CLIMATIC CHANGE ADAPTATION STRATEGIES AND ITS EFFECTIVENESS IN RELATION TO BUILDINGS OF AYETORO COMMUNITY, ONDO STATE.

Abstract

Background: Climate change is a global phenomenon that has already begun to alter ecosystems and disrupt traditional patterns of weather and oceanic conditions. Adaptation strategies to climate change impacts that cannot be avoided particularly in the aspect of buildings, is absolutely an important aspect of global response.

Study Purpose: The study examined the climatic change adaptation strategies adopted by the residents of Ayetoro community and its effectiveness.

Methodology: The data was gathered using a pre-tested, self-administered questionnaire, sectioned into three different parts. The 27 instruments of the questionnaire had 0.878 Cronbach's Alpha Coefficient. A total of 379 respondents were sampled based on Krejcie and Morgan (1970) sample size calculation. The collected were presented by means of frequencies & percentage on tables and graph. Analysis to achieve objective was conducted using descriptive statistical tools (Mean, Median and Standard Deviation). Median represents cut-off point and serves as the baseline for decision.

Result: The study found that all climate change adaptation strategy falls within the interval level of Strongly Agree level, except relocating permanently which falls within the neither agree nor disagree and Remain in the house, which falls within the Disagree interval level. Climate change adaptation strategies such as relocating temporarily, remaining in the house, erecting a barrier/fortifying the house, digging trenches around the house, placing valuable goods on higher level and raising ground floor level were found effective climate change adaptation strategies (Mean scores are equal or greater than median which is the cut-off point). Meanwhile, climate change adaptation strategies such as permanent relocation, construction of new drains and clearing of drainage were found not effective strategies (Mean score are less than median which is the cut-off point).

Keyword: Climate Change, Buildings and Adaptation Strategies.

Introduction

For many years, communities have been witnessing, evaluating, and experiencing the profound effects of climate change. Unexpectedly frequent flooding and sea level rise, an increase in extreme storms, and more alkaline, acidic, and turbulent aquifers all have varying degrees of impact on the environment, ecosystems, infrastructure, livelihood, and buildings. These factors have led to significant financial losses, health risks, and human casualties in recent years, particularly in coastal areas (Jing-Yu Liu et al., 2021). Intense droughts, storms, heat waves, rising sea levels, melting glaciers, and warming oceans are some effects of extreme weather events that can cause direct harm to animals. Demolish homes and cause severe damage to people's livelihoods and communities (World Wide Fund 2022). As a result, communities, particularly in developing nations, have embraced local adaptation strategies in accordance with their capacity. These strategies include routine maintenance that is ongoing, defense to coexist, and retreating when effects become too great to bear in order to survive (Laura and Cater, 2019). Raising awareness, enacting climate policies, implementing sensible and appropriate insurance policies, planning for adaptation, employing adequate management techniques, acquiring the necessary professional skills, and improving socioeconomic traits will all help to improve the adequate adaptation strategies that will

support sustainability in the coastal area in the face of these threats. A natural or human system's adaptation to existing or anticipated stimuli, or to the effects of extreme weather events, is defined by the IPCC (2014) as either taking advantage of advantageous chances in an environment or causing disastrous outcomes. The study's suggested building adaptation strategies are a step in the right direction toward more complex structures to deal with climate change issues and improve the efficiency and sustainability of buildings in coastal areas. Adaptation strategies to climate change impacts that cannot be avoided are unquestionably an important aspect of global response (Yau and Hasby, 2013).An increasing number of dangerous typhoons and tropical storms are forming in tandem with rising ocean levels. These storms move more slowly and dump more rain, creating incredible storm surges that have the power to completely demolish anything in their path. In his research, Nunez (2018) confirmed that storm surges were responsible for almost half of the deaths caused by Atlantic typhoons between 1963 and 2012. People are currently fleeing to higher land due to flooding in low-lying coastal zones, and millions more remain defenseless against surge hazards and other effects of climate change. Because increasing sea levels obstructs a large portion of the foundational communications infrastructure, the possibility of climate immersion jeopardizes essential administrations like web access. Due to these effects, numerous adaptation strategies—many of which come at a significant cost—have been proposed in publications to deal with the long-term projections of all-weather inundations. These strategies include building seawalls, geo-tubes, protecting the seashore, rethinking roads, and planting mangroves or other vegetation to capture water and ward off windstorms. Among the suggested solutions for controlling erosion are the installations of barriers, jetties, drainage systems, and culverts, as well as the employment of suitable technologies and building materials (NG, 2019). In the context of this study, building adaptive strategy is predicated on the emergence of an unplanned pattern of residential building additions and/or modifications. Constructed by Ayetoro residents or those who lack the resilience to withstand the consequences of climate change. Therefore, the purpose of this study is to evaluate completed or partially completed but occupied homes in the Ayetoro community in order to identify their vulnerability and, eventually, inform the construction of building adaptable measures. It is difficult to criticize Maslow's hierarchy of requirements since it ranks physiological needs (clothing, food, and shelter) highest. Before learning about Maslow's theory of motivation, most people would agree that, in a hierarchy of requirements, shelter comes after food because it is a physiological need (Maslow, 1954). Additionally, the process of producing food requires it. Regarding the methods and laws used to mitigate and resolve these issues, housing difficulties are not a recent development. According to Turner (1982), housing is the process by which people build or invest in housing in order to give shelter. This allows housing to impart diverse benefits and provide varying amenities for users in both individual households and the country as a whole. The term "environment" refers to the entirety of all internal components that have an impact on an organism. These factors can include non-living variables like water, soil, climate, and light, or they can be other living things (biotic factors) (UNICEF, 2020). Seventy percent of Nigerians live in rural areas (Elijah, 2020). The natural splendor of the countryside is matched by the relationships between the local culture and the built environment. The way the building is structured places the occupant in a system where he interacts with both the living and non-living environments in a communal and symbiotic way to meet his fundamental needs and those of the dwelling, such as air and fresh health. The traditional building techniques used in the Ilaje region have organically grown to suit the needs and resources of the riverine region. Ignoring these measures would not be right, acceptable, or feasible. The southernmost region of Ondo state is the Ilaje LGA, which has its headquarters in Igbokoda. It is mostly made up of marshes with small areas of muddy/marshy arable land near the coast (Ojo, 2019). This is a unique area with a

complicated network of rivers and creeks that is surrounded by the Atlantic Coast. The term "littoral zone" refers to the coastal environment; the word "littoral" derives from the Latin meaning "shore." The coastal environment of Ilaje is dynamic and distinct, allowing for constant change. Along the continental borders, tides, waves, and erosion characteristics are produced by the interaction of the land, water, and atmosphere. Building techniques vary from culture to culture and place to place. Because of the low-lying terrain, frequent annual flooding, and environmental and topographical conditions, Ayetoro's housing strategies have changed throughout time. It is shown that variations in temperature, windstorm frequency, sea level rise (SLR), and rainfall patterns have a significant impact on the environment. In the Ayetoro community, biodiversity, structures, and ecosystems are negatively impacted (Enete, 2012; NDDC, 2014; Odjugo, 2019). Road buckling, mud splash covering, drainage and culvert destruction, building and jet tie collapse, ecosystem destruction without a portable water supply, electrification, waste and effluent disposal systems, transportation, and other infrastructural facilities are the resultant effects of climate change in this community. The extent to which the ongoing devastation brought about by the effects of climate change and the intervention tactics utilized by stakeholders to address the dire situation in the coastal village of Ayetoro are still subjects of investigation. There is a paucity of research on housing options in the Ayetoro community, but there are many on the causes and impacts of extreme weather events with different adaption tactics in the coastal area. According to Adegun and Olusoga (2020), the majority of research on the effects of climate change on housing and the environment in coastal areas has focused on the effects of persistent gas flares (anthropogenic and overheating), oil spills, industrialization that causes SLR, flooding, and windstorms that negatively affect the environment, ecosystems, and most buildings. In the coastal region of the Ayetoro community, it is evident that there are no records of professional services, housing approval from relevant authorities prior to construction, or coordinated housing adaptation strategies that have the capacity to withstand the effects of climate change. This study aims to close this gap. As a result, this study evaluates the buildings that are now in use in the Ayetoro coastal community, whether they are finished or not, in order to ascertain their susceptibility and, eventually, help establish building adaptation methods for the study region. In order to improve the housing situation in the riverine area, the study will help both public and private housing cooperation (oil firms). Additionally, it will aid in the reconstruction of the catastrophe zone—communities swept away by sea erosion—and aid in the resettlement of the war-torn Ilaje Ward for both public and private oil businesses. The Ayetoro hamlet in Nigeria's Ondo State's Ilaje Local Government Area served as the study's site. Just SLR, floods, and windstorms are the subject of this study out of all the meteorological events related to climate change. There is an urgent need for adequate adaptation techniques because to the catastrophic effects of harsh weather events on dwellings, ecosystems, and the environment in coastal areas. Fortification of structures is one strategy that can be very helpful in mitigating these effects. This concept shows the domains and connections of interest that Conner the gap between conceptual paradigms explaining a research framework as a product, in graphic or narrative form. Climate impact assessment paves way for the timely identification of multi-stakeholder infrastructure resilience, as demonstrated in the literature review, which shows that the continuous impact of extreme weather events on houses in the Ayetoro community is partly due to factors such as constant SLR, flooding, windstorm, poverty, information, low awareness, policy criteria, and low government responses (Adger et al., 2009). that highlights the key elements (causes and effects) with particular attention to the research project (building adaptation to the effects of climate change) through increased local technology and building material awareness, construction technologies, and the selection of these structural materials. Depending on regional factors like the kind of building impacts that could be disrupted by climate change,

the community's current environmental status, the degree of socioeconomic development, including public infrastructure, the availability of data, technical know-how, and financial resources, as well as cultural preferences, the best option for this framework will differ depending on assessments. At this level of the hierarchy, housing adaptation has the ability to save the entire community and will probably involve a range of strategies, such as incorporating climate change adaptation into or near infrastructure and the surrounding environment. This is consistent with reports by Biessbroek et al. (2010) and Makino (2017), which found that employing interdisciplinary approaches set to integrate expert and academic viewpoints in assessing climate change effects through an appropriate and applicable framework through appropriate information and awareness of the current situation, policy formulation, planning / design, implementation by using appropriate coastal friendly construction materials and adequate supervision, ensures appropriate choices for flexibility that will bring about a favorable and sustainable home development as well as a sustainable environment in the coastal area. In order to mitigate the impact of climate change on housing quality, adaption and mitigation techniques must be put into place. Using climate-resilient building materials, enhancing building rules and regulations, and incorporating sustainable design principles are a few examples of these tactics. In addition, raising awareness and advancing resilient housing methods can be greatly aided by community involvement and education. Here, the term "conceptual framework" refers to the expression of ideas that will support the creation of policies, designs, and other initiatives targeted at lessening the consequences of climate housing adaptation on the environment and buildings. The framework is used to differentiate between necessary and desired research interests, as well as regulatory angles and essential research interests. It starts with awareness and moves through design criteria, strategy implementation, and monitoring to ensure that strategies adhere to policy standards for projects involving coastal development. It can be used to address mitigation/adaptation or responses to shock situations. It will also show the scope of possible policy reactions. Within the Niger Delta, In order to create strong precast reinforced concrete, NDDC and NBRRI Lagos collaborated to build a concrete moulding machine akin to Hydraform invention. PPC cement was combined with clinkers to create geometric sizes of 300x550mm and 225x225x5000mm, as well as footings measuring 1200x1200x300mm. This study used the Klein and Nicholls (1999) existing framework solution to develop the framework that involves the strategies for adaptation management in the coastal region by applying strategies from awareness, planning /design, implementation, supervision, policy criteria, and the main development objectives. As a result, for this investigation, both structural and non-structural adaptation strategy choices were recommended. As an alternative to traditional "omeghen" wood, precast reinforced concrete columns and footings with a predetermined strength, shape, length, and structure that can withstand all extreme weather events in the coastal area are included in the structural option. These materials are used as sub-structure materials in building construction. The non-structural plans address problems that mainly support the structural strategies, such as the use of professional services in community development, water supply, drainage, waste disposal, and sewage management, livelihood and employment, poor sanitation, informative approach, economic approach, legislative options, and so forth.

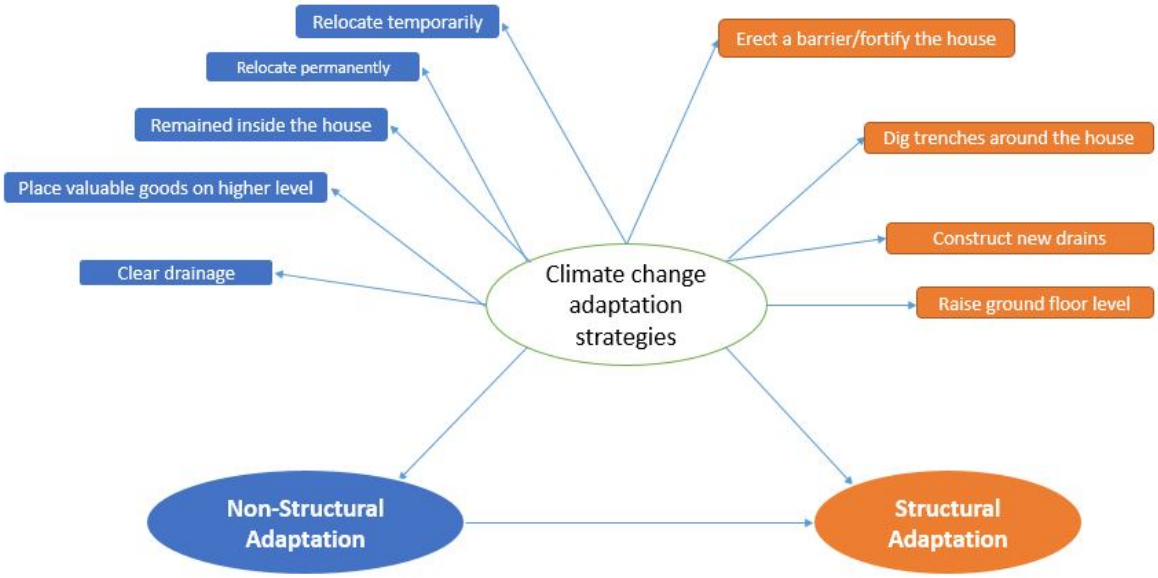

Figure 1: Schematic Representation of Climate change adaptation model [**Source**: Researchers work].

Materials and Method

Study Area

In the Ondo State town of Ayetoro, the study was carried out. The research area is located around 160 km east of Lagos, at latitude 6°13.785 N and longitude 4°38.975' E. The Ilaje people live in the swampy area that separates the study area from the mainland by about 40 km. The Atlantic Ocean marks the community's easternmost point, and the west and north canals serve as its western and northern borders. This town was primarily drawn by theocracy and the opportunity to fish for a living provided by the Atlantic Ocean and the Canal, where communism was accepted as a way of life (Carleton and Hsiang, 2016). The Ayetoro community was selected because of its high degree of decadence from the damaging effects of extreme weather events like SLR/flooding and windstorms on the environment and buildings, which could be appropriately contained. Additionally, the community was chosen because of the immediate sea incursion that has encroached into it by more than 900 meters, severely damaging the infrastructure and buildings, and requiring corrective intervention strategies without displacing the locals. Up until recently, the only ways to go from Ayetoro to other settlements was via river or ocean; there was no road connection. The majority of the neighborhood is vulnerable to periodic flooding due to the marshy surroundings. Closeness to the low-lying environment and the Atlantic Ocean. The Ayetoro village has no fenced-in buildings (Jiboye et al., 2019).

Figure 2: Map of Nigeria showing Ondo State in the National Setting[**Source**: Ondo State Ministry of Works and Housing (2023)].

Research Design

Mixed-methods approach comprising of quantitative (questionnaire survey) and qualitative (direct observations) was adopted for the study. Mixed method allows for an investigation that addresses more complicated research questions, to collect complementary data that enables researcher to gain more contextual understandings of the phenomenon being researched. The study was also a cross-sectional study, conducted in partial fulfillment of a PhD program. Cross-sectional studies are conducted over short-medium stipulated time.

Research Population

This is universally a large collection of individuals or objects that are the main focus of a scientific query (Explorable.com, 2009). According to the Digest of Demographic Statistics of Ondo State, (DDS), (2006), Ayetoro community has a provisional census figure of about 20,070 according to the 2006 census and a projection of 33,173 in 2023 using a 3% yearly increase as recommended by the National Population Commission (NPC). The research population includes all categories of buildings (residential, religious, civic, and commercial), streets and the environment in Ayetoro community.

Sampling Techniques and sample size

Sampling Techniques

The sample and the sampling techniques involved the choice of sampling techniques and the derivation of sample size used. since it is technically wasteful to attempt to collect data from the entire residents of Ayetoro community, it is therefore desirable to adopt a sampling process that will be suitable for the target population. This study adopted a random sampling procedure of the selection of the most affected streets in the study area from the existing 56 streets, where twenty-five (25) streets were selected alternately along the main Broad Street, representing about 45% of the entire streets in the community. Secondly, a random sampling

with a simple interval of 5 also used to select buildings to be assessed in each street. About 10-12 owners were chosen from the selected 24 streets - (310 buildings) depending on the extent of the streets. The main Broad Street that runs the full length of the community had 65 buildings selected. Simple random sampling is the randomly selected subset of a populace where every member is eligible to be selected (Kibuacha, 2021). The method is most straightforward with high internal and external validity and lower risk for research sampling and selection biases.

Sample Size

This is the process of selecting the number of observations or prototypes to include in a statistical sample. It is an important make-up of any empirical study in which the goal is to make inferences about population from a sample (Kibuacha, 2021). With regards to the purpose of this study, consideration was given to the method of Krejcie and Morgan (1970) in determining sampling size for a finite population, because of its simplicity and clarity. Thus the total population which consists of a fixed number of elements and the updated cartographic maps form the basis for an estimated population upon which quantitative information were obtained from the respondents in the study area was utilized. Therefore, with a projected population of 33,173 and using the sample size calculator, with a confidence degree of 95% and margin error of 5%. an overall number of 379 respondents were chosen for this research. Responses were retrieved from 352 respondents giving an equal completion rate of 92.9%, these respondents were used to generalize the assessment of the effects of climate change effects on buildings and the environment in Ayetoro community.

Sample Frame

The sample frame for this study was the entire Ayetoro community as represented by the randomly selected representatives. The sample frame has been limited to owners or occupants of sampled 379 buildings in the study areas, either completed or uncompleted (but excluding unoccupied or uninhabited buildings) upon which information was taken from the owners' occupants above the age of twenty-four (24) years and domiciled in the community.

Instrumentation for Data collection

Data were gather with the use of a well-articulated multiple choice questionnaire, administered on randomly selected 379 respondents in Ayetoro community. A set of questionnaire was employed to extract quantitative data from residents (sample size= 379), who are over 20 years old, living in completed or uncompleted houses in Ayetoro community. The sample size was calculated with reference to Krejcie and Morgan (1970) at a sure and interval level of 95% and 5% respectively. The questionnaire used to the data collection comprises of twenty-seven items, with Section A capturing sociodemographic information of the respondents and containing ten different sociodemographic factors. The section B and C was used to capture the climatic change strategies adopted by the residents of Ayetoro and its effectiveness respectively. Section B and C includes nine and eight different questions. Section B questions were measure using 5 Likert scale, from strongly disagree through strongly agree, while section C questions were measured using 3 Likert scale, from Not effective through Very effective.

Method of Data analysis

The collected form the field survey was presented by means of frequencies & percentage on tables and graph. Analysis to achieve objective was conducted using descriptive statistical tools (Mean, Median and Standard Deviation). Median represents cut-off point and serves as the baseline for decision.

Reliability of instrument

Table 1 Result of reliability Test of the Instrument of the questionnaire

Reliability Statistics

Cronbach's Alpha	N of Items
.878	27

Table 1 shows the SPSS result of the reliability test. It demonstrated that the Cronbach Alpha coefficient was 0.878 which is considered Excellent. This connotes internal consistency.

Results and Discussion

Socio-demographic Characteristics of Respondents

Table 2 Respondents 'sociodemographic information [Number of Respondents = 352(100)]

Factor	Variables	Frequency (F)	Percentage (%)
Sex	Male	208	59.1
	Female	144	40.9
Age group	18 – 27years	40	11.4
	28 – 37years	64	18.2
	38 -47years	16	4.5
	48 – 57years	160	45.5
	Above 57years.	72	20.5
Marital status	Single	64	18.2
	Married	240	68.2
	Widow	48	13.6
Religion practicing	Christianity	256	72.7
	Islam	48	13.6
	Traditional	24	6.8
	Preferred not to say	24	6.8
Education level	No formal Education	80	22.7
	Secondary	72	20.5
	Tertiary Education.	200	56.8
Stay in the Community	Less than 5years	40	11.4
	5years – 10years	40	11.4
	Above 10years	272	77.3
Employment Status	Not employed	16	4.5
	Government Employed	88	25.0
	Self-employed	224	63.6
	Private-sector employed	24	6.8
Occupation	Fishing	96	27.3
	Craftsmanship	96	27.3
	Farming	8	2.3
	Timber Merchant	8	2.3
	Civil servant	32	9.1
	Trading	56	15.9
	Unemployed	32	9.1

	Retired	24	6.8
Monthly household incomes	Less than N30, 000	24	6.8
	N31, 000 – N70, 000	96	27.3
	N71, 000 - N120,000	160	45.5
	N121,000 - 250,000	72	20.5
Size of household	Less than 3	8	2.3
	3 – 6	248	70.5
	7 – 10	64	18.2
	Above 10.	32	9.1

Table 2 presents the result of the sociodemographic characteristics of the Respondents. It demonstrated that majority of the respondents 208 (59.1) were male. The highest age group distribution 160(45.5) was between the ages 48 and 57years. Largest number of the respondents 240(68.2) were married, with greater distribution 256(72.7) practicing Christianity. It demonstrated that most of the respondents 200(56.8) had Tertiary Education. Majority of the respondents 272(77.3) had stayed in the Community for more than 10years. The result also showed that majority of the respondents 224(63.6) were self-employed, with highest distributions of the respondents 96(27.3) having their occupations as Fishing and Craftsmanship. The majority of the respondents 160(45.5) monthly household incomes falls with N71, 000 to N120,000. The highest distribution of the respondents 248(70.5) household size falls within 3 and 6.

Climate Adaptation Strategies Explored from 2000 to 2022.

Table 3 Showing climate adaptation strategies explored from 2000 to 2022

Factor	Variables	Frequency (F)	Percentage (%)
Relocate temporarily	Agree	120	34.1
	Strongly Agree	232	65.9
Relocate permanently	Disagree	120	34.1
	Neutral	160	45.5
	Agree	72	20.5
Remain in the house	Disagree	232	65.9
	Neutral	48	13.6
	Agree	72	20.5
Erect a barrier/fortify the house	Agree	192	54.5
	Strongly Agree	160	45.5
Dig trenches around the house	Neutral	48	13.6
	Agree	144	40.9
	Strongly Agree	160	45.5
Construct new drains	Neutral	48	13.6
	Agree	168	47.7
	Strongly Agree	136	38.6
Clear drainage	Neutral	48	13.6

	Agree	168	47.7
	Strongly Agree	136	38.6
Place valuable goods on higher level	Agree	96	27.3
	Strongly Agree	256	72.7
Raise ground floor level	Agree	96	27.3
	Strongly Agree	256	72.7

Table 3 shows the result of the responses on the strategies adopted to cushion the effect of the climate change. The outcome demonstrated that highest distribution of respondents 232(65.9) strongly agree that the strategies adopted to cushion the effect of the climate change were to temporarily relocate from the environment. Meanwhile, majority of respondents 160(45.5) neither agree nor disagree that the strategies adopted was to permanently relocate from the environment. Only 72(20.5) agree that the strategies adopted were to remain in the house, majority of the respondents 23(65.9) disagreeing. Highest distribution of the respondents 192(54.5) agree that Erecting a barrier or fortifying the house is a strategy adopted, while, 160(45.5) respondents that is the majority strongly agree that digging trenches around the house was strategy adopted. A greater number of the respondents 168(47.7) each agree that strategies adopted were construction of new drains and clearing of drainage. Majority of the respondents 256(72.7) each strongly agree that placing valuable goods on higher level and raising ground floor level were strategies used to cushion the effect of the climate change was to temporarily relocate from the environment.

Effectiveness of adaptation strategies explored from 2000 to 2022

Table 4 Showing the responses on the effectiveness of climate adaptation strategies explored from 2000 to 2022

Factor	Variables	Frequency (F)	Percentage (%)
Relocate temporarily	Not effective	48	13.6
	Effective	232	65.9
	Very Effective	72	20.5
Relocate permanently	Not effective	96	27.3
	Effective	240	68.2
	Very Effective	16	4.5
Remained inside the house	Not effective	256	72.7
	Effective	96	27.3
Erect a barrier	Not effective	24	6.8
	Effective	280	79.5
	Very Effective	48	13.6
Dig trenches around the house	Not effective	48	13.6
	Effective	256	72.7
	Very Effective	48	13.6
Construct new drains	Not effective	56	15.9
	Effective	296	84.1
Clear drainage	Not effective	80	22.7
	Effective	272	77.3
Place valuable goods on	Not effective	24	6.8

higher level			
	Effective	232	65.9
	Very Effective	96	27.3

Table 4 shows the responses on the effectiveness of climate change adaptation strategies explored to cushion the effect of the climate change. It demonstrated that majorities of the respondents 232(65.9) and 240(68.2) were of the opinion that temporary and permanent relocation from the environment are effective strategies to cushion the effect of the climate change. Highest distribution of the respondents 256(72.7) believe that remaining in the house is not an effective strategy for mitigating the climate change effect on the quality of their building. Meanwhile, majority of the respondents 280(79.5), 256(72.7) and 296(84.1) considered erecting a barrier, digging trenches around the house and construction of new drains as effective strategies. Also, clearing drains and placing valuable goods on higher level were considered as effective strategies by the majorities of the respondents 272(77.3) and 232(65.9).

Assessing the climate adaptation strategies explored by the Ayetoro community and its effectiveness in relation to their buildings from 2000 to 2022.

Research Question: What are the climate adaptation strategies explored from 2000 to 2022 and how effective were they?

Table 5 Result of the descriptive statistics of climate adaptation strategies explored by the Ayetoro community

Factors	Mean	SD	Remarks
Relocate temporarily	4.66	0.47	*Strongly Agree*
Relocate permanently	2.86	0.73	*Neither agree nor disagree*
Remain in the house	2.55	0.81	*Disagree*
Erect a barrier/fortify the house	4.45	0.49	*Strongly Agree*
Dig trenches around the house	4.32	0.70	*Strongly Agree*
Construct new drains	4.25	0.68	*Strongly Agree*
Clear drainage	4.25	0.68	*Strongly Agree*
Place valuable goods on higher level	4.73	0.45	*Strongly Agree*
Raise ground floor level	4.73	0.45	*Strongly Agree*

Note: *The 5-points Likert scale is measured as an interval scale, making the MEAN very Significant. By description, from 1-1.8 means strongly disagree, 1.81-2.60 means disagree, 2.61-3.40 means neither agree nor disagree from 3.41-4.20 means agree, from 4.21-5 means strongly agree (*According to Ekong et al. 2021). *S.D-Standard Deviation***.**

Table 5 shows the descriptive statistics result for climate change adaptation strategies explored by the residents in Ayetoro community from 2000 to 2022. The result is used to provide answer to research question five of the study, 'what are the climate change adaptation strategies explored from 2000 to 2022 and how effective were they?'. The result demonstrates that the Mean Score (M.S) ± Standard Deviation (SD) for Relocate temporarily is 4.66 ± 0.47 as a climate change adaptation strategy. The M.S ± S.D for Relocate permanently is 2.86 ± 0.73, while 2.55 ± 0.81 for Remain in the house as a strategy. Meanwhile, MS ± SD for Erection of a barrier/fortifying the house, digging trenches around the house, Construction of new drains, clearing of drainage, placing valuable goods on higher level and Raising ground floor level were 4.45 ± 0.49, 4.32 ± 0.70, 4.25 ± 0.68, 4.25 ± 0.68, 4.73 ± 0.45 and 4.73 ± 0.45 respectively. The 5-points Likert scale is measured as an interval scale; this makes MEAN score very Significant in making decision. According to Ekong et al. (2021), the description of five Likert scales at interval level is, from 1-1.8 can be considered strongly disagree, 1.81-2.60 as disagree, 2.61-3.40 as neither agree nor disagree from 3.41-4.20 as agree and from 4.21-5 as strongly agree. Based on this, all climate change

adaptation strategy falls within the interval level of Strongly Agree level. Except relocating permanently which falls within the Neither agree nor disagree and Remain in the house which falls within the Disagree interval level.

Table 6 Result of the descriptive statistics of effectiveness of climate adaptation strategies explored by the Ayetoro community

Factors	Mean ± S.D	Median	Remark
Relocate temporarily	2.07±0.58	2.00	*Effective*
Relocate permanently	1.77±0.52	2.00	*Not Effective*
Remain in the house	1.27±0.45	1.00	*Effective*
Erect a barrier/fortify the house	2.07±0.45	2.00	*Effective*
Dig trenches around the house	2.00±0.52	2.00	*Effective*
Construct new drains	1.84± 0.36	2.00	*Not Effective*
Clear drainage	1.77±0.42	2.00	*Not Effective*
Place valuable goods on higher level	2.20±0.55	2.00	*Effective*
Raise ground floor level	2.14±0.50	2.00	*Effective*

** Median represent cut-off point and serves as the baseline for decision.

Table 6 and figure 3 shows the descriptive statistics result for the effectiveness of climate change adaptation strategies explored by the residents in Ayetoro community from 2000 to 2020. The result demonstrates that Mean ± S.D for effectiveness of temporary and permanent relocation and Remain in the house, as adaptation strategies were 2.07±0.58, 1.77±0.52 and 1.27±0.45 respectively. Meanwhile, Mean ± S.D for effectiveness of Erection of a barrier/fortifying the house, digging trenches around the house, Construction of new drains, clearing of drainage, placing valuable goods on higher level and Raising ground floor level were 2.07±0.45, 2.00±0.52, 1.84± 0.36, 1.77±0.42, 2.20±0.55 and 2.14±0.50 respectively. Median is assumed the cut-off point on which the decision of the effectiveness of the adopted climate change adaptation strategies is based. Based on the mean scores in Table 6 and the graphical representation (figure 3), Climate change adaptation strategies such as relocating temporarily, remaining in the house, erecting a barrier/fortifying the house, digging trenches around the house, placing valuable goods on higher level and raising ground floor level can be considered effective climate change adaptation strategies (Mean scores are equal or greater than median which is the cut-off point). Meanwhile, climate change adaptation strategies such as permanent relocation, construction of new drains and clearing of drainage are considered not effective strategies (Mean score are less than median which is the cut-off point).

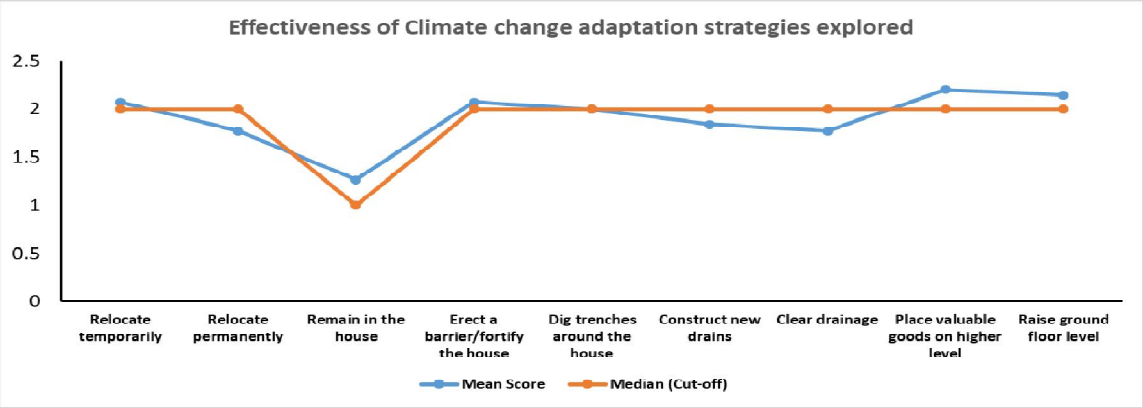

Figure 3 Linear graph of the descriptive statistics of effectiveness of climate adaptation strategies explored by the Ayetoro community

Discussion of findings

The study evaluated the Ayetoro community's climate adaptation strategies and their efficacy with regard to their buildings between 2000 and 2022. The study comes to the conclusion that the adaptation strategies adopted included permanent or temporary relocation, staying in the house, building a barrier or fortifying the house, digging trenches around the house, building new drains and clearing new drainage. Fabiyi (2013) noted that coastal rural regions have undocumented knowledge of local meteorologists, which are derived from tradition, observation, and belief systems. Because of their unique local meteorology, the Ilajes, Itshekiris, and Ijaws who inhabit the study area are able to forecast flooding in real time as well as on a seasonal and long-term basis. The rural coastal communities' way of life, customs, and religious beliefs centre on managing excess water from the Atlantic Ocean and the Niger River's distributaries, such as by building new drains and clearing drainage ditches. However, according to this study, the Ayetoro Community finds the following climate adaptation strategies more effective: temporal relocation,remaining insidethehouse,erect a barrier/fortify the house, Dig trenches around the house.This result is consistent with that of Owusu et al. (2023), who discovered that local coping strategies to lessen the impact of floods on buildings include creating temporary barriers, excavating trenches around homes both before and during floods, and directing floodwaters away from homes using rocks, sandbags, and concrete.In the aspect of relocating temporarily,King et al. (2014) discovered that while unsupported relocation is not generally an option due to family commitment, employment opportunities, financial constraints, and emotional ties, relocation is a strategy that some people can use as part of a wide range of responses to severe weather situations. Usamah and Haynes (2012) noted that people are sometimes forced to relocate Ayetoro community due to unsustainable environments, which puts pressure on rural areas and other cities that may also be vulnerable to overpopulation, sea level rise, or subsidence. Rural environments become unsustainable in spurts when natural disasters cause immediate to protracted crises for the populace. According to Lei et al. (2017), relocation is most beneficial when people are fully engaged in and in control of the decision-making process pertaining to their resettlement, and adequate livelihood provisions are met. Nevertheless, when people move, the buildings suffer because no one is left to maintain or update them.McNamara (2016) opined that relocation brought on by climate change is a "failure of adaptation frequently because it places the burden of support on individuals to relocate rather than stay put.Also, most Ayetoro residents choose to stay inside when the effects of climate change become too great. There may occasionally be excessive precipitation combined with a high sum, which can result in flooding. When the flooding is not too bad, people seek safety in the comfort of their own homes. Creative approaches to building design, development, and management can be sparked by human presence. Two of the earliest innovations to lessen the impacts of climate change have been identified as the construction of waterways and dams (Lienou, et al., 2014).Many of the current dams in the Ayetoro community, such as Owena Dam, are not operating at full capacity, and the canals are in a comatose or deteriorating state as a result of a low maintenance culture. Additionally, unapproved housing has been built in canal-designated areas, severely obstructing the free flow of storm water. Although dams facilitate water flow during periods of heavy rainfall and flooding, this has a detrimental effect on homes. The ways in which communities adapt to climatic variability and severe weather conditions are well documented (FAO, 2008). However, some policies for the management of natural resources such as those pertaining to the protection of forest resources, fishing regulations, and coastal management remain based on a top-down methodology that excludes local communities. Fabiyi and Oloukoi (2013) observed that although these indigenous practices and knowledge have been crucial for research on mitigation as well as adaptation towards sustainable ecological developments, they have been

lost, concealed, or just disregarded.

Conclusion and Recommendations

The study examined the climatic change adaptation strategies adopted by the residents of Ayetoro community and its effectiveness. The study found that climate change adaptation strategies such as relocating temporarily, remaining in the house, erecting a barrier/fortifying the house, digging trenches around the house, placing valuable goods on higher level and raising ground floor level were found effective climate change adaptation strategies. Meanwhile, climate change adaptation strategies such as permanent relocation, construction of new drains and clearing of drainage were found not effective strategies (Mean score are less than median which is the cut-off point). It is therefore recommended that there should be improvement in the use of flood-resistant building materials and construction techniques to mitigate the impact of water damage and improve the durability of structures. Both government and NGOs in Ondo state should conduct public awareness campaigns and educational programs to inform residents about climate change impacts and promote proactive measures for safeguarding their homes and communities. Strengthen and enforce building codes that incorporate climate resilience requirements, including measures for flood-proofing, structural integrity, and hazard mitigation.

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