, and operations as the three pillars of an organization's overall success, encompassing sales volume, return on equity, profit margin, turnover rate, and efficiency. Product performance, customer satisfaction, and operational success are influenced by factors like functionality, service, running costs, comfort, and ease of use, with improved performance increasing satisfaction and staff happiness. Collecting, analyzing, reporting, and analyzing performance data, as well as defining a set of performance measures, are all components of performance measurement (Paulraj et al., 2017). Efficiency refers to how efficiently requests from consumers are fulfilled with the available resources, whereas effectiveness evaluates how well those resources are put to use (Peng et al., 2022). Performance measurement helps organizations assess their effectiveness, identify areas for improvement, and enhance process visibility, efficiency, and competitive advantage through a well-implemented management system.

After, the review of literature on Climate change risk and organizational performance it comes out that organization’s performance of may be impacted by climate change in diverse ways, as suggested by Luo and Tang (2016). The risk could be direct, or indirect. The researchers, therefore, hypothesize that:

H_1: Climate change risk significantly influences organizational performance

1.4. Supply Chain Engagement

Supply chain engagement refers to the proactive participation, coordination, and communication between various actors in a supply chain network, such as suppliers, manufacturers, distributors, retailers, and customers. In order to improve the overall effectiveness and efficiency of the supply chain, it places a major emphasis on cultivating connections, encouraging collaboration, and coordinating interests and objectives (Ahi & Searcy, 2013). Supply chain engagement is a business strategy that involves a company's carbon management efforts to engage both its upstream and downstream supply chain partners in achieving common goals. These goals may include addressing challenges related to climate change and reducing carbon emissions throughout the supply chain (Lintukangas et al., 2022; Ahi & Searcy, 2013). Supply chain engagement lowers information asymmetry and makes it easier to analyze sustainability data from both suppliers and consumers through relational behaviors and collaborative activities (Dahlmann & Roehrich, 2019). Non-governmental, market-based strategies to combat global climate change, such as the adoption of quality management system standards like ISO 9000 throughout supply chains, are also a part of carbon management (Corbett, 2006). Operational advancements, such as the incorporation of technology into the supply chain, encourage more cooperation amongst all supply chain participants on environmental issues (Vachon & Klassen, 2006). From the views of both the upstream (suppliers) and downstream (customers) supply chain, the supply chain interaction is explained (Lintukangas et al., 2022).

After a review of the literature on the concepts organizational performance and supply chain engagement, it is noticed that, supply chain engagement enhances the organizational performance, by boosting its overall efficiency, and by reducing its overall operating costs (Dung, et al., 2020). Engaging the supply chain may also be a helpful strategy for supporting organizational strategies and preserving competitive advantages. Thus, the researchers, therefore, hypothesize that:

H_2: Supply chain engagement significantly influences organizational performance

After the literature review on the three key concepts namely it is notice that companies that sponsor efforts to protect the environment may find that it helps them in the long run (Li et al., 2019). Companies should invest in equipment, technology, and production models to improve performance, reduce environmental compliance costs, and promote resource efficiency, while proactively responding to climate change and publishing emissions information. The researchers, therefore, hypothesize that:

H_3: Supply chain engagement significantly mediates the relationship between climate change risk and organizational performance.

1.5. Research Model

The basic tenet of this model is that the link between climate change and organizational performance is mediated by supply chain engagement. Figure 1 serves as an illustration of the relationships between the different variables.

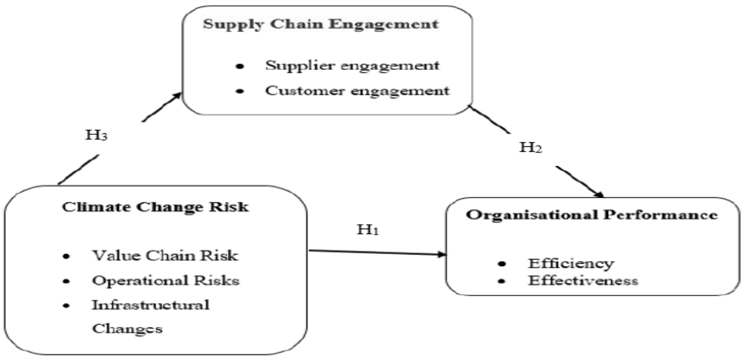


Figure 1: Research model
Source: Authors' construct (2023)

2. Methodology

Research Approach: This research is basically quantitative. The selection of quantitative research was based on the study's purpose, specific objectives or inquiries, and the primary data to be gathered and analyzed. The quantitative approach involves describing phenomena using numerical data and interpreting them using statistical methodologies (Creswell, 2014). The quantitative research involves collection of data, predicated on a hypothesis or theory, and the use of descriptive and inferential statistics (Teddlie & Tashakori, 2003). Quantitative analysis is crucial for its accuracy, truthfulness, and generalizability in estimating cause and effect (King, Cassell & Symon, 1994).

Research Design: A research design, according to Babbie and Mouton (2003), is a plan that specifies how data on a certain topic should be gathered and processed. The descriptive research design is adopted here because it helps to evaluate how climate change affects organizational performance. To better explain phenomena, several academics have stated that descriptive research design enables researchers to acquire huge volumes of data (Creswell & Clark, 2017) and it avoids the difficulties of compiling and managing huge sample sizes (Creswell, 2014).

Population: The population include both privately and publicly held manufacturing companies, with an emphasis on Sekondi-Takoradi, Kumasi, Accra, and Tema, respectively. Table 1 shows the 704 manufacturing companies that were selected as part of the target population in the AGI (2017) study. Thus, the population comprised 704 procurement officers, operations managers, and officers of manufacturing firms. Hence, the units of analysis are procurement officers, operations managers, and officers of manufacturing firms of these four manufacturing firms in Ghana.

Table 1: Population of Study

Metropolis	Population
Tema	104
Accra	382
Sekondi-Takoradi	9
Kumasi	209
Total	704

Source: AGI (2017)

Sample Size and Sampling Procedure: For Kumar (2011) sampling is a methodical procedure for selecting a subset of the population from which to draw inferences about the frequency distribution of a variable of interest. Bryman and Lilley (2009) argue that sampling is vital and they identified three sampling strategies: non-probability, probability, and mixed-approach sampling. To ensure a sufficient number of participants, a random sample method is used instead of a large population-sampling frame. To determine the sample size, the formula by Ganassali (2009), and Nassè et al. (2019) is used: $n = (p \times (1-p)) / (e / 1.96)^2$; p is the observed percentage and e the maximum error. Therefore, $n = (0.5 \times (1 - 0.5)) / (e / 1.96)^2 = 0.25 / (0.07/1.96)^2 = 196$. The number of respondents for a maximum error of 7% is 196. The total number of respondents that filled out the questionnaire and returned it is 226 for 248 questionnaires distributed. This represents 91.1% of the response rate and it is a little bit appropriate. A response rate of at least 70 % is considered a representative sample (Babble, 2007). The multi-stage sampling approach is also used to ensure equal selection of respondents, minimized bias, high-quality data collection, reliability and competence of the informant. To make sure it matches the model, the PLS-SEM sample size was also examined. Basic guidelines for assuring sample adequacy in a PLS-SEM model were offered by Hair et al. (2012). The minimal sample size, they emphasized, should be equivalent to 10 times the number of structural routes that lead to a particular latent variable in the model. A maximum of three structural routes can each be directed at the different latent variables in the structural model that was used for this study. As a result, the model's utilization of 248 replies was accurate and pertinent.

Data Collection Instrument: A questionnaire was used to collect primary data. According to Zikmund (2003) standardized surveys save time and money due to their efficiency in administration, evaluability, and cost-effectiveness. Causal investigations necessitate structured primary data-collecting procedures because they are inherently well-structured (Maxwell & Mittapalli, 2010). Questionnaire surveys, as mentioned by Young and Javalgi (2007), are perhaps the most popular method of data gathering in research (Singer & Couper, 2017). Respondents choose a single answer from a pre-established group and evaluate it independently. For Singer and Couper (2017), checklists are commonly utilized in research and consist of closed-ended items such as lists of activities, attributes, or other studied phenomena. Additionally, Likert scales are recommended for evaluating behaviors, attitudes, or other relevant phenomena on a continuum. A Likert scale of five points was used to determine the views, attitudes, and behaviors of the participants.

Data Collection Procedures: Warner (1965) suggests using data collection methods that provide researchers access to confidential information while protecting the privacy of study participants. Six weeks were spent on the first data collection. Data was gathered via Google Forms that were shared with participants online and self-administered surveys. Companies that continued to employ COVID-19 methods were asked to fill out Google forms.

Data Processing and Analysis: To highlight important information in decision-making, data analysis is a method of editing, cleaning, manipulating, and modelling data (Adèr, 2008). The data gathered from the respondents was thoroughly cleaned and checked for inaccuracies before being entered into the system. All collected questionnaires were coded to facilitate the sorting of non-responses, and to facilitate the data analysis by SPSS. The structural equation modelling (SEM) is used to test the hypothesis (Babin, Hair & Boles, 2008) and correlations between constructs (Hair et al., 2021).

Validity and Reliability of Instrument: The survey's validity was calculated using Cronbach's alpha. When the reliability coefficient was 0.70 or above, the information was trusted (Cohen, 2006). However, the validity dispute revolves around how well data techniques evaluate their focus variables. For Saunders et al. (2009), an instrument is only as trustworthy as the precision with which it measures its target concept. The researchers ensured the validity of questionnaires by examining relevant supplementary material and obtaining reliable evidence from reliable sources.

3. Results and Discussions

This section covers the respondents' demographic information, and the findings. Discussions based on the data collected make up the last portion.

Table 2: Response category

Questionnaire	Frequency
Total Distributed	248
Total Returned	226
Response Rate	**91.1%**

Source: Field Survey, (2023)

The response rate was 91.1%, based on a total of 226 replies. The goals, as seen by the respondents, are discussed and findings are presented in this part. Since the study by Mugenda and Mugenda (2003) indicates that a response rate of 60% or above can be utilized, the response rate is valid.

3.1. Demographic Data

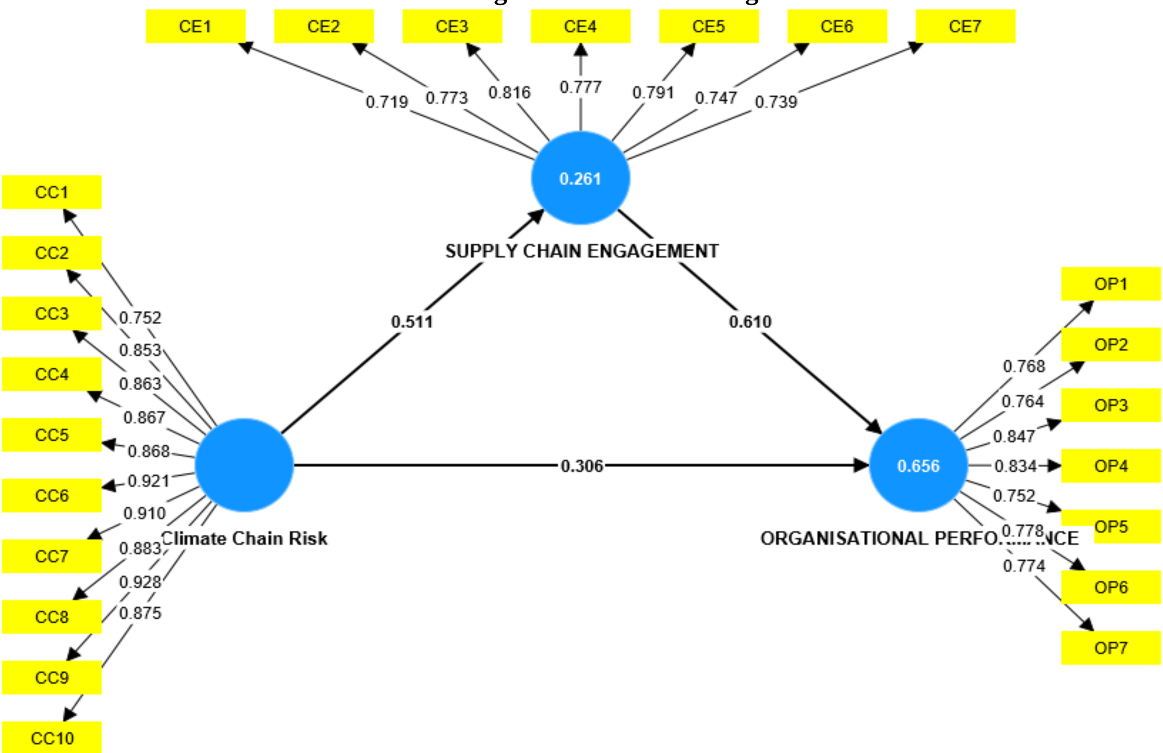
The demographic data shows that 143 respondents are male, while 83 respondents are female. Additionally, 125 respondents are within the age range of 21 to 30 years, 53 respondents are within the age range of 31 to 40 years, 32 respondents are aged between 41 to 50 years, and 11 respondents are above the age of 50 years (see Appendix 1).

3.2. Measurement Criteria

This research evaluated measurement criteria such as factor loadings, construct reliability, discriminant validity, and collinearity statistics, assessing whether individual items accurately reflect the study's construct. Hair *et al*. (2021) proposed a 0.708 threshold. For an indicator to be accepted, it must exceed the recommended threshold of 0.708. Similarly, Hair *et al*. (2019) and Gaskin *et al*. (2018) indicated that for the reflective constructs to be valid, the factor loadings should attain a minimum of 0.7 and their respective t-values must be greater than 1.96.

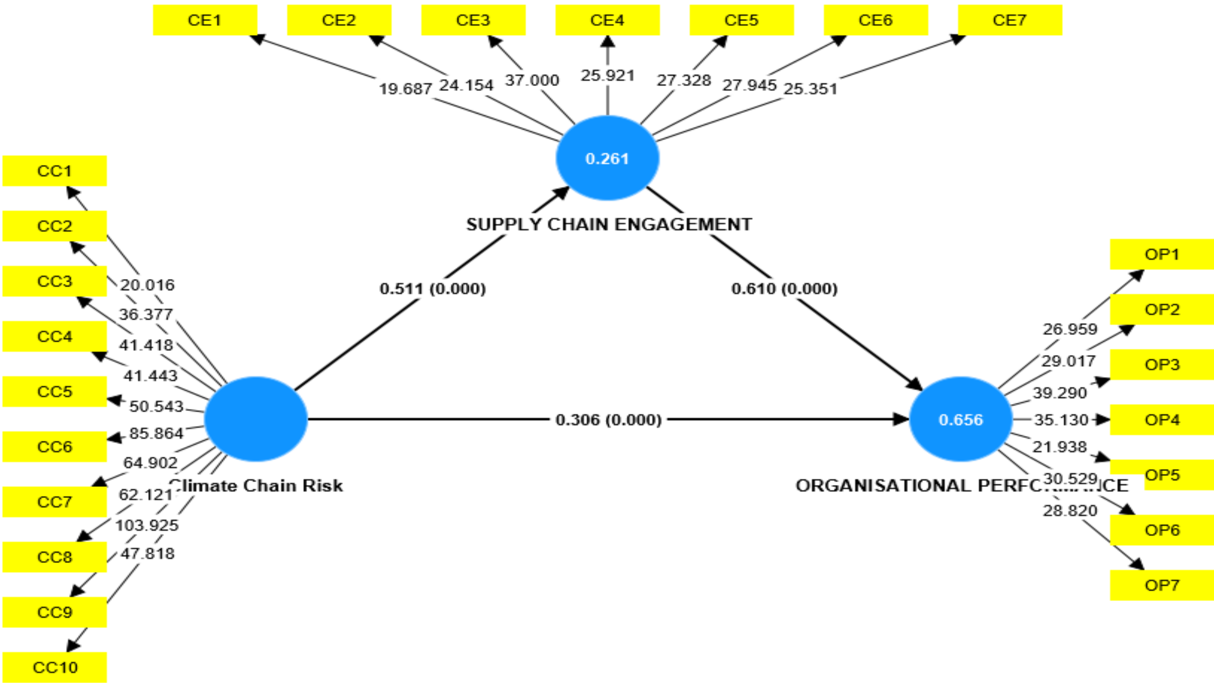
The results presented in Figure 1 show that all the indicators are higher than 0.708 indicating that all the reflective indicators are valid. Indicator loadings ranged from 0.719 to 0.928. Similarly, findings presented in Figure 2 indicated that all the indicators have t-values greater than 1.96 as proposed by Hair *et al*. (2019) and Gaskin *et al*. (2018). The t-values presented in Figure 2 ranged from 19.687 – 103.925. The figures presented indicated that all the indicators are valid.

Figure 2: Factor Loadings



Source: Field Survey, (2023)

Figure 3: T-Values for the indicator loadings



Source: Field Survey, (2023)

The research provided an analysis of the reliability of the construct and its convergent validity. Table 3 presents an analysis of the Cronbach alpha, composite reliability, Rho-A, and average variance extracted (AVE). According to the recommendations of Hair et al. (2018), and Ringle et al. (2022), it is advisable to use a threshold of greater than 0.70 for composite reliability, greater than 0.50 for average variance extracted, greater than 0.70 for rho_A, and greater than 0.70 for Cronbach's Alpha. The results presented in Table 3 showed that all values for the variables exceeded the recommended thresholds. The Cronbach values ranged from 0.884 (supply chain engagement) to 0.899 (organizational performance) and 0.965 (climate change risk). Similarly, the values for rho-A ranged from 0.888 (supply chain engagement) to 0.920 (organizational performance) and 0.970 (climate change risk). Additionally, the composite reliability values ranged from 0.909 (supply chain engagement) to 0.920 (organizational performance) and 0.970 (Climate change risk). Lastly, the average variance extracted (AVE) was computed to establish the convergent validity. Hair *et al.* (2022) revealed that convergent validity would be established if the AVE value is higher than or equal to 0.50 and items converge to measure the underlying construct. The result presented in Table 3 showed that all the AVE values are greater than 0.50, indicating no problem with convergent validity. The values ranged from 0.588 (supply chain engagement) to 0.662 (organizational performance) and 0.762 (climate change risk). The results presented in Table 3 indicate that construct reliability and convergent validity have been established.

Table 3: Construct Validity and Reliability

	Cronbach's Alpha	**Rho_A**	**Composite reliability**	**Average Variance Extracted (AVE)**
Climate Change Risk	0.965	0.970	0.970	0.762
Organizational Performance	0.899	0.905	0.920	0.622
Supply Chain Engagement	0.884	0.888	0.909	0.588

Source: Field Survey, (2023)

Table 4: Heterotrait-monotrait ratio of correlations

	1	2	3
Climate Change Risk (1)	-		
Organizational Performance (2)	0.65	-	
Supply Chain Engagement (3)	0.534	0.838	-

Source: Field Survey, (2023)

The average correlations of the indicators between different constructs are what the HTMT criterion looks at. The discriminant validity levels that are considered acceptable (less than 0.90), as proposed (Henseler et al., 2015). It is recommended for determining the distinctiveness of the constructs, although it ought to be used with 0.85 or 0.90 as a precautionary factor. The discriminant validity was assessed using the heterotrait-monotrait ratio of correlations. Hensler et al (2015) revealed that to establish discriminant validity with the HTMT all values must be less than 0.9. The results presented in Table 4 indicated no issue of discriminant validity because the values are all below the recommended threshold of 0.90.

The quantification of multicollinearity in regression analysis is accomplished through the use of VIF. Multicollinearity arises in a multivariate regression model when there exists a correlation among multiple independent variables. The regression findings may be significantly impacted by this. Finally, the inner variance inflationary factors (VIFs) in Table 5 show no evidence of multicollinearity and common method bias because all the inner VIFs are smaller than 5 (Ringle et al., 2009).

Table 5: Collinearity Statistics

	Climate Change Risk	Organizational Performance	Supply Chain Engagement
Climate Change Risk		1.353	
Organizational Performance			1.00
Supply Chain Engagement		1.353	

Source: Field Survey, (2023)

3.3. Hypothesis testing

The individual hypothesis was examined after determining whether or not the measurement model satisfies the PLS-SEM criteria. The hypotheses were examined by looking at the direction and strength of the relationship using the path coefficient. The significance level was determined using t-statistics produced from 5000 consistent bootstraps, a 2-tailed test suggested by Hair *et al.* (2014). According to Hair *et al.* (2014), the t-statistics must be greater than 1.96, and the p-values must be lower than 0.05 for the hypothesis to be statistically significant. The hypotheses were analyzed and the results presented in Table 6 showed that all the hypotheses were supported because all the t-values were greater than 1.96 and the respective p-values were all less than 0.05.

Table 6: Hypothesis testing

	B	mean	Standard deviation	T statistics	P values	Decision
Climate Change Risk -> Organizational Performance	0.306	0.308	0.057	5.344	0.001	**Supported**
Climate Change Risk -> Supply Chain Engagement	0.511	0.514	0.055	9.360	0.001	**Supported**

Supply Chain Engagement -> Organizational Performance	0.610	0.608	0.051	11.910	0.001	**Supported**
			Specific Indirect Effect			
Climate Change Risk -> Supply Chain Engagement -> Organizational Performance	0.312	0.312	0.034	9.260	0.001	**Supported**

Source: Field Survey, (2023)

A. Climate Change Risk and Organizational Performance

The first objective seeks to investigate the effect of climate change risk on organizational performance. The study hypothesized that climate change risk enhances organizational performance. The results showed that climate change risk significantly and positively enhances organizational performance ($\beta = 0.306$; $t = 5.344$; $p = 0.001$; $p<0.05$). The t-stats of 5.344 is greater than the recommended threshold of 1.96, and the p-value is less than 0.05 ($p = 0.00$). Thus, climate change risk positively and significantly enhances organizational performance; thus, the hypothesis was supported. The findings imply that a unit change in climate change risk will enhance organizational performance by 30.6%. According to Luo and Tang (2016), there is a statistical link between organizational performance and climate change risk. The organization's financial performance may be impacted by climate change in a number of different ways. The risk could be direct (cost of production), indirect (loss of client base owing to reputational risk), or present an opportunity (loss of business opportunities due to a delay in the implementation of a project). The findings of the study align with the study of Luo and Tang (2016), Firdaus et al. (2019), Sun et al. (2020), and Siamabele (2021). The findings of Firdaus et al. (2019) showed a positive relationship between stock performance and climate change risk. Similarly, Siamabele (2021) confirmed a positive relationship between climate change risk and performance.

B. Climate Change Risk and Supply Chain Engagement

The research hypothesized that climate change risk enhances supply chain engagement. The results showed that climate change risk significantly and positively enhances supply chain engagement ($\beta = 0.511$; $t = 9.360$; $p = 0.001$; $p<0.05$). The t-stats of 9.360 is greater than the recommended threshold of 1.96, and the p-value is less than 0.05 ($p = 0.001$). Thus, climate change risk positively and significantly enhances supply chain engagement; thus, the hypothesis was supported. The findings imply that a unit change in climate change risk will enhance supply chain engagement by 51.1%. For Dahlmann and Roehrich (2019) supply chain engagement improves data accuracy and carbon accounting, reducing emissions and mitigating climate change risks through optimization of products, logistics, and procurement.

C. Supply Chain Engagement and Organizational Performance

The research hypothesized that supply chain engagement enhances organizational performance. The results showed that supply chain engagement significantly and positively correlates with organizational performance ($\beta = 0.610$; $t = 11.910$; $p = 0.001$; $p<0.05$). The t-stats of 11.910 is greater than the recommended threshold of 1.96, and the p-value is less than 0.05 ($p = 0.001$). Hence, supply chain engagement positively and significantly enhances organizational performance; thus, the hypothesis was supported. The findings indicated that a unit change in supply chain engagement will enhance organizational performance by 61.0%.

This research findings aligned with the study of Feng and Zhao (2014), Sousa Jabbour et al., (2018), Lim-Camacho et al. (2017) and Ghadge et al., (2020). The findings of Feng and Zhao (2014) revealed that organizations optimized performance when they are able to integrate their supplier and customers in managing climate change. The findings of Lim-Camacho et al

(2017) and Jabbour et al., (2018) affirmed that engaging supply chain partners in managing climate chain risk enhance organizational performance. Similarly, the findings of Ghadage et al (2020) confirmed a positive relationship between supply chain engagement and organizational performance.

D. Supply Chain Engagement, Climate Change Risk and Organizational Performance

Finally, a mediation test was conducted to evaluate the supply chain's mediating function in the link between the risk posed by climate change and organizational performance. The findings showed that there was a substantial effect of climate change risk on organizational performance ($\beta = 0.306$; $t = 5.344$; $p = 0.001$; $p < .05$). The effect of climate change risk on organizational performance was shown to be significant ($\beta = 0.312$, $t = 9.260$, $p = 0.001$) with the mediation variable supply chain engagement included. Thus, supply chain engagement partially mediates the association between climate change risk and organizational performance. The results show that there would be a 31.2% increase in the association between climate change risk and organizational performance for every percentage increase in supply chain engagement.

This indirect effect is statistically significant, as indicated by the t-statistic of 9.260 and the corresponding p-value of 0.001. This suggests that the link between climate change risk and organizational performance is mediated, at least in part, by the level of engagement with the supply chain. Andreoni and Miola (2015) highlight the increasing complexity and interdependencies of the global economic system, making societies vulnerable to crises, exemplified by unforeseen events and climate change.

The indirect effect of supply chain engagement according to Lintukangas et al. (2022), leads to the alteration of the operational and competitive environment, which includes environmental legislation, climate policy, stakeholder attitudes, legal issues, and so forth. The sustainability and performance of the firm also change because of both direct and indirect effects (Sun et al., 2020). Global climate change impacts nature, affecting infrastructure and causing increased costs for companies operating normally.

Climate change threatens businesses with physical asset loss, increased expenses, business interruptions, and decreased operational income, exacerbated by natural catastrophes that can disrupt manufacturing processes and negatively impact earnings (Lim-Camacho et al., 2017). Climate change affects the value chain of product-producing industries, affecting raw material availability, production tasks, marketing, suppliers, employees, and market demand.

E. Coefficient of Determination

The R^2 is a statistical measure that indicates the degree to which one variable may explain the variation in another (Hair & Alamer, 2022). It has been established that the value of R^2 must be between 0 and 1. Values below 0.10, between 0.11 and 0.30, between 0.31 and 0.50, and over 0.50, respectively, indicate low, moderate, medium, and high levels of explanatory power. The findings reveal that climate change risk explains the variation in supply chain engagement by 26.1%. Similarly, climate change risk and supply chain engagement explain the variation in organizational performance by 65.6%. Thus, climate change risk and supply chain engagement explained 65.6% variation in organizational performance, the remaining 34.4% is explained by other variables not captured in the study.

F. Effect Size

The evaluation of the effect size is limited to the measurement of the strength of the relationship between latent variables, as stated by Wong (2013). Effect size can be used by researchers to assess the overall impact of a study. According to Cohen (1988) and Wong

(2013), effect size (f^2) values of 0.02, > 0.15, and >0.35 indicate small, moderate, and large effect sizes, respectively. The table depicts f^2 values ranging from 0.202 for climate change risk and organizational performance to 0.800 for supply chain engagement and organizational performance. Thus, supply chain engagement has a high effect size on organizational performance compared to climate change risk.

G. Predictive Relevance

Predictive relevance (Stone-Geisser's Q2) indicates the model's ability to detect indicators of each latent endogenous variable and shows that the data can be reformed with the help of the model and PLS parameters (Hair et al., 2014). Q-square, a predictive relevance indicator, is used to evaluate a model's accuracy in making predictions (a value greater than 0 is preferable). Q2 further establishes the predictive significance of the endogenous components. If the Q-square is positive, then the model has predictive relevance and has successfully reproduced the researcher's values.

After measuring the magnitude of R^2, predictive accuracy was also assessed (Geisser, 1974). The Q^2 assists in assessing the prediction performance of variables (Shmueli *et al*., 2016). Q^2 values in < 0, >0.25, and >0.50 can be described as weak, moderate, and strong, respectively. The data revealed a strong predictive relationship between climate change risk and supply chain engagement. Also, the findings show a strong predictive strength on climate change risk and supply chain engagement on organizational performance.

Table 7: Output of R-square, F-square and Predictive Relevance

Organisational Performance	0.656	0.654
Supply Chain Engagement	0.261	0.258

Effect Size	Climate Chain Risk	Organisational Performance	Supply Chain Engagement
Climate Chain Risk		0.202	0.353
Organisational Performance			
Supply Chain Engagement		0.800	

Predictive Relevance	Q^2predict	RMSE	MAE
Organisational Performance	0.374	0.796	0.572

Source: Field Survey, (2023)

Conclusion

This research examines the effect of supply chain engagement on climate change and organizational performance. It suggests that collaboration with suppliers can mitigate risks, improve operational efficiency, and foster innovation, ultimately enhancing resilience to climate change. Organizations should prioritize supply chain engagement to manage climate change risks, reduce costs, and improve performance. This involves collaboration, knowledge-sharing, and sustainability practices, identifying innovation opportunities, reducing environmental impact, and enhancing reputation.

Recommendations

To identify possible risks and vulnerabilities related to climate change, businesses should perform a complete climate risk assessment, according to study goal one. Physical, regulatory, and reputational risks, as well as any direct and indirect threats to the organization, should all be covered in the evaluation. These manufacturing firms should integrate climate risk into their strategic planning process. This includes developing strategies to address climate risks, such as investing in renewable energy, improving supply chain resilience, applying business ethics (Gbamara et al., 2024), observing corporate social responsibility (Nassè et al. 2024). The effect of business ethics and corporate social responsibility on business success: and enhancing sustainability practices.

Suggestions for Future Studies

Further research is needed to compare supply chain engagement practices across contexts and examine how cultural differences influence effectiveness.

Acknowledgements

The researchers are grateful to the respondents, and to the editors of the Journal of Emerging Trends in Marketing and Management for their valuable suggestions.

References

Adèr, H. J. 2008. Advising on research methods: A consultant's companion. *Johannes van Kessel Publishing*.

Ahi, P., & Searscy, C. 2013. A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production*, *52*, 329-341.

Andreoni, V., & Miola, A. 2015. Climate vulnerability of the supply-chain: Literature and methodological review, JRC science and policy reports, European Commission. *Luxemburg: Publications Office*.

Babbie, E. R., & Mouton, J. 2003. Social statistics. Practice of social research.

Babin, B. J., Hair, J. F., & Boles, J. S. 2008. Publishing research in marketing journals using structural equation modelling. *Journal of Marketing Theory and Practice*, *16*(4), 279-286.

Blanco, C. C. 2021. Supply chain carbon foot printing and climate change disclosures of global firms. *Production and Operations Management*, *30*(9), 3143-3160.

Bode, C., Wagner, S. M., Petersen, K. J., & Ellram, L. M. 2011. Understanding responses to supply chain disruptions: Insights from information processing and resource dependence perspectives. *Academy of Management Journal*, *54*(4), 833-856.

Bryman, A., & Lilley, S. 2009. Leadership researchers on leadership in higher education. *Leadership*, *5*(3), 331-346.

Busse, D., Yim, I. S., & Campos, B. 2017. Social context matters: Ethnicity, discrimination and stress reactivity. *Psych Neuroendocrinology*, *83*, 187-193.

Ching, J., Mills, G., Bechtel, B., See, L., Feddema, J., Wang, X., ...& Theeuwes, N. 2018. WUDAPT: An urban weather, climate, and environmental modelling infrastructure for the Anthropocene. *Bulletin of the American Meteorological Society*, 99(9), 1907-1924.

Cohen, L. 2006. The prevalence of anxiety and associated factors in a multiracial sample of older adults. *Psychiatric Services*, *57*(12), 1719-1725.

Creswell, J. W. 2014. *A concise introduction to mixed methods research*. *SAGE publications*.

Creswell, J. W., & Clark, V. L. P. 2017. Designing and conducting mixed methods research. *SAGE publications*.

Daft, R. L., & Lengel, R. H. 1986. Organizational information requirements, media richness and structural design. *Management Science*, *32*(5), 554-571.

Dahlmann, F., & Roehrich, J. K. 2019. Sustainable supply chain management and partner engagement to manage climate change information. *Business Strategy and the Environment*, *28*(8), 1632-1647.

Dung, T. Q., Bonney, L. B., Adhikari, R. P., & Miles, M. P. 2020. Entrepreneurial orientation, knowledge acquisition and collaborative performance in agri-food value-chains in emerging markets. *Supply Chain Management*, *25*(5), 521-533.

Firdaus, R. R., Senevi Gunaratne, M., Rahmat, S. R., & Kamsi, N. S. 2019. Does climate change only affect food availability? What else matters? *Cogent Food & Agriculture*, *5*(1), 1707607.

Ganassali, S. 2009. Les enquêtes par questionnaire avec Sphinx. *Pearson education*.

Galbraith, J. R. 1974. Organization design: An information processing view. *Interfaces*, *4*(3), 28-36.

Gbamara, L., Nassè, T. B. & Akparep, J. Y. 2024. Examining the relationships between Business ethics, customer satisfaction and purchase behaviour: Perspectives from Wa Township in Ghana. *Advances in Consumer Research*, *1*(1), 1-13.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. 2021. Partial least squares structural equation modelling (PLS-SEM) using R: A workbook (p. 197). *Springer Nature*.

Hair, J. F., Ringle, C. M., & Sarstedt, M. 2012. Partial least squares: the better approach to structural equation modelling? *Long Range Planning*, *45*(5-6), 312-319.

Hong, C., Zhang, Q., Zhang, Y., Davis, S. J., Tong, D., Zheng, Y. ... & Schellnhuber, H. J. 2019. Impacts of climate change on future air quality and human health in China. *Proceedings of the national academy of sciences*, *116*(35), 17193-17200.

Hsu, C. W., Kuo, T. C., Chen, S. H., & Hu, A. H. 2013. Using DEMATEL to develop a carbon management model of supplier selection in green supply chain management. *Journal of Cleaner Production*, *56*, 164-172.

King, N., Cassell, C., & Symon, G. 1994. Qualitative methods in organizational research: A practical guide. *The Qualitative Research Interview*, *17*.

Kumar, K. 2011. Direct seeding of rice: recent developments and future research needs. *Advances in Agronomy*, *111*, 297-413.

Lim-Camacho, L., Plagányi, É. E., Crimp, S., Hodgkinson, J. H., Hobday, A. J., Howden, S. M., & Loechel, B. 2017. Complex resource supply chains display higher resilience to simulated climate shocks. *Global Environmental Change*, *46*, 126-138.

Lin, C., Schmid, T., & Weisbach, M. S. 2020. Climate change and corporate investments: Evidence from planned power plants. *Fisher College of Business Working Paper (2019-03)*, 026.

Lintukangas, K., Arminen, H., Kähkönen, A. K., & Karttunen, E. 2022. Determinants of supply chain engagement in carbon management. *Journal of Business Ethics*, 1-18.

Luo, L., & Tang, Q. 2016. Determinants of the quality of corporate carbon management systems: An international study. *The International Journal of Accounting*, 51(2), 275-305.

Maxwell, J. A., & Mittapalli, K. 2010. Realism as a stance for mixed methods research. *SAGE Handbook of Mixed Methods in Social & Behavioral Research*, *2*, 145-168.

Nassè, T. B., Nangpiire, C. & Linda, G. 2024. The effect of business ethics and corporate social responsibility on business success: Insights from Ghana. *Advances in Consumer Research, 1*(1), 1-17.

Nassè, T. B., Ouèdraogo, A. & Sall, F. D. 2019. Religiosity and consumer behavior in developing countries: An exploratory study on Muslims in the context of Burkina Faso. *African Journal of Business Management*, *13*(4), 116-127.

OECD, P. 2015. *OECD-FAO agricultural outlook 2015-2024*. OECD

Oelze, N., Hoejmose, S. U., Habisch, A., & Millington, A. 2016. Sustainable development in supply chain management: The role of organizational learning for policy implementation. *Business Strategy and the Environment*, *25*(4), 241-260.

Pankratz, N., & Schiller, C. 2021. Climate change and adaptation in global supply-chain networks. In proceedings of Paris December 2019 Finance Meeting EUROFIDAI-ESSEC. *European Corporate Governance Institute–Finance Working Paper* (No. 775).

Paulraj, A., Chen, I. J., & Blome, C. 2017. Motives and performance outcomes of sustainable supply chain management practices: A multi-theoretical perspective. *Journal of Business Ethics*, *145*, 239-258.

Peng, Y., Zhang, X., van Donk, D. P., & Wang, C. 2022. How can suppliers increase their buyers' CSR engagement: The role of internal and relational factors. *International Journal of Operations & Production Management*, *42*(2), 206-229.

Plambeck, E. L. 2012. Reducing greenhouse gas emissions through operations and supply chain management. *Energy Economics*, *34*, S64-S74.

Rafindadi, A. A., & Usman, O. 2019. Globalization, energy use, and environmental degradation in South Africa: startling empirical evidence from the Maki-cointegration test. *Journal of Environmental Management*, *244*, 265-275.

Ringle, C. M., Götz, O., Wetzels, M., & Wilson, B. 2009. On the use of formative measurement specifications in structural equation modeling: A Monte Carlo simulation study to compare covariance-based and partial least squares model estimation methodologies. *METEOR Research Memoranda (RM/09/014)*.

Sarkis, J. 2012. A boundaries and flows perspective of green supply chain management. *Supply Chain Management: an International Journal*, *17*(2), 202-216.

Saunders, M., Lewis, P., & Thornhill, A. 2009. Research methods. *Business Students 4th edition Pearson Education Limited, England*, *6*(3), 1-268.

Schulz, B., Backman, C., Verbeke, A. C., & Heger, H. R. 2022. Firm adaptation to climate change: Applying the GISTe model to a cohort of FT500 Firms 2004-2020. *Academy of Management Proceedings*, *1*(1), 17504.

Siamabele, B. 2021. The significance of soybean production in the face of changing climates in Africa. *Cogent Food & Agriculture*, *7*(1), 1933745.

Simanjuntak, M., Anggraini, A. M. T., & TRI, M. 2024. Toward safer E-Commerce transactions: The Influence of system quality, information accuracy, and government oversight. *Journal of Emerging Trends in Marketing and Management*, *1*(3), 7-19.

Singer, E., & Couper, M. P. 2017. Some methodological uses of responses to open questions and other verbatim comments in quantitative surveys. *Methods, Data, Analyses: a Journal for Quantitative Methods and Survey Methodology (Mda)*, *11*(2), 115-134.

Solér, C., Bergström, K., & Shanahan, H. 2010. Green supply chains and the missing link between environmental information and practice. *Business Strategy and the Environment*, *19*(1), 14-25.

Sun, Y., Yang, Y., Huang, N., & Zou, X. 2020. The impacts of climate change risks on financial performance of mining industry: Evidence from listed companies in China. *Resources Policy*, *69*, 101828.

Sussman, F. G., & Freed, J. R. 2008. Adapting to climate change: A business approach (p. 41). *Arlington, VA: Pew Center on Global Climate Change*.

Tetteh, B., Baidoo, S. T., & Takyi, P. O. 2022. The effects of climate change on food production in Ghana: evidence from Maki (2012) cointegration and frequency domain causality models. *Cogent Food & Agriculture*, *8*(1), 2111061.

Vachon, S., & Klassen, R. D. 2006. Extending green practices across the supply chain: The impact of upstream and downstream integration. *International Journal of Operations & Production Management*, *26*(7), 795-821.

Villena, V. H., & Dhanorkar, S. 2020. How institutional pressures and managerial incentives elicit carbon transparency in global supply chains. *Journal of Operations Management*, *66*(6), 697-734.

Warner, S. L. 1965. Randomized response: A survey technique for eliminating evasive answer bias. *Journal of the American Statistical Association*, *60*(309), 63-69.

Yawar, S. A., & Seuring, S. 2018. The role of supplier development in managing social and societal issues in supply chains. *Journal of Cleaner Production*, *182*, 227-237.

Young, R. B., & Javalgi, R. G. 2007. International marketing research: A global project management perspective. *Business Horizons*, *50*(2), 113-122.

Zikmund, V. 2003. Health, well-being, and the quality of life: Some psychosomatic reflections. *Neuroendocrinology Letters*, *24*(6), 401-403.

Appendix 1

Demographic data

	Frequency (n=226)	**Percentage (%)**
Gender		
Male	143	63.3
Female	83	33.7
Age of respondents		
Below 20 years	5	2.2
21-30 years	125	55.6
31-40 years	53	23.6
40-50 years	32	14.2
Above 50 years	11	4.4
Managerial Level		
Functional Level	123	54.4
Middle level	75	33.2
Top-level	28	12.4
Educational level		
SHS	26	11.5
Diploma	74	32.7
Degree	102	45.1
Masters/PhD	24	10.6

Years of experience		
12 months and less	42	15.2
1-5 years	67	32.4
6-10 years	71	37.2
More than 10 years	46	15.2

Source: Field Survey, (2023)