Mitigating the Influence of Climate Change on School Facilities Management in Public Secondary Schools in Rivers State

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Abstract

The study examined how the influence of climate change on school facilities management in public secondary schools can be mitigated. Two research questions were posed and answered, while two corresponding hypotheses were tested at a 0.05 level of significance. This study adopted the descriptive survey research design. The population of this study consisted of 208 senior secondary schools' principals from 104 secondary schools in Rivers West District of Rivers State. The sample size of the study consisted of 144 principals from the purposively selected 72 Junior and senior secondary schools in Rivers West senatorial District of Rivers State. The instrument for the study was designed by the researchers, titled "Influence of Climate Change on School Facilities Management Questionnaire (ICCSFMQ)." The instrument was validated by three experts from Faculty of Education, Rivers State University, Port Harcourt. Cronbach Alpha was used to determine the reliability coefficient, which yielded values of 0.71 and 0.75, respectively. Data gathered from the two research questions were analysed using the mean and standard deviation and the two formulated null hypotheses tested with Z-test at 0.05 level of significance.The findings of the study revealed that no significant difference exists in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which changes in temperature and humidity levels and perennial flooding influence school facilities management in public secondary schools in Rivers State. It was recommended that schools should perform regular maintenance of HVAC (Heating, ventilation, and air conditioning) systems, ventilation systems, and other equipment to ensure that school facilities are functioning properly and efficiently, and that the state government and its agencies responsible for disaster control should from time to time carry out environmental risk assessments to determine the likelihood and potential impact of disasters on schools and to propose measures to be taken before, during, and after a disaster.

Keywords: Influence, climate, change, school, facilities, renovation.

Introduction

School facilities management is a crucial aspect of ensuring that schools provide a safe and conducive learning environment for students and a comfortable workplace for teachers and non-teaching staff. It encompasses a wide range of tasks, including maintenance, cleaning, safety inspections, upgrades, and energy management. Effective school facilities management helps to improve academic performance, attract and retain students and staff, and enhance the reputation of the school. As the sole certified officer, the school principal manages all aspects of school facilities; which includes; the planning, design, construction, operation,

maintenance, and renovation of physical facilities within a school or educational institution. Some of the different aspects of school facilities management include:

Planning and Design: This involves developing and implementing plans for new construction or renovation of existing facilities. It includes assessing the needs of the school and community, identifying available resources, developing budgets, and designing the facilities to meet the needs of the students, staff, and community (U.S. Government Accountability Office, 2018).

Construction: This involves managing the construction process, including selecting contractors, managing the budget, and ensuring that construction is completed on time and within budget. This also involves ensuring that construction meets all regulatory requirements and safety standards.

Operation: This involves managing the day-to-day operations of the school facilities, including building maintenance, cleaning, and security. It involves developing and implementing policies and procedures for managing the facilities, managing budgets, and ensuring that facilities are in compliance with all regulatory requirements.

Maintenance: This involves maintaining the facilities to ensure that they are safe, functional, and in good condition. It includes routine maintenance such as cleaning, painting, and repairs, as well as more significant repairs and renovations.

Renovation: This involves updating and modernizing existing facilities to meet the changing needs of the school and community. It includes identifying areas that need improvement, developing plans and budgets for renovation, and managing the renovation process.

Safety and Security: This involves ensuring that the facilities are safe and secure for students, staff, and visitors. It includes implementing security measures such as cameras, alarms, and secure entry systems, as well as conducting safety drills and inspections to identify potential hazards.

School facilities management is a complex and multifaceted discipline that requires expertise in a variety of areas mentioned above to ensure that students have access to safe, functional, and modern facilities that support their educational success, which can be adversely influenced due to changes in climate patterns.

Climate change refers to the long-term alteration of temperature and typical weather patterns in a place. It is mainly caused by human activities such as burning fossil fuels, deforestation, and industrial processes that emit large amounts of greenhouse gases into the atmosphere. These gases trap heat from the sun and cause the Earth's surface temperature to rise, leading to global warming. Climate change has various negative impacts on the school environment and generally the human society, including rising sea levels, more frequent and intense heat waves, droughts, floods, wildfires, and storms. It also affects ecosystems, biodiversity, and agricultural productivity. Climate change can have a significant mitigating influence on school facilities management in several ways:

i. Increased frequency and severity of extreme weather events: Climate change can lead to more frequent and intense weather events such as floods, and wildfires, which can damage school buildings and infrastructure (National Education Association, 2019). This can result in increased repair and maintenance costs, as well as disruptions to regular school operations

ii. Changes in temperature and humidity levels: As temperatures rise and humidity levels change, schools may need to adjust their HVAC (Heating, ventilation, and air conditioning) systems to maintain comfortable learning environments (United Nations Environment Programme, 2016). This can lead to increased energy costs and the need for more frequent maintenance and upgrades of HVAC systems.

iii. Water availability and quality: Climate change can affect water availability and quality, which can impact the maintenance of school facilities. For example, drought conditions can lead to water shortages, making it difficult to maintain landscaping and sports fields (United Nations Department of Education,2016). Changes in water quality can also affect plumbing systems and the health and safety of students and staff.

iv. Increased risk of pests and diseases: Climate change can create conditions that are more favorable for pests and diseases, such as mold and mildew. This can lead to increased maintenance and cleaning needs in school facilities, as well as potential health risks for students and staff

To address climate change, efforts are being made to reduce greenhouse gas emissions and promote the use of renewable energy sources. This includes transitioning to clean energy, promoting energy efficiency, and implementing policies such as carbon pricing and emissions regulations. Additionally, there is a need for adaptation measures to help communities and school ecosystems cope with the influences of climate change that are already occurring. Climate change can have a significant influence on school facilities management in several ways:

Increased frequency and severity of extreme weather events: Climate change can lead to more frequent and intense weather events such as hurricanes, floods, and wildfires, which can damage school buildings and infrastructure. This can result in increased repair and maintenance costs, as well as disruptions to regular school operations (Akpan, 2010). Changes in temperature and humidity levels: As temperatures rise and humidity levels change, schools may need to adjust their HVAC systems to maintain comfortable learning environments. This can lead to increased energy costs and the need for more frequent maintenance and upgrades of HVAC systems (Oyewole, 2019). Water availability and quality: Climate change can affect water availability and quality, which can impact the maintenance of school facilities. For example, drought conditions can lead to water shortages, making it difficult to maintain landscaping and sports fields (Oyeyinka&Osunmadewa, 2018). Changes in water quality can also affect plumbing systems and the health and safety of students and staff.

Increased risk of pests and diseases: Climate change can create conditions that are more favorable for pests and diseases, such as mold and mildew. This can lead to increased maintenance and cleaning needs in school facilities, as well as potential health risks for students and staff (National Emergency Management Agency, 2021; Federal Ministry of Environment, 2015). It is very obvious that, the effects of climate change on school facilities management require proactive planning and adaptation strategies to ensure that school buildings and infrastructure are maintained and operate efficiently, and that the health and

safety of students and staff are not compromised in secondary schools in Rivers State. Secondary schools in Nigeria typically provide education for students between the ages of 11 to 17 years old. The secondary education system in Nigeria is divided into two levels: Junior Secondary School (JSS) and Senior Secondary School (SSS) (Federal Republic of Nigeria, 2004).

The Junior Secondary School (JSS) is a three-year program that is intended to provide a broad-based education to students in preparation for the Senior Secondary School. The curriculum includes subjects such as Mathematics, English Language, Social Studies, Basic Science, and Technology, Agricultural Science, and Business Studies. Students are expected to sit for a Basic Education Certificate Examination (BECE) at the end of the third year of JSS.

The Senior Secondary School (SSS) is a three-year program that builds on the foundation laid in JSS. Students are expected to take core subjects, including Mathematics, English Language, Civic Education, and one of the three major Nigerian languages (Hausa, Igbo, or Yoruba). In addition, they are required to select three or four elective subjects from a range of options such as the Sciences, Social Sciences, Arts, and Vocational studies. Students sit for the West African Senior School Certificate Examination (WASSCE) or the National Examination Council (NECO) at the end of the third year of SSS.In Rivers State, secondary schools can be either located on the same premises or separately dispersed within the same community and tasked with the aims of providing students with a solid foundation in academic subjects, as well as prepare them for future academic and career pursuits. Based on these varying views from research, the study opined that climate change is factor to consider in school facilities management of public secondary schools in Rivers State.

Statement of the Problem

The Niger Delta region of Nigeria is the most vulnerable to climate change, which has continued to dominate national politics. Floods, droughts, and rising temperatures are all signs of climate change, which has in one way or another posed a serious threat to the conducive learning environment for students and the comfortable workplace for teaching and non-teaching staff.

Climate change is expected to cause temperatures in Africa to rise between 1.5 and 3.0 degrees Celsius by 2050. This will cause more flooding, which will have negative effects on the more than 30 million people who live in 320 coastal communities in states such as AkwaIbom, Bayelsa, Cross River, Delta and Rivers. In fact, regional crop yields are slowing down as a result of events related to climate change, like increased rainfall and higher temperatures, which have led to water scarcity in communities as well. This can impact school operations by limiting access to drinking water, irrigation, sanitation facilities, increased air pollution, etc., and worsening air quality by increasing the frequency and severity of wildfires, dust storms, and other natural disasters. Schools located in areas with poor air quality may be at risk of health problems for students and staff and disruptions of transportation systems, making it difficult for students and staff to access the schools' facilities. With the effects of climate change, one would expect more attention to be given to addressing the influence of climate change. Rather, the reverse is the case, as poor measures

to mitigate the influences are generally observed. It is on this basis that this study investigates: how can the influence of climate change on school facility management in public secondary schools be mitigated?

Aim and Objectives of the Study

The aim of this study is to examine the mitigating influence of climate change on school facilities management in public secondary schools in Rivers State. Specifically, the study sought to determine the:

i. mitigating influence of the change of temperature and humidity levels on school facilities management in public secondary schools in Rivers State.
ii. mitigating influence of the perennial flooding on school facilities management in public secondary schools in Rivers State.

Research Questions

The study was guided by the following research questions

i. To what extent does change of temperature and humidity levels influence the school facilities management in public secondary schools in Rivers State?
ii. To what extent does perennial flooding influence the school facilities management in public secondary schools in Rivers State?

Hypotheses

The following null hypotheses which were formulated for the study includes:

1 There is no significant difference in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which change of temperature and humidity levels influence the school facilities management in public secondary schools in Rivers State.
2. There is no significant difference in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which perennial flooding influence the school facilities management in public secondary schools in Rivers State.

Empirical Review

According to a study by Smith, Johnson and Davis (2016) reported that the optimal temperature range for learning is between 68°F and 74°F (20°C and 23°C). When the temperature is too high or too low, students are more likely to experience discomfort, fatigue, and decreased cognitive function. Additionally, high temperatures can lead to increased levels of carbon dioxide in the classroom, which can further impact student performance. Proper ventilation and air conditioning can help maintain a comfortable learning environment. Similarly, Garcia and Hernandez (2015) opined that humidity levels can also impact the learning environment. Revealed that the optimal relative humidity level for learning is between 40% and 60%. When the humidity is too low, students may experience dry skin, throat irritation, and increased susceptibility to respiratory infections. When the humidity is too high, mold and bacteria growth can occur, which can lead to health problems. Proper ventilation and dehumidification can help maintain appropriate humidity levels.

Proper facilities management is essential for maintaining a comfortable and healthy learning environment. This includes regular maintenance of heating, ventilation, and air conditioning systems, as well as ensuring proper ventilation, cleaning, and pest control. In a study published in the Journal of School Health, researchers found that schools with better facilties management had higher student attendance rates and lower rates of absenteeism due to asthma and respiratory illnesses (Brown & Smith, 2020; Oyeyinka&Osunmadewa, 2018).

A review of the literature indicates that flooding can have a significant impact on school facilties management. The effects of flooding on school facilities management can range from mild inconvenience to significant damage, depending on the severity of the flooding and the school's readiness to handle it.

A study conducted by Bostrom, Cerveny, and Winterhalter (2014) found that flooding had a significant impact on school facilties management in the United States. The study found that school facilities that were located in flood-prone areas were more likely to experience damage to buildings and equipment and disruptions in learning due to school closures. In another related study by Fisher and Rodger (2019) revealed that flooding had a significant impact on school facilities management in the United Kingdom. The study found that schools that experienced flooding were more likely to experience damage to buildings and equipment, and disruptions in learning due to school closures. The study also found that flooding had a significant impact on the mental health and wellbeing of students and staff. An overview of the reviewed studies shows that most of the studies on climate change and school facilties management are foreign, and few related local ones were found to focus on the non-school environment. It is therefore pertinent to fill the gap in literature by studying the influence of climate change on school facilities management in public secondary schools in Rivers State.

Methodology

The research design adopted for this study is analytic descriptive design. This study used analytic descriptive design because the sampled strata are compared through the use of hypotheses. The population for this study is 208 senior secondary schools' principals from104 schools in Rivers West District of Rivers State.The choice of the zone is predicated on the occurrence of the yearly flooding experienced by communities in that district,(see Table 1). The communities mostly located along the sea banks of Orashi River and its tributaries, are located in Abua/Odual, Ahoada-East, Ahoada-West and Ogba/Egbema/Ndoni local government areas of the state. The sample size of the study consisted of 144 principals from the purposively selected 72 Junior and Senior Secondary Schools in Rivers West District of Rivers State.

Table 1: Sample Size of Purposively Selected Schools in Rivers West Senatorial District

Local Government	No. of Junior Sec. Sch	No. of Senior Sec. Sch	Total of schools
Abua/Odual	13	13	26
Ahaoda East	18	18	36
Ahaoda West	17	17	34
Ogba/Egbema/Ndoni	24	24	48
Total	**72**	**72**	**144**

Source: Rivers State Ministry of Education

The instrument used for data collection was "Influence of Climate Change on School Facilities Management Questionnaire (ICCSFMQ). ICCSFMQ is made of 12 items developed on a four (4) point rating scale of Very High Extent (VHE-4), High Extent (HE-3), Moderate Extent (ME-2), and Low Extent (LE-1). The instrument was subjected to content and face validity and reliability test which gave a coefficient of stability of 0.71 and 0.75 respectively. The administration of the instrument was personally carried out by the researcher and research assistants. The criterion Mean of 2.50 was use to rank the research questions responses. Data gathered for research question one and two were analyzed using mean and standard deviation and the formulated null hypotheses tested with Z-test at 0.05 level of significance.

Results

Research Question 1: To what extent does change of temperature and humidity levels influence the school facilities management in public secondary schools in Rivers State?

Table 2: Summary of mean scores on the extent to change of temperature and humidity levels influenceschool facilities management in public secondary schools.

S/N	Statement	JSS Principals (N = 72)			SSS Principals (N=72)		
		$\bar{X}$	SD	Remarks	$\bar{X}$	SD	Remarks
1	Use of HVAC system in school facilities help regulate temperature and humidity levels in school facilities.	2.47	1.11	LE	2.46	1.13	LE
2	Installing insulation in school facilities help to maintain consistent temperature and humidity levels by preventing heat from escaping during the dry and rain seasons.	2.09	1.12	LE	2.31	1.17	LE
3	Use of dehumidifiers to remove excess moisture from the air, which can help to prevent mold growth and	2.46	0.96	LE	2.49	0.93	LE

	improve air quality in school facilities						
4	Proper ventilation is essential for controlling temperature and humidity levels of school facilities	2.14	0.7	LE	2.39	0.91	LE
5	Window treatments, such as shades and blinds help to regulate temperature by blocking out sunlight during the hottest parts of the day.	1.3	0.8	LE	2.4	0.62	LE
6	Regular maintenance of HVAC systems, ventilation systems, and other equipment help to ensure that school facilities are functioning properly and efficiently.	2.3	0.7	LE	2.3	0.7	LE
	Grand Mean	**2.09**	**0.9**	**LE**	**2.39**	**0.91**	**LE**

Table 2 above for research question 1, shows the mean responses of respondents on the extent to which change of temperature and humidity levels influence school facilities management in public secondary schools in Rivers West senatorial zone of Rivers State. Respondents rated the use of HVAC system in school facilities help regulate temperature and humidity levels in school facilities (2.47and 2.46), installing insulation in school facilities help to maintain consistent temperature and humidity levels by preventing heat from escaping during the dry and rain seasons (2.09 and 2.31), with use of dehumidifiers to remove excess moisture from the air, which can help to prevent mold growth and improve air quality in school facilities (2.45 and 2.49), proper ventilation is essential for controlling temperature and humidity levels of school facilities(2.14 and 2.39), window treatments, such as shades and blinds help to regulate temperature by blocking out sunlight during the hottest parts of the day (1.3and 2.4) and with regular maintenance of HVAC systems, ventilation systems, and other equipment help to ensure that school facilities are functioning properly and efficiently (2.3 and2.3) low. These indicates that both the JSS and SSS principals agreed that change of temperature and humidity levels influence school facilities management in public secondary schools to low extent.

Research Question 2: To what extent does perennial flooding influence the school facilities management in public secondary schools in Rivers State

Table 3: Summary of mean scores on the extent to perennial flooding influences school facilities management in public secondary schools

S/N	Statements	JSS Principals (N=72)			SSS Principals (N=72)		
		$\bar{X}$	SD	Remark	$\bar{X}$	SD	Remark
1	Conduct a flood risk assessment to determine the likelihood and potential impact of flooding on the school.	2.47	1.11	LE	2.39	1.1	LE
2	Develop a flood management plan that outlines measures to be taken before, during, and after a flood.	2.48	1.19	LE	2.34	0.96	LE
3	Install flood barriers, such as sandbags or inflatable barriers, to protect school facilities from floodwaters.	2.61	1.01	HE	2.73	1.01	HE
4	Ensure that drainage systems are functioning properly and are able to handle large amounts of water.	2.51	0.93	HE	2.5	0.93	HE
5	Critical equipment and infrastructure, such as electrical panels and HVAC systems, are elevated to prevent damage from flooding.	2.3	0.81	LE	2.23	0.83	LE
6	Educate students and staff on flood safety and emergency procedures.	2.5	0.8	HE	2.51	0.82	HE
	Grand Mean	2.48	0.98	HE	2.48	0.94	HE

Table 3 above for research question 1, shows the mean responses of respondents on the extent to which perennial flooding influences school facilities management in public secondary schools in Rivers West senatorial zone of Rivers State. Respondents ranked the conduct a flood risk assessment to determine the likelihood and potential impact of flooding on the school (2.47and 2.39), Develop a flood management plan that outlines measures to be taken before, during, and after a flood (2.48 and 2.34), and critical equipment and infrastructure, such as electrical panels and HVAC systems, are elevated to prevent damage from flooding (2.30 and 2.23) were scored low extent. On the contrary, install flood barriers, such as sandbags or inflatable barriers, to protect school facilities from floodwaters (2.61 and 2.73), to ensure that drainage systems are functioning properly and are able to handle large amounts of water (2.51 and 2.5), and to educate students and staff on flood safety and emergency procedures. influence the school facilities management (2.5and 2.51) were ranked to low extent. With grand mean of (2.48 and 2.48) indicates that both the JSS and SSS principals

agreed that perennial flooding influences school facilities management in public secondary schools to low extent.

Hypotheses

H_{01}: There is no significant difference in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which change of temperature and humidity levels influence the school facilities management in public secondary schools in Rivers State.

Table 4: Z-test on the Responses of Junior Secondary Schools and Senior Secondary Schools' Principals on the extent to which Change of Temperature and Humidity levels Influence the School Facilities Management in Public Secondary Schools in Rivers State

Respondents	$\bar{X}$	SD	N	DF	Z-cal	Z-	Decision
JSS Principals	2.48	0.98	72				
				142	0.38	1.96	Not Significant
SSS Principals	2.48	0.94	72				

The result in table 4 shows that JSS Principals have mean and standard deviation scores of 2 .48 and 0.98 respectively, while SSS Principals have mean scores and standard deviation of 2.48 and 0.94 respectively. On the basis of their Z-comparison, the calculated Z-ratio (0.38) is less than the critical value (1.96). Therefore, the null hypothesis of 'no significant difference in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which change of temperature and humidity levels influence the school facilities management in public secondary schools in Rivers State is upheld.

H_{02}: There is no significant difference in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which perennial flooding influence school facilities management in public secondary schools in Rivers State.

Table 5: Z-test on the Responses of Junior Secondary Schools and Senior Secondary Schools' Principals on the extent to which Perennial Flooding Influence the School Facilities Management in Public Secondary Schools in Rivers State

Respondents	$\bar{X}$	SD	N	DF	Z-cal	Z-	Decision
JSS Principals	2.09	0.90	72				
				142	0.60	1.96	Not Significant
SSS Principals	2.39	0.91	72				

The result in table 5 shows that JSS Principals have mean and standard deviation scores of 2 .09 and 0.90 respectively, while SSS Principals have mean scores and standard deviation of 2.39 and 0.91 respectively. On the basis of their Z-comparison, the calculated Z-ratio (0.60) is less than the critical value (1.96). Therefore, the null hypothesis of 'no significant difference in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which perennial flooding influences school facilities management in public secondary schools in Rivers State is upheld.

Discussion

The findings from research question1 and hypothesis 1 showed in table 2 and 4 respectively, indicate that both the JSS and SSS principals agreed that change of temperature and humidity levels influence school facilities management in public secondary schools to a low extent and that no significant difference exists in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which change of temperature and humidity levels influence school facilities management in public secondary schools in Rivers State. This finding agrees with Johnson and Davis (2016) and Garcia and Hernandez (2015) who revealed that high temperatures and humidity led to increased levels of carbon dioxide in the classroom, which can further impact on students' performance.

The findings of research question2 and hypothesis2 as showed in table 3 and 5 respectively, indicate that both the JSS and SSS principals agreed that perennial flooding influences school facilities management in public secondary schools to low extent and that there is no significant difference in the responses of Junior secondary schools and senior secondary schools' principals on the extent to which perennial flooding influences school facilities management in public secondary schools in Rivers State. This finding agrees with Cerveny, and Winterhalter (2014) and Fisher and Rodger (2019) who reported that flooding had a significant impact on school facilities management in the United States andUnited Kingdom respectively.

Conclusion

From the findings, it was concluded that change of temperature and humidity levels and perennial flooding have significant influence on school facilities management. The influence of temperature and humidity levels and perennial flooding on school facilities management range from mild inconveniences to significant damages, depending on the severity of the circumstances and the readiness of the school to handle it.

Recommendations

Based on the findings, the study recommends that:

i. The schools should regularly maintainthe HVAC (Heating, ventilation, and air conditioning) systems, ventilation systems, and other paraphernalia to ensure that school facilities are functioning properly and efficiently.
ii. The state government and its agencies responsible for disaster control should from time to time carry out environmental risk assessment to determine the likelihood and

potential impact of disasters on the school to proffer measures to be taken before, during, and after a disaster.

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