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Climate Mitigation Strategies and Sustainable Housing Development: Experience of Flooding in Rivers State

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Abstract
This examined the impact of climate mitigation strategies and sustainable housing developmental Rivers State. In conducting the study, a descriptive survey design was used. The Population covered all the employees of federal and state ministries, agencies, real estate developers and registered surveyors. A multi-stage random Sampling technique was used to select the respondent for the study. A sample size of 266 was used. Quantitative data collected were analyzed by the use of descriptive statistics presented through percentages, means, standard deviations and frequencies. The study found that that 3.17 and a standard deviation of 1.103, the mean indicated the significant impact of Sustainable drainage systems in mitigating climate change for sustainable development. From the second variable, the study found that a mean of 2.78 which proved that flood risk management and spatial planning affect sustainable housing development. The result found a mean of 3.00 and indicated that disaster vulnerability and preparedness affect sustainable housing development. The study found a mean of 2.41 and proved that spatial planning and land use management impact on sustainable housing development. From the findings, the study concludes that mitigation strategies significantly impact on sustainable housing development in Rivers State. It therefore recommends implementable policies and strategies to advances climate mitigation to enhance sustainable housing development in the state.

Keywords: *Climate Mitigation Strategies, Sustainable Housing Development, Flooding, Rivers State*

INTRODUCTION

Housing Shelter is one of the basic needs for human survival besides food and clothing. Everyone has the right to adequate housing for health and well-being. Housing has close relationship to a person's life, livelihood, health and overall well-being and therefore directly includes the social themes of vulnerability, social protection and livelihoods (Oladokun & Proverbs. 2016). Adequate housing is not just limited to physical structure. Adequate housing means adequate privacy; adequate space; physical accessibility; adequate security; security of tenure; structural stability and durability; adequate lighting, heating and ventilation; adequate basic infrastructure, such as water-supply, sanitation and waste-management facilities; suitable environmental quality and health-related factors and adequate and accessible location with regard to work and basic facilities: all of which should be available at an affordable cost. Housing is often the most valuable and important asset for many people and its principal role is to provide protection from the elements of nature. Disasters throughout the world often impact severely on housing, and it is usually the most visible element that is damaged or destroyed. Rapid onset disasters such as earthquakes and cyclones cause significant devastation to housing, often leading to loss of this valuable asset; slow onset disasters such as floods and bushfires often displace people from their homes and can also cause destruction (CMC, 2015).

Buildings consume vast quantities of raw materials and energy which result in significant negative impacts on the environment. According to the United Nations Environment Program, construction and operation of buildings account for 40% of total energy use, 40% of raw materials use, 30% of solid waste generation,16% of total building also account for one third of greenhouse gas emissions (GHG) worldwide, which increase sharply as construction increases estimated at 8.6 billion tons in 2004 (UNEP 2006). According to Intergovernmental Panel on Climate Change (IPCC 2007), building related GHG emissions could almost double by 2030 to reach 15.6 billion tons under high-growth construction. The relevance of buildings and construction activities in climate change mitigations strategies was further emphasized at the 2014 Conference of International Union of Architects (IUA) held in Durban, South Africa (Ezema et al. 2016). The Sustainable housing development process Sustainable development can be described as that which meets the needs of the present, without compromising the ability of future generations to meet their own needs. There are many reasons for the building sector to be the main focus of ecological, social, economic and environmentally sustainable development in Nigeria and other developing countries; (i) Nigeria desires to save energy, and resources; (ii) the reduction of generated waste going to landfill; (iii) the possibility to choose or specify building materials and methods that address better indoor environment quality.

Developing countries tend to bear the brunt of disaster impacts, with the poor there often being the most severely affected; the impact of disasters on the built environment is much higher than in developed countries, estimated at more than 20 times in magnitude (Nkwunonwo, Whitworth, & Baily, 2016; Okoye, 2019). Climate mitigation in housing refers to those structures that is expected to not collapse or be destroyed, but may still suffer some damage which however, can be repaired. In detail, Climate mitigation in housing means to build structures and a community that incorporates disaster resilient strategies and disaster risk reduction measures so that the houses can withstand the impact of any natural hazards such as, cyclones, floods, earthquakes, landslides.

Climate mitigation in housing does not only depend on the structure, material, design and construction of the houses but also depends on the socio-economic conditions, administrative and local governance of the community (Saira 2015; Ezeaku, 2017). A flood mitigation plan can decrease damages by reducing discharge, stage or damage susceptibility. Net benefit of these plans can be calculated by costs/benefits analysis of project in optimum design flood. Optimum return period of design flood can be determined by tradeoff between construction costs and operational benefits in certain plan considering risk of failure of the structure. However the optimum retune period was considered 25 year for river training measures such as dykes and diversion based on the guidelines and the flood mitigation alternatives were designed for this flood peak discharge after routing along the rivers.

Detention dam height was determined based on maximum feasible height regardless of flood magnitudes. The damage-reduction benefit can be computed by subtracting damages in without and with project condition. The random nature of flood causes to use "Expected Value" for computing the benefit of damage reduction. Hydrodynamic modeling of the river is necessary in order to determine floodplain discharge, water level and inundation areas in two condition of without and with mitigation plan. Flood can be diverted from the river reach with high damages and returned to the reach in high-capacity or low- damages. Same as the detention dam flood peak discharge is reduced in the river immediately after diversion point. Natural diversions into the floodways reduce flood damage in the existing situation. This study focused on flood mitigation strategies and sustainable housing in Rivers State.

REVIEW OF RELATED LITERATURE

Flood Mitigation

Flooding is the most common disaster in Nigeria. The majority of Nigeria's states are increasingly suffering from annual flooding during the rainy seasons caused by increased precipitation linked to climate change (Aja & Olaore, 2014). Unlike some natural disasters, rainfall flooding can be controlled with proper planning and the provision of necessary infrastructure (Agbonkhese et al., 2014; Satterthwaite, 2017). Nigeria's flooding is mainly human induced with current poor urban planning practices and inadequate to non-existent environmental infrastructure contributing to and exacerbating the issue. The absence of a national flood risk management strategy or comprehensive flood risk maps, for example, are indicators of the lack of attention paid to Nigeria's flooding problem (Oladokun & Proverbs, 2016). This suggests designing and implementing adequate flood risk management strategies comprising proper spatial planning and infrastructure would help in controlling the floods which adversely impact Nigeria's sustainable development (Ouikotan et al., 2017).

Flood frequency analysis is required to identify the flood magnitude for each return period. Therefore a comprehensive flood frequency analysis has been carried out for the upper and intermediate catchments. Reservoir flood control simulation determines flood attenuation by upper storage reservoirs and provides the flood hydrograph for the downstream area for different return periods. The critical situation is assumed regarding to initial condition of reservoirs and flood hydrographs combination of the catchments. Therefore the computed hydrograph in upstream of floodplain area is the maximum possible flood based on the river system features. In order to determine flood inundation depth in the floodplain areas, hydrodynamic river model is required.
Flood damage estimation in inundated areas is one of the key parts of the flood studies. In order to provide an accurate damage amount, a flood damage survey was carried out in the most critical

areas of the flood plains in addition to gathering historical data of damage from recent floods. Historical flood damage data was not reliable due to lack of insurance support in the area and main sources of these data was newspapers and general evaluation of natural disaster office. Therefore estimating of potential damage based on the vulnerability of the region was the only reliable method in the damage analysis. In the flood survey, potential flood damage areas were identified and a set of questionnaires were designed and filled out for residential, agricultural and industrial properties.

Climate Mitigation Strategies

Flood Risk Management and Spatial Planning

Flood Risk Management comprises measures aimed at reducing the likelihood and impact of floods. It encompasses the prediction of flood hazards, socio-economic factors and consequences, and measures/tools for risk reduction (Schanze, 2006). It is not a static approach but adapts to changing circumstances. The adoption of a particular flood risk management strategy is influenced by numerous factors from environmental (geographical features of an area and the type of flood risk an area is prone to) to socio-economic factors and can include both structural and non-structural measures (Adelekan, 2016; Bubeck et al., 2017). Countries adopt approaches that suit their own local situation (Bubeck et al., 2017).

Historically, Nigeria has been more focused on post-disaster flood response than control (Cirella & Iyalomhe, 2018). Reducing and addressing exposure to flood risk is now a national priority in the Nigerian government's disaster risk management agenda. A national framework, now in place, aims at moving reactive flood response and recovery to pro-active risk management, however, nothing concrete has been done and a national FRM strategy to ensure harmonization of practice is still not in place (FGN, 2013; Okoye, 2019). This is not encouraging despite the comprehensive post-disaster needs assessment conducted in 2012 by the federal government with international collaboration. This raises questions on the political will to achieve this goal. Funds are readily released post-floods but not pre-flood to avert it. In 2017 alone, the Nigerian government released as much as N1.6 billion as a post-flooding response (Adekola & Lamond, 2018).

Inadequate attention has been paid to flood control and management on a nationwide level and efforts aimed at addressing the challenge have lacked proper coordination and therefore, failed (Okoye, 2019). Despite evidence of flood interventions in the past, the lack of an integrated FRM practice means that sub-optimal solutions are adopted and in numerous cases, more problems are created in the process. For instance in 2017, parts of Port Harcourt city witnessed massive flooding as a result of improper channeling of drains to a burrow pit which got filled up during the rainy season causing water to flow into the surrounding suburbs and cause flooding of unprecedented magnitude (Ezeaku, 2017).

The government is not lacking research institutions and agencies with the skills to design an FRM strategy, for instance, the National Emergency Management Agency (NEMA) has a department of planning utilizing Geographical Information System (GIS) to work on flood data but there is no still no effective national early warning system in place for floods at all levels of federal, state, and local governments, while the National Meteorological Agency (NIMET) provides seasonal rainfall predictions, but communication remains a problem (FGN, 2013). Integration and coordination are lacking among the existing government bodies that sometimes carry out flood control projects without liaison with each other and control projects become ineffective due to improper coordination (Oladokun & Proverbs, 2016). FRM in Nigeria is mainly carried out by the state governments with inadequate federal input but there is also a lack of coordination among the states which ensures that different practices are obtainable even in cities with similar environmental problems and characteristics. Some of the state-level FRM have been critiqued for being deficient. For, example, the FRM of Lagos state has been critiqued for lacking evaluation and early warning systems which makes it ineffective (Adelekan, 2016; Ugonna Nkwunonwo, Whitworth, and Baily, 2016). The lack of flood data has also been decried in the FRM plan of Oyo state (Egbinola, Olaniran & Amanambu, 2017).

To address the shortcomings of current practices, spatial planning is advocated as a suitable FRM strategy for Nigeria because it has the potential of integrating existing practices. It is recognized as the most sustainable flood risk management method. The adoption of coordinated and sustainable spatial planning involving relevant agencies, planning practitioners, and stakeholders are an important tool for mitigating flooding. This is because spatial planning provides for managing flood risks, and influences factors like type, location, function, and design of development (Porter & Demeritt, 2017; Ran and Nedovic-Budic, 2017). Currently, the planning system in Nigeria is weak and there is an absence of integration of planning with existing FRM in Nigeria (Nkwunonwo, Malcolm, and Brian, 2015; Oladokun and Proverbs, 2016). Focusing contemporary flood risk management in Nigeria on spatial planning is best suited to the local situation given that the country is located in a relatively stable geological zone which is not prone to extreme natural disaster events like landslides, cyclones, hurricanes which cannot be controlled. This removes uncertainties from not knowing when the next geological disaster will eventuate (Egbenta, Udo & Otegbulu, 2015; Oladokun & Proverbs, 2016).

The adoption of modern concepts of spatial planning like collaborative and sustainable planning, which is flexible, and involves the public, and integrates environmental issues to take the lead in the urban growth process and effectively manage flooding (Dyachia et al., 2017; Lagopoulos, 2018; Oyefara, 2013). Spatial planning incorporating sustainable drainage systems as an FRM strategy could also be combined with ICT/technological tools like applications that residents can use to communicate with the relevant authorities in the event of an emergency or blockage of drains and onset of flooding. Integrating spatial planning and FRM is key to controlling flooding and moving Nigeria a step closer to achieving the social development goals.

Disaster Vulnerability and Preparedness

Vulnerability to disasters describes the degree to which a socio-economic system or physical assets are either susceptible or resilient to the impact of natural hazards (Birkmann, 2006). UNDRO (1991) defined it as the degree of loss to a given element at risk or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from 0 (no damage) to 1 (total damage). Blaikie (1994) on the other hand define vulnerability as the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from impacts of a hazard", while UNDP (2004) said that it is human condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard.

It is determined by a combination of several factors, including awareness of hazards, the condition of human settlements and infrastructure, public policy and administration, the wealth of a given society and organized abilities in all fields of disaster and risk management. Recent studies especially in developed countries have emphasized the significance of people's vulnerability to hazards, rather than retaining a narrow focus on the hazards themselves (Mitchell (ed.), 1999; Twigg & Bhatt, 1998). It is particularly important to operationalise the term vulnerability. In addition, it is equally vital to crucial to recognize that vulnerability is balanced by peoples' capabilities and resilience, and that if they are perceived only or mainly as victims then the problem of what causes vulnerability may be evaded (Cannon, 2000). Vulnerability analysis is developed from a range of socio-economic approaches to hazards and what we could call 'the disaster of everyday life' (Blaikie et al, 1994; Cannon, 2000). Social vulnerability is a set of characteristics of a group or individual in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is at risk by a discrete and identifiable event in nature or society (Blaikie et al, 1994). Vulnerability, according to Cannon (2000) can be considered in terms of five components

i. Initial well-being: This appraises the initial nutritional and health status (both physical and mental) of people in everyday life (or before the impact of a hazard). It is indicative of their capacity to cope with illness and some types of injury resulting from a hazard such as flood.
ii. Livelihood resilience: It is a measure of the capacity of an individual and/or their household to cope with the aftermath of a given hazard impact, and to reinstate their earning or livelihood pattern. This might include their likely continued employment, level of savings, loss of welfare benefits, loss or injury of supportive family members, hazard damage to their normal livelihood activity (for example in floods this might include damage to agricultural land by sediment deposits, seawater incursion, toxic or sewage contamination, loss of dwelling place).
iii. Self-protection: This is concerned with the ability or willingness (readiness) of an individual and/or household (with a given level of knowledge of apparent risks) to provide themselves with adequate protection, or to be able to avoid living or working in hazardous places. It will be influenced by the level of knowledge of physical measures, and the capacity of people to implement them.
iv. Societal protection: This refers to the ability or willingness of social and political structures at political or social levels above the individual or household, to provide protection (especially structural and technical preparations) from particular hazards. This might include local government, state government, national government, relevant organizations (e.g. fire department, civil defence, NEMA, NGOs), or community-based initiatives.
v. Social capital: This involves the 'soft' security provided by group or community capacities to enhance (or reduce) a person's resilience. This may include the degree of cohesion or rivalry that might affect rescue and recovery. There are various forms of social capital that

may enhance or hinder recovery such as support networks (belonging to a church or other group), some of which may provide mutual aid in times of hardship. It should however, be noted that each one of these is crucially linked to the likely severity of impact of a given hazard, and yet primarily they are all determined by political, economic or social processes. They also contains the possibility of both vulnerabilities and capabilities, with these varying over time (as individuals and groups subsist and compete within given livelihood possibilities), and being affected in regard to different types of natural hazards. The concept of vulnerability is oriented towards the perception of disaster risk and has a wide range of interpretations. Multiple definitions and different conceptual frameworks of vulnerability exist because several distinct groups have different views on vulnerability (Birkmann, 2006).

Building Capacities to Reduce Flood Disaster: Role of Spatial Planning and Land Use Management

Throughout the world, countries have recognized the need to formulate a clear regulatory agenda aimed at the prevention, management and reduction of disasters. A number of steps taking in the right direction would boost the capacity to confront most natural disasters such as flooding. Capacity building can be at the individual, institutional and systemic levels. Individual capacity depends on the availability, the knowledge and skills, as well as the performance of human resources. The capacity question focuses on all aspects of the emergency management system at national and local levels, and also includes an assessment of the political, cultural, social, economic and environmental factors which influence vulnerability to disasters. At the institutional level, capacity focuses on overall organizational performance and management capacities. They include, for example, the existence of an organization with a specific mandate on flood management. The systemic level focuses on the creation of enabling environment, such as the overall policy, economic, regulatory, and accountability frameworks within which organizations and individuals operate.

Olowu (2010) emphasized that in many developing countries especially in Africa, the weakness of State infrastructures, absence of appropriate legal and policy frameworks and sometimes inadequate resources particularly render them more vulnerable to the gory consequences of large-scale disasters. Disaster management is still at infancy stage in Nigeria despite the fact that the year 1906 marks the earliest efforts at disaster management in Nigeria with the establishment of the Police Fire Brigade (now Federal Fire Services) with functions beyond firefighting role to saving of lives, properties and provision of humanitarian services in emergencies.

In 1999, the National Emergency Management Agency (NEMA) was established via Act 12 as amended by Act 50 of 1999, to manage disasters in Nigeria. NEMA was set up to tackle disaster related issues through the establishment of concrete structures and measures, such measures as the education of the public in order to raise their level of awareness and reduce the effects of disasters in the Nigeria. The Agency has put in place structures that enable it detect, respond and combat disasters in a timely manner. Prevention is better and cheaper in disaster management due to the fact that if care is not taken, once there is a disaster the entire budget of a country may be diverted to contain it. States governments in Nigeria have been encouraged to establish their own separate Emergency Management Agencies (SEMAs) to complement the role of the federal agency in their areas.

Comprehensive geographical information is very critical for making important decisions because of the spatial coverage of most disasters and the fact that disaster management work usually involves a large number of different agencies working in different areas. It allows sharing of information in real-time, thus saving the time which have been spent to gather these resources. In addition, GIS provides a mechanism to centralize and visually display critical information during an emergency by showing an interactive flood risk map. Flood risk mapping defines the area at risk and should be the basis for all flood damage reduction programmes and subsequent actions. The purpose of a flood risk map is to:

i. Increase public awareness of the areas at risk of flooding
ii. Provide information of areas at risk by defining flood risk zones to give input to spatial planning. iii. Support the processes of prioritizing, justifying and targeting investments in order to manage and reduce the risk to people, property and the environment Spatial planning and land management can provide various tools to prevent natural hazards (Kötter, 2003). In the context of flood disasters, spatial planning and land management can be used to support the following essential functions
iii. Early warning system: Spatial planning needs a detailed data base, to get sound information about the spatial development. In practise monitoring systems have to be extended systematically to inform about natural and environmental risks (UNDP, 1997; Uitto, 1998; Samarajiva et al., 2005). The efficient data acquisition needs special measurement methods that have to be investigated and implemented.
iv. Risk assessment and mapping: Prevention of flood disasters needs comprehensive information and data about the reasons and effects of the hazards. Therefore a comprehensive vulnerability analysis need to be undertaken for disaster-prone areas, incorporating information about past disaster events, the socio-economic conditions of the population living in the affected area, and inventories of major structures liable to damage.
v. Risk assessment and flood hazard mapping would then be used to delineate areas vulnerable to natural hazards and determine the frequency, intensity, impact, return period and other data in relation to each category of hazard.
vi. Prevention and reduction: Spatial planning has to analyse the interrelations between the spatial influences and the environmental disasters in order to reduce the impacts.

Sustainable Drainage Systems

Sustainable Drainage Systems (SUDS) is an alternative to conventional drainage is to mimic natural drainage, with the aim of reducing flooding and improving the quality of water draining from urban surfaces (runoff). The sustainable drainage systems (SUDS) may take the form of areas of vegetation like grassy banks of green roofs, or natural water storage features like ponds is even engineered components such as porous paving. The components of SUDS vary greatly, but one or more of the following is usually employed:

i. Encouraging uptake of water by the ground ('infiltration')
ii. Reducing peak flow rates of run-off ('attenuation')
iii. Transferring run-off in a controlled manner to other site ('conveyance')
iv. Capturing water directly on site for controlled discharge later ('.storage')

SUDS also employ a range of natural process to purify urban run-off. Removal of sediments, biofiltration, biodegradation and water uptake by plants all help to remove pollutants. The SUDS principles have been well-known for many years and are widely used in many European countries; there has been no known up-take in Nigeria and many other developing countries of the world. The benefits of well-designed SUDS are:

i. A lower risk of flooding because runoff is reduced (although not when there are bigger storms)
ii. Increased recharging of natural groundwater levels;
iii. Improved quality of water returned to water bodies;
iv. Provision of an aesthetically-pleasing environment that encourages urban wildlife and biodiversity

Disaster losses could reach over trillions of dollars in a single year therefore, disasters such as flooding presents challenges and even opportunities for the finance sector. Insurance measures is seen from the perspective of sustainable development as a beneficial for many developing countries for transferring risk from natural or man-made disasters. Very few people in developing countries are cover by insurance and more often the poor are completely left out of {insurance}, even though they are the most in need of protection. Although a flood can often be assigned to a single event type, on many occasions a combination of flood types and other natural hazards such as hurricanes, hailstorms and earthquakes may have occurred. In these circumstances, problems with insurance cover can arise if some occurrences are covered, but others are not (Collins and Simpson, 2007). It is therefore imperative for insurers to develop a better understanding of the livelihoods of the poorest groups and how disasters affect them to make sure they get pay-out triggers such as food price rises, or below- average rainfall right.

According to the Convention (Article 4.8) of the UNFCCC, insurance related actions constitute one of the three main means of response to the adverse effects of climate change such as recurring floods, alongside funding and technology transfer. They can enhance financial resilience to external shocks and provide a unique opportunity to spread and transfer risk. They provided incentives for risk reduction and prevention while engaging the private sector in climate change response action. In order to build the capacity to cope with the effects of natural disasters and also prepare for the unavoidable ones, governments should ensure that insurance coverage against natural disasters was readily available for social and economic infrastructure. Efforts should be made so the price of such insurance coverage do not become volatile or so expensive that a substantial portion of the social and economic infrastructure is either without coverage or under-insured. One of the benefits of promoting insurance-related actions is that it may help advance efforts on quantifying risks and potential losses due to climate change. Minimizing risk can result in a reduction of the rates for insurance, which thereby become more affordable.

Nigeria's National Emergency Management Agency

Nigeria's National Emergency Management Agency (NEMA) was formed by Act 12 of 1999. This was modified by Act 50 of 1999 which give mechanisms for funding post-disaster recovery measures and rehabilitation of affected areas and communities. It also mandates the creation of a disaster management strategy in the individual states and be a key part of their development plans (NEMA, 2012). NEMA also formulated the disaster management plan to highlight approaches to be used in reducing vulnerability of people in disaster prone areas together with measures to prevent and mitigate flooding disasters. "Nigeria Vision 20:20:20" mentions, very briefly, disaster emergency needs and made no mention of FRM or disaster prevention. Although NEMA is working hard, flood risk management is not yet acknowledged as a national priority, and decision-makers are unaware of or have little understanding of disaster reduction issues.

Most of the flood risk interventions made at the three levels of government are mostly responsive, as they only focus on helping affected communities cope with the disaster by providing them with emergency services such as make-shift housing, food and medical supply. Nigeria currently does not have an effective flood risk management framework since more of the interventions are curative and not preventive, a factor that negatively affects communities in flood prone areas.

METHODOLOGY

In order to ensure an effective study, the researcher will use survey design. The survey research method is a veritable way of eliciting the views of a group, people or population of study about an event, activity or phenomenon. The survey technique is the most commonly used research method in the behavioral sciences and it involves drawing up a set of questions on various subjects or aspects of a subject and a selected number of a population are requested to answer. Therefore, the rational for using the two research methods was because, survey provides the best means of collecting the views of the youth concerning how violence films aids in shaping their social behaviour (development of militancy). For the survey aspect of the work, a 15 item questionnaire was developed by the researcher based on the research objectives and administered to the sample selected from employees of the ministries, agencies, real estate developers, and registered architects in Rivers State. The population for this study was all employees of federal and state ministries of housing and urban development. The sample size comprised 266 employees of the ministries, agencies, real estate developers, and registered architects. The instruments that were used for collecting data in this study are questionnaire. A questionnaire is a data gathering instrument, which provides uniformed questions to be answered by respondents in written form. The questionnaire adopted four- point likert scale structured as follow: Strongly agree, agree, strongly disagree and disagree. Prior to processing the responses, the completed questionnaires were edited for completeness and consistency. Quantitative data collected was analyzed by the use of descriptive statistics using SPSS and presented through percentages, means, standard deviations and frequencies. This offers a systematic and qualitative of the study objectives.

ANALYSIS AND DISCUSSION OF FINDINGS

The structured questionnaire was adopted as the primary data instrument and a total of 260 respondents were targeted for inclusion in the study, however, as a result of various unexpected in contingencies, only 241 questionnaire copies were successfully retrieved and utilized in the study. This reduction and shortage is attributed to the absence and failure of some of the respondents to complete their copies of the questionnaire. Furthermore, after retrieval, questionnaire copies were treated for errors and missing values and results revealed a 2% error rate due to missing values which were thereafter treated through the allocation of mode values to the blank sections. This implies that 241 questionnaire were used for analysis in the study.

Table 1: Sustainable Drainage Systems and Sustainable Housing Development

S/N	Sustainable Drainage Systems	N	SD	D	A	SA	$\bar{X}$
1	Sustainable drainage systems affect housing development	232	7	8	131	86	3.17
2	Sustainable drainage systems reduces peak flow rates of run-off	232	17	53	81	81	2.78
3	Capturing water directly on site for controlled discharge later	232	23	161	41	7	2.83

Table 2: Flood Risk Management, Spatial Planning and Sustainable Housing Development

S/N	Flood Risk Management and Spatial Planning	N	SD	D	A	SA	$\bar{X}$
1	Flood risk management prediction of flood hazards, socio-economic factors and consequences, and measures/tools for risk reduction	232	57	84	74	17	2.78
2	Reducing and addressing exposure to flood risk is now a national priority	232	88	69	12	63	2.79
3	Spatial planning is advocated as a suitable flood risk management strategy	232	111	111	3	7	3.40

Table 3: Disaster Vulnerability, Preparedness and Sustainable Housing Development

S/N	Disaster Vulnerability and Preparedness	N	SD	D	A	SA	$\bar{X}$
1	Vulnerability balances peoples' capabilities and resilience	232	96	55	64	17	3.00
2	Vulnerability enable person or group to anticipate, cope with, resist and recover from impacts of a hazard	232	80	95	13	44	2.92
3	Vulnerability analysis is developed from a range of socio-economic approaches to hazards	232	102	61	48	21	3.05

Table 4: Spatial Planning, Land Use Management and Sustainable Housing Development

S/N	Spatial Planning, Land Use Management	N	SD	D	A	SA	$\bar{X}$
1	Increase public awareness of the areas at risk of flooding	232	50	44	90	48	2.41
2	Provide information of areas at risk by defining flood risk zones to give input to spatial planning.	232	65	77	41	49	2.68
3	Prevention of flood disasters needs comprehensive information and data	232	87	56	51	38	2.82

Source: Survey Data, 2024

Analysis and Discussion of Findings

Table 1, items aimed to ascertain whether sustainable drainage systems enhance sustainable housing development. The result shows that 3.17 and a standard deviation of 1.103, the mean and the standard deviation of the items indicate the rejection of null hypothesis and the acceptance of alternate hypothesis. All the items in the table proved high mean and low standard deviation. Table 2, the items aimed to ascertain whether flood risk management, spatial planning and sustainable housing development. The result shows that 2.78 and a standard deviation of 1.20, the mean and the standard deviation of the items indicate the rejection of null hypothesis and the acceptance of alternate hypothesis. Table 3, items aimed to ascertain whether disaster vulnerability, preparedness and sustainable housing development. The result shows that 3.00 and a standard deviation of .998, the mean and the standard deviation of the items indicate the rejection of null hypothesis and the acceptance of alternate hypothesis. Table 4. Items aimed to ascertain whether spatial planning, land use management and sustainable housing development. The result shows that 2.41 and a standard deviation of 2.101 the mean and the standard deviation of the items indicate the acceptance of null hypothesis and the acceptance of alternate hypothesis.

In general, Nigeria is experiencing rapid urbanization due to massive housing development from both the informal and formal sectors of the building industry. The consequences of the provision of such infrastructure for the population settlements are directly linked to sustainability issues. IUA collectively adopted 2050 as target year to achieve zero carbon emission from buildings. This resolution was followed up by the leading efforts of a non-governmental organization known as Architecture 2030 challenge", founded in 2002 to expedite actions towards achieving sustainable and zero-carbon buildings. Considering these global environmental actions for climate change mitigation and reduction in CO_2 emissions from building, there is no national environmentally efficient assessment strategy for building and its allied sectors in Nigeria (Giwa & Peng 2012). These are very important both as driving force for development and as a basis for research. According to Osman (2010), in comparison with other sectors, on a global scale, buildings make up the largest energy consuming and CO_2 emitting sector. However, Nigeria's CO_2 emissions data shows that agriculture and land use change and forestry account for the bulk of carbon emissions to the environment in contrary to other climes. In addition, according to (World Resources Institute 2012), the total GHG emissions from the five main sectors of energy, industry, agriculture, land-use change and forestry as well as waste amounted to about 330,946 $GgCO_2e$. Total CO_2 emission for the energy sector was 108,000 Gg in the year 2000 and is projected to rise to 232,000 Gg in 2030 (Federal Ministry of Environment 2010). The improvement of building design and material specifications for the overall performance of the environment is very important for, lowering costs, reducing consumption and related greenhouse gas emissions. Hence, there is need to consider the GHG emission profile of existing buildings as a preface, for further devising the climate change mitigation strategies.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study examined the climate mitigation strategies and sustainable housing development in Rivers State. The study adopted survey methods and a sample size of 266 was used. Data were analysed by the use of descriptive statistics using SPSS and presented through percentages, means, standard deviations and frequencies. This offers a systematic and qualitative of the study objectives. The result shows that 3.17 and a standard deviation of 1.103, the mean and the standard deviation of the items indicate the rejection of null hypothesis and the acceptance of alternate hypothesis. The result shows that 2.78 and a standard deviation of 1.20, the mean and the standard deviation of the items indicate the rejection of null hypothesis and the acceptance of alternate hypothesis. The result shows that 3.00 and a standard deviation of .998, the mean and the standard deviation of the items indicate the rejection of null hypothesis and the acceptance of alternate hypothesis. The result shows that 2.41 and a standard deviation of 2.101 the mean and the standard deviation of the items indicate the acceptance of null hypothesis and the acceptance of alternate hypothesis.

Recommendations

i. The need for an effective policy based early warning system for flood prevention and control for Nigeria cannot be over emphasized, Government at all levels need to shift from being reactive to being proactive in responding to flood menace.
ii. There is also the need for government at all levels and its agencies to fund and map out contingency plans and emergency preparedness plans to prevent flood outbreaks crisis in Nigeria.
iii. The stakeholders needs a clear, robust and forwardlooking strategic plan that is informed by rigorous research, administrative data gathering, dialogue with the public, evaluation and learning on flood mitigation.
iv. There is need fore stakeholders, professionals and academia to prepare at various levels for larger floods and the disasters that ensue no damage to sustainable housing development. Such preparations can include strengthening disaster planning measures, including early warning and evacuation systems, and other forms of post-disaster response to quickly rebuild affected communities

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