

## **Strategies for Managing the Effects of Climate Change on Infrastructural Development in Public Tertiary Institutions in Rivers State**

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### **Abstract**

The study examined the strategies for managing the effects of climate change on infrastructural development in public tertiary institutions in Rivers State. The study adopted the descriptive survey research design. Three research questions and three hypotheses were formulated and tested at a 0.05 level of significance. The population of the study comprises 4532 respondents, 1250 lecturers, and 3282 final-year students from the five (5) selected public tertiary institutions affected by climate change. Purposive sampling technique was used for the study while simple random sampling technique was used to select 303 lecturers and 357 final year students of the selected federal tertiary institutions as determined by Taro Yamen making a total sample size of 660. The instrument for data collection was a self-structured questionnaire titled "Strategies for Managing the Effects of Climate Change on Infrastructural Development Questionnaire (SMTECCIDQ)". The reliability of the instrument was established using Cronbach Alpha method and a reliability index of 0.89 was obtained and was used for the study. Data collected were analyzed using mean and standard deviation for research questions while the hypotheses were tested using z-test. The findings of this study revealed that increasing public awareness positive incentives to encourage choices that lower emissions, adding a price to greenhouse gas emissions which creates incentives to reduce emissions broadly risk reduction management of the effect of climate change on infrastructural development in public tertiary institutions. The findings revealed that allowing tertiary institutions to 'self-insure' itself against climatic stressors, building the resilience of populations through social protection and related measures risk retention management of the effect of climate change on infrastructural development in public tertiary institutions. The findings also revealed that encouraging sustainable land management measures and institutions led initiatives to cope with climate change, using disaster risk transfer mechanisms such explicit links between risk financing and disaster risk management, using catastrophe bonds to provide coverage against exposure to extreme weather events help in the risk transfer management of the effect of climate change on infrastructural development in public tertiary institutions. Result from hypothesis revealed that there is no significance difference in the mean responses of students and lecturers on the risk reduction, risk retention and risk transfer management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State. Based on the findings of the study, it was recommended among others that Federal and State government should provide a good management and preventive measures such as risk reduction management to control heavy rain and flood for improvement of infrastructural development in tertiary institutions

**Keyword: Climate Change, Infrastructural Development, Management, Tertiary Institution.**

## **Introduction**

Climate change has been seen as a geometrical variation that continues for an extended period, typically for an era or longer. Climate change according to Ogbuabor and Egwuchukwu (2017) includes shift in the occurrence and magnitude of sporadic weather events as well as the slow but continuous rise in global average surface temperature. Climate change is a peril already having substantial impact on human beings especially those within the school environment and the natural eco-system both in developed and developing countries but at varying degrees.

Climate change has been a global concern for several decades, and its impact varies widely across different regions and countries. Developed countries have been able to mitigate the adverse effects of climate change to a significant extent due to their natural advantages, advanced adaptation techniques, advanced technology, mechanized agricultural systems, and wealth. In contrast, developing countries like Nigeria are particularly vulnerable to the effects of climate change due to the high temperatures, poor adaptation capacity, and lack of an early warning system. In addition to these challenges, climate change poses a serious threat to the infrastructure of tertiary institutions, which are dedicated to academic activities such as teaching and learning. This threat arises from physical damage to buildings, roads, and utilities caused by events such as floods and storms, which can lead to disruptions in campus activities and require costly repairs. Furthermore, it is important to note that climate change may have a significant impact on academic performance in tertiary institutions. Studies suggest that this impact may be due to several factors, including increased stress levels, health problems, and reduced productivity among students and faculty members. Given these challenges, it is essential to develop effective management strategies to mitigate the adverse effects of climate change on tertiary institutions. Such strategies may include improved infrastructure design, early warning systems, emergency response plans, and capacity building for students, faculty members, and staff. Only by taking proactive measures can we ensure that tertiary institutions continue to serve their academic mission in the face of climate change.

According to Edo and Osuji (2016), climate change has been identified as the leading human and environmental crisis of the 21<sup>st</sup> century. The problem of understanding climate change is one of the major challenges of individuals, governments, and other stakeholders. It refers to long-term alterations in the Earth's climate, particularly changes in temperature and precipitation patterns, as well as more frequent and intense extreme weather events. These variations are largely attributed to human activities, primarily the release of greenhouse gases into the atmosphere, which trap heat and lead to a warming effect commonly referred to as global warming. These climate patterns also play a fundamental role in shaping the natural ecosystem, and the students' activity and cultures that depend on them. Fundamentally, every system, whether institution or otherwise, is tied to climate. Climate change hence, can affect many related aspects of where and how people, plants, and animals live, such as food production, availability and use of water, and health risks.

The primary effect of climate change has been linked to higher concentration of carbon dioxide and other greenhouse gases in the atmosphere, which are dominantly of anthropogenic origin such as industrial processes, fossil fuel combustion, change in land use

and deforestation (Ekpoh, 2009). Natural causes include volcanic eruptions, ocean current, the earth's orbit change, solar variations, and plate tectonics, gradual and sudden shifts (Norgaard, 2010). Climate change is a hindrance that does not spare anything that falls on it. The dawn of climate change and its negative effect on the environment such as tertiary institutions can be traced to the later part of the twentieth century, precisely 1990s, when the increase in the warming of the atmosphere started to generate serious concern all over the world, with the Western World championing it. Evidence has revealed that the global mean temperature increased by 60% during the 20th Century, with the six hottest years occurring between 1997 and 2007 (IPCC, 2007). This warming has resulted to rise in sea level, which inundated coastal areas and increased beach erosion, widespread flooding from coastal storms, changes in precipitation patterns, increased risk of droughts and flood, threats to biodiversity and potential challenges for tertiary institutions in the country. In real life, these hazards were witnessed in floods which ravaged parts of Nigeria in 2010 such as Lagos, Ogun, Oyo and Sokoto States, and the thunderstorm which hit Ogoja in Cross River State in May 2009 (Ekpoh, 2009). In Nigeria, the situation is trickier. Research shows that about one third of the nation's territory is under siege by the expanding frontiers of the Sahara Desert, with whole villages in the North disappearing under sand dunes, turning the affected villagers into refugees.

In the North also, the flood disaster in Sokoto Metropolis in 2010 led to the destruction of properties worth billions of Naira. In the south, the Atlantic Ocean is threatening coastal cities including Nigeria's financial and industrial hub, Lagos and Niger Delta while increased storm and floods have dissipated infrastructure and human habitat in the East (Eze, 2009). Tertiary institutions in Nigeria are also experiencing the harsh effects of climate change and feeling the pangs of environmental disruptions that challenge their administrations, academic staff, and effective functioning of these institutions, especially their teaching and learning situations. Also, a case in point is the flooding of parts of Usman Dan Fodio University in Sokoto in 2010, which disrupted academic activities and rendered them comatose until succor came from the Federal Government and other well-meaning individuals in the country. The effects of climate change on infrastructural development can be felt in disruption of teaching and learning activities, poor instructional delivery, irregular class attendance, difficulty in maintaining the institutions infrastructural materials and other expensive facilities (Ajayi, 2010).

Whenever academic staff of tertiary institutions experience the harsh effects of climate change such as erosion, flooding, increased rainfall, excessive heat, windstorms, and rainstorms, amongst others, their level of role or task accomplishment is drastically affected. Climate change confronts education with chaos, complexity, and uncertainty, presenting a system in which changes in one or more elements can reverberate through the whole (Selby, 2007). That is, it affects academic staff role performance in such a way that when one aspect such as classroom teaching is involved, other aspects are not spared. It does not only contaminate the classroom atmosphere but also the overall institutional learning environment. Under this scenario, academic staff role performance usually suffers terrible setbacks leaving on its trail, low achievement of set goals, and poor output. However, Basil (2012) explained that there is a ray of hope in providing a solution to the dangers posed by climate change in

Nigeria with the activities of such bodies as Nigeria Climate Action Network (Nigeria CAN), which organizes conferences aimed at proffering a way out of climate change threat on infrastructural development in tertiary institutions.

Infrastructural development according to Basil (2012) is the construction and improvement of fundamental services to spark institutional growth and improvement in quality of education. He further stated that infrastructural development involves any type of infrastructure including transportation, water, energy, social, and green infrastructure. Infrastructural development is used to describe improvement in physical and non-physical infrastructure that is vital to a country's institutions development. Also, Infrastructure development is a vital driver for progress across the African continent and a critical enabler for productivity and sustainable economic growth and it can contribute significantly to institutions development, poverty reduction, and the attainment of the Sustainable Development Goals (SDGs). Investment in infrastructure accounts for over half of the recent improvement in institution growth in Nigeria and has the potential to achieve even more with adequate management strategies or approaches (African Development Bank, 2022).

According to Xianfu and Rexel (2017) management of climate change is an intervention designed to reduce the human influence on the climate system, primarily through increased removal of greenhouse gases from the atmosphere, the reduction of greenhouse gas emissions, and the reduction of feedback that might enhance warming in the tertiary institutions in Nigeria. It was further explained that management of climate change includes risk reduction management, risk retention management and risk transfer management and these types of management are very essential in climate change. Risk reduction, and climate risk management in particular, provide powerful capacities for substantially reducing risks and adapting to climate change with tertiary institutions.

Climate change risk reduction management is defined in the UN International Strategy for Disaster Reduction (UNISDR) terminology as “action taken to reduce the risk of disasters climate change) and the adverse impacts of natural hazards, through systematic efforts to analyze and manage the causes of disasters, including through avoidance of hazards, reduced social and economic vulnerability to hazards, and improved preparedness for adverse events” (UNISDR, 2009). The risk reduction approach entails putting in place measures (either structural or non-structural) before an event occurs with the goal of reducing loss and damage, which could be caused by slow onset events, such as desertification, sea level rise, and ocean acidification, or by extreme weather events, such as storms and flash floods (Xianfu & Rexel, 2017). It is therefore tailor-made to help counteract the added retention risks management arising from climate change within tertiary institutions in Nigeria.

According to Poundrik (2011) risk retention is defined as an approach by which a society or tertiary institutions (at national or local level) would accept a degree of risk of loss and damage associated with impacts from slow onset and extreme weather events. It was further asserted that risk retention management includes unplanned and planned risk management and a distinction is made between planned and unplanned risk retention management. Planned risk retention management involve setting aside public funds explicitly to respond to emergency needs. Unplanned risk retention management involve drawing from the general budget for an unforeseen emergency, making it an unexpected burden to fiscal resources.

Risk retention is the practice of setting up a self-insurance reserve fund to pay for losses as they occur, rather than shifting the risk to an insurer or using hedging instruments.

Tertiary institutions are more likely to engage in risk retention when it determines that the cost of self-insurance is lower than the insurance payments or hedging costs required to transfer the risk to a third party. A large deductible on an insurance policy is also a form of risk retention. Complete retention can be seen as a risk management technique in which a company facing a risk or risks decides to absorb, or accept, any and all potential loss rather than transfer that risk to an insurer or other party. Complete retention is an aggressive form of self-insurance in climate change which also be combined with risk transfer management.

Risk transfer management which is one of the management of climate change involves shifting the risk of loss and damage from one entity to another in an institutions of learning (Goteng, Emmanuel & Alikeju, 2012). It is further opined that risk transfer management of climate change is typically undertaken when the potential loss and damage is greater than the ability to manage it. Insurance (including micro insurance) is a risk transfer measure and so are catastrophe bonds, risk pooling, conditional risk transfer, and combined insurance-credit programs and can be invaluable to governments, or even households, as they help limit the financial burden of rebuilding or recovering from loss and damage in the tertiary institutions.

Conversely, Eze (2009) reports that Government demonstrated a firm grasp of the situation by raising an alarm on the dangers and declaring that climate change pose threats to national infrastructural development. Notwithstanding, these laudable efforts, the Federal Government is yet to provide the requisite effective management strategies for the articulation of a national programme for the mitigation of the dangers of the climate change. It is on this background that this study seeks to assess management of the effects of climate change on infrastructural development in Nigerian tertiary institutions.

### **Statement of the Problem**

Climate change has led to the destruction of infrastructural facilities such as libraries, laboratories, halls, offices, administrative blocks, hostels, road facilities, water, electricity, and internet among others in many tertiary institutions across the country. The availability of infrastructural facilities in adequate quantities will support the effective functioning of tertiary institutions and the inadequacies will prevent the effective functioning of tertiary institutions. Many public universities in Nigeria do not have adequate lecture halls, laboratories, and offices for both students and academic staff as a result of the effects of climate change such as flooding or rainstorms.

In 2019, facilities and infrastructures worth over N500 million were destroyed by a heavy rainstorm at Alex Ekwueme Federal University, Ndufu-Alike Ikwo (AE-FUNAI), in Ebonyi State. The rainstorm badly damaged the roofs of about eight buildings in the school, exposing them to the hazards of the rain. The winds also pulled down about 15 solar-powered security lights, buildings, some equipment, documents, and other office materials that were destroyed. Also, studies have been carried out on the challenges of climate change on the provision of and accessibility to quality education in Nigeria and found out that climate change has led to the destruction of school buildings and other infrastructural development in tertiary institutions, therefore requiring adequate management such as risk reduction management,



risk retention management, and risk transfer management. It is against this backdrop that the study seeks to examine the management of the effects of climate change on infrastructural development in public tertiary institutions in Rivers State.

### **Purpose of the Study**

The purpose of the study is to examine the strategies for management of the effects of climate change on infrastructural development in public tertiary institutions in Rivers State. The study sought to

1. Determine the extent to which risk reduction strategy is used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State.
2. Find out the extent to which risk retention strategy is used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State.
3. Ascertain the extent to which risk transfer strategy is used to manage the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State.

### **Research Questions**

The following research questions were answered in the study;

- i. To what extent is risk reduction strategy used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State?
- ii. To what extent is risk retention strategy used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State?
- iii. To what extent is risk transfer strategy used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State?

### **Hypotheses**

The following null hypotheses were tested at 0.05 level of significance to guide the study.

1. There is no significance difference in the mean responses of students and lecturers on the extent to which risk reduction strategy is used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State.
2. There is no significance difference in the mean responses of student and lecturers on the extent to which risk retention strategy is used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State.
3. There is no significance difference in the mean responses of student and lecturers on the extent to which risk transfer strategy is used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State.

### **Methodology**

The study adopted the descriptive survey design. The study was conducted in public tertiary institutions in Rivers State. The population of the study was 4532 comprised of 1250 lecturers and 3282 final year students of the public tertiary institutions affected by climate

change. Taro Yamen was used to determine a sample of 303 and 357 lecturers and students respectively. Purposive sampling technique was used to select five (5) public tertiary institutions with high effect of climate change while simple random sampling technique was employed to 303 lecturers and 357 final year students of the selected federal tertiary institutions making a total sample size of 660. The instrument for data collection was a self-structured questionnaire titled “Strategies for Managing the Effects of Climate Change on Infrastructural Development Questionnaire (SMTECCIDQ)”. The instrument “SMTECCID” was subdivided into sections A and B. Section A was used to capture the demographic features of the respondents such as sex, age, school, level, and qualification. Section B was made up of 24 items on managing the effect of climate change on infrastructural development in public tertiary institutions. This section contains questions eliciting responses in order to achieve the objectives of the study. Furthermore, the questionnaire was structured on a modified 4-point rating scale of strongly Agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD) with numerical values of 4, 3, 2 and 1 respectively. The instrument (SMTECCID) was validated by two experts in Measurement and Evaluation, Rivers State University, Port Harcourt for face and content validity. The instrument was vetted in terms of appropriateness, relevance, and level of language. Recommendations and corrections made were effected in the final edition of the instrument before administering. The reliability of the instrument was elicited for measures of stability of the instrument. The instrument was administered to 30 respondents that are not part of the study in Niger Delta University, Wilberforce, Bayelsa State.

The reliability of the instrument was obtained using Cronbach Alpha Coefficient method and a reliability index of 0.89 was established. The instrument was administered directly by the researcher to the respondents with the help of two research assistants. Out of 357 and 303 copies of the instrument that was administered to students and lecturers, only 207 and 276 copies of the questionnaire administered were completely filled and retrieved for lecturers and students. Research questions were analyzed using mean with standard deviation while the hypotheses were tested using z-test. For the research question, the real limit of 0.50-2.49 was disagreed while between 2.50- 4.00 was agreed. In the hypotheses testing, if the calculated value of z is less than the critical value of z (z-crit), the null hypothesis was accepted while if the calculated value of z (z-cal) is greater than the critical value of z (z-crit), the null hypothesis was rejected.

## Results

The following results were obtained from the study.

**Research Question 1.** To what extent is risk reduction strategy used in managing the effect of climate change on infrastructural development in Public Tertiary Institutions in Rivers State?

**Table 1: Mean Response on Risk Reduction Management of Climate Change**

S/N	Item statement	Students (N=276)			Lecturers (N=207)		
		$\bar{X}_1$	$SD_1$	Remark	$\bar{X}_2$	$SD_2$	Remark
1.	Increasing public awareness	3.20	0.34	High Extent	3.48	0.30	High Extent
2.	Positive incentives to encourage choices that lower emissions.	3.00	0.40	High Extent	3.10	0.42	High Extent
3.	Adding a price to greenhouse gas emissions, which creates incentives to reduce emissions broadly.	3.12	0.31	High Extent	3.02	0.25	High Extent
4.	Increasing Sufficient and effective climate policies	3.09	0.29	High Extent	2.89	0.24	High Extent
5.	Avoiding dangerous anthropogenic interference	2.57	0.20	High Extent	2.67	0.28	High Extent
6.	Combination of policy responses in tertiary institutions	3.58	0.10	High Extent	4.00	0.00	High Extent
7.	Expanding the knowledge base that allows policy makers to understand, select, and refine specific risk management strategies and to thereby increase the effectiveness of risk management efforts	2.90	0.27	High Extent	2.60	0.14	High Extent
<b>Average Mean/SD</b>		<b>3.02</b>	<b>0.27</b>	High Extent	<b>3.09</b>	<b>0.26</b>	High Extent

**Source: Field Survey, 2023**

The result in Table 1 shows the responses of lecturers and final year students on the risk reduction management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State as well as their respective level of decision on a



particular item. The result indicated in Table 1 revealed that creating public awareness, increasing sufficient and effective climate policies, avoiding dangerous anthropogenic interference, positive incentives to encourage choices that lower emissions, and expanding the knowledge base that allows policymakers to understand, select, and refine specific risk management strategies and to thereby increase the effectiveness of risk management efforts help manage the effect of climate change on infrastructural development.

**Research Question 2:** To what extent is risk retention strategy used in managing the effect of climate change on infrastructural development in public tertiary institutions in Rivers State?

**Table 2: Mean with Standard Deviation of Responses of Respondents on the Risk Retention Management of the Effect of Climate Change on Infrastructural Development in Public Tertiary Institutions in Rivers State.**

S/N	Item Statement	Students (N=276)			Lecturers (N=207)		
		$\bar{X}$	SD	Remark	$\bar{X}$	SD	Remark
9.	Allowing tertiary institutions to 'self-insure' itself against climatic stressors	2.80	0.29	High Extent	2.70	0.22	High Extent
10.	Establishing reserve funds for the purpose of offsetting unexpected financial burdens associated with effect of climatic change.	2.81	0.44	High Extent	3.06	0.57	High Extent
11.	Building the resilience of populations through Social protection and related measures.	2.86	0.50	High Extent	2.59	0.60	High Extent
12.	Combinations of risk reduction measures and climate change adaptation.	3.20	0.21	High Extent	3.00	0.24	High Extent
13.	exploring the sectorial use of a range of activities to prepare for and manage the L&D related to slow onset climatic processes.	2.54	0.49	High Extent	2.69	0.32	High Extent
	<b>Average Mean/SD</b>	<b>2.84</b>	<b>0.39</b>	High Extent	<b>2.81</b>	<b>0.39</b>	High Extent

**Source:** Field Survey, 2023

The result in Table 2 revealed the responses of lecturers and students on the risk retention management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State. The result as shown in Table 2 revealed that allowing tertiary institutions to 'self-insure' themselves against climatic stressors, establishing reserve funds to offset unexpected financial burdens associated with the effect of climatic change, building the resilience of populations through social protection and related measures and exploring the sectorial use of a range of activities to prepare for and manage the L&D related to slow onset climatic processes are risk retention management of the effect of climate change on infrastructural development.

**Research Question 3:** To what extent is risk transfer strategy used in managing the effect of climate change on infrastructural development in public tertiary institutions in Rivers State?

**Table 3: Mean with Standard Deviation of Responses of Respondents of Lecturers and Students on the Risk Transfer Management of the Effect of Climate Change on Infrastructural Development in Public Tertiary Institutions in Rivers State.**

S/N	Item Statement	Students (N=276)			Lecturers (N=207)		
		$\bar{X}$	SD	Remark	$\bar{X}$	SD	Remark
1.	Sounding analysis of the target institution and the financial capacity	3.00	0.67	High Extent	3.08	0.55	High Extent
2.	Creating frameworks or institutions that more closely link approaches to address climatic change disaster and emphasize complementarities	3.08	0.56	High Extent	2.99	0.45	High Extent
3.	Encouraging sustainable land management measures and institutions led initiatives to cope with climate change	2.55	0.70	High Extent	2.80	0.65	High Extent
4.	Constructions of dams, embankments and drainage to address flooding problems	2.99	0.44	High Extent	2.84	0.20	High Extent
5.	Using disaster risk transfer mechanisms such explicit links between risk financing and disaster risk management.	3.07	0.41	High Extent	3.67	0.32	High Extent
6.	Using catastrophe bonds to provide coverage against exposure to extreme weather events	2.89	0.33	High Extent	2.90	0.39	High Extent
7.	Strengthening institutional capacity	2.77	0.5	High	2.6	0.49	High

	such as collaborative programs between public and private sectors, regional climate policies		0	Extent	6		Extent
8	Strengthening the available technical expertise in planning in order to Address climate change impacts on infrastructural development.	2.57	0.7 0	High Extent	2.5 4	0.77	High Extent
9	Encouraging index-based weather insurance by providing financial security against climate extremes, insurance instruments and present an Opportunity for the region to reduce untimely disaster and adapt to climate change.	3.07	0.1 8	High Extent	3.0 5	0.19	High Extent
10.	Enhancing understanding of locally available resources, including community-embedded knowledge and technologies, and their role in disaster risk management processes	2.48	0.9 0	Low Extent	2.4 9	0.89	Low Extent
11	Ensuring current and future initiatives are complementary and build on lessons learned	3.00	0.2 4	High Extent	3.0 2	0.52	High Extent
	<b>Average Mean/SD</b>	<b>2.86</b>	<b>0.5 1</b>	High Extent	<b>2.9 1</b>	<b>0.49</b>	High Extent

**Source:** Field Survey, 2023

The result in Table 3 indicates the responses of lecturers and students on the risk transfer management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State. The result as indicated in Table 3 revealed that encouraging sustainable land management measures and institutions led initiatives to cope with climate change, using disaster risk transfer mechanisms such explicit links between risk financing and disaster risk management, using catastrophe bonds to provide coverage against exposure to extreme weather events, strengthening the available technical expertise in planning in order to address climate change impacts on infrastructural development and encouraging index-based weather insurance by providing financial security against climate extremes, insurance instruments and present an opportunity for the region to reduce untimely disaster and adapt to climate change risk transfer management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State.

### Test of Hypotheses

**Hypothesis 1:** There is no significant difference in the mean responses of student and lecturers on the risk reduction management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State.

**Table 4: z-test Analysis on the Risk Reduction Management of the Effect of Climate Change on Infrastructural Development in Public Tertiary Institutions in Rivers State.**

Respondents	N	$\bar{X}$	SD	Df	z-cal.	z-crit.	Sign	Decision
Students	276	3.02	0.27	481	-1.50	1.96	0.05	Accepted
Lecturers	207	3.09	0.26					

**Source: Field Survey, 2023**

The analyzed data in table 4 revealed that the z-calculated value is -1.50 and the z-critical table value is 1.96 with a degree of freedom of 638 at 0.05 level of significance. Since the z-cal (-1.50) is less than the z-critical value (1.96), the null hypothesis was accepted indicating that there is no significance difference in the mean responses of students and lecturers on the risk reduction management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State.

**Hypothesis 2:** There is no significance difference in the mean responses of students and lecturers on the risk retention management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State.

**Table 5: z-test Analysis on the Risk Retention Management of the Effect of Climate Change on Infrastructural Development in Public Tertiary Institutions in Rivers State.**

Respondents	N	$\bar{X}$	SD	Df	z-cal.	z-crit.	Sign	Decision
Students	276	2.84	0.39	481	-1.23	1.96	0.05	Accepted
Lecturers	207	2.81	0.39					

**Source: Field Survey, 2023**

The analyzed data in table 5 revealed that the z-calculated value is -1.23 and the z-critical table value is 1.96 with a degree of freedom of 638 at 0.05 level of significance. Since the z-cal (-1.23) is less than the z-critical value (1.96), the null hypothesis was accepted indicating that there is no significance difference in the mean responses of students and lecturers on the risk retention management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State.

**Hypothesis 3:** There is no significance difference in the mean responses of student and lecturers on the risk transfer management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State.

**Table 6: z-test Analysis on Risk Transfer Management of the Effect of Climate Change on Infrastructural Development in Public Tertiary Institutions in Rivers State.**

Respondents	N	$\bar{X}$	SD	Df	z-cal.	z-crit.	Sign	Decision
Students	276	2.86	0.51	481	-0.85	1.96	0.05	Accepted
Lecturers	207	2.91	0.49					

**Source:** Field Survey

The analyzed data in table 6 indicated that the z-calculated value is -0.85 and the z-critical table value is 1.96 with a degree of freedom of 638 at 0.05 level of significance. Since the z-cal (-0.85) is less than the z-critical value (1.96), the null hypothesis was accepted indicating that there is no significance difference in the mean responses of students and lecturers on the risk transfer management of the effect of climate change on infrastructural development in public tertiary institutions in Rivers State.

### Discussion of Findings

The result of the findings in table 1 revealed that the risk reduction management of the effect of climate change on infrastructural development in public tertiary institutions include increasing public awareness positive incentives to encourage choices that lower emissions, adding a price to greenhouse gas emissions which creates incentives to reduce emissions broadly, increasing sufficient and effective climate policies, avoiding dangerous anthropogenic interference combination of policy responses in tertiary institutions. Expanding the knowledge base allows policy makers to understand, select, and refine specific risk management strategies and to thereby increase the effectiveness of risk management efforts, research, observations, scientific assessments, and technology development can help reveal risks and opportunities associated with the climate system and support decision-making with respect to climate change risk management. The findings of this study agrees with that of Xianfu and Rexel (2017) which stated that the risk reduction approach entails putting in place measures (either structural or non-structural) before an event occurs with the goal of reducing loss and damage, which could be caused by slow onset events, such as desertification, sea level rise, and ocean acidification, or by extreme weather events, such as storms and flash floods.

Findings from research question 2 shows the risk retention management of the effect of climate change on infrastructural development in public tertiary institutions. The results of the finding revealed that allowing tertiary institutions to 'self-insure' itself against climatic

stressors, establishing reserve funds for the purpose of offsetting unexpected financial burdens associated with effect of climatic change, building the resilience of populations through social protection and related measures, combinations of risk reduction measures and climate change adaptation, exploring the sectorial use of a range of activities to prepare for and manage the L&D related to slow onset climatic processes are the management strategies that can help avert the effect of climate change on infrastructural development in Nigerian tertiary institutions. The findings of this study are in line with the opinion of Poundrik (2011) which asserted that risk retention management includes unplanned and planned risk management and a distinction is made between planned and unplanned risk retention management.

The result from research question 3 in table 3 reveals the risk transfer management of the effect of climate change on infrastructural development in public tertiary institutions includes sounding analysis of the target institution and the financial capacity, creating frameworks or institutions that more closely link approaches to address climatic change disaster and emphasize complementarities, encouraging sustainable land management measures and institutions led initiatives to cope with climate change, constructions of dams, embankments and drainage to address flooding problems, using disaster risk transfer mechanisms such explicit links between risk financing and disaster risk management, using catastrophe bonds to provide coverage against exposure to extreme weather events. Strengthening institutional capacity such as collaborative programs between public and private sectors, regional climate policies, strengthening the available technical expertise in planning to address climate change impacts on infrastructural development, encouraging index-based weather insurance by providing financial security against climate extremes, insurance instruments and present an opportunity for the region to reduce untimely disaster and adapt to climate change for the improvement of infrastructural development. The finding is in line with the opinion of Xianfu & Rexel (2017) which posited that insurance (including micro insurance) is a risk transfer measure and so are catastrophe bonds, risk pooling, conditional risk transfer, and combined insurance-credit programs and can be invaluable to governments, or even households, as they help limit the financial burden of rebuilding or recovering from loss and damage in the tertiary institutions in Rivers State.

## **Conclusion**

The study findings suggest that the implementation of risk reduction management, risk retention management, and risk transfer management strategies can have a positive impact on the infrastructural development of tertiary institutions in Rivers State. The study confirms that students and lecturers have identified climate change as a significant factor that affects infrastructural development in these institutions. If these strategies are implemented exponentially, the benefits could be substantial, leading to a reduction in unemployment and poverty among undergraduates after graduation. However, the inability of tertiary institutions authority and government to perform their management roles creditably is a direct result of the devastating effects of climate change on infrastructural development in public tertiary institutions in Rivers State.



## **Recommendations**

The study recommended among others that:

1. Federal and State government should provide a good management and preventing measures such as risk reduction management to control heavy rain and flood for improvement of infrastructural development in tertiary institutions in Rivers State.
2. For a balance, the tertiary institutions authorities and state government should combine risk reduction and risk retention management measures identified and confirmed by both students and lecturers in various tertiary institutions in order to prevent the effect of climate change on infrastructural development.
3. Federal Government should provide the requisite effective risk transfer management strategies through the various tertiary institutions' authorities for the mitigation of the dangers of the climate change on infrastructural development.

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