

# An Investigation of Factors Accelerating Rise in Building in the Flood Prone Areas of Port-Harcourt

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**Abstract-** Many areas vulnerable to flooding are receiving significant development of residential buildings despite the existing flood risk. With the recent increase in flooding, government and the residents of such flood prone areas are spending huge amount of money every year to afford resilience to flooding. Efforts are being made continually to contain or manage flood risk, yet, stocks of residential buildings are on the increase in such areas. What could have informed the choice of the continued increase in property development of such areas in Port-Harcourt, Nigeria? The study concluded that the major encouraging factor that influences continuing inhabitation of flood prone residential properties is affordability (cheap land and house rents). It is therefore recommended that the government should through appropriate agencies revisit the contents of housing policy, device viable mechanism for providing low income housing, create adequate awareness of the risk of building in the flood plains and provide structural flood risk management measures to optimize the efforts of the occupants.

**Indexed Terms-** Acceleration, Flooding, Residential properties, Resilience, Port Harcourt

## I. INTRODUCTION

Residential property remains an important element in the life of every individual and also serves as an investment option for many investors as is the case in Port-Harcourt metropolis. Adequate housing (residential property) is a fundamental element of a healthy society. A society's state of development can be measured by the level and availability of safe, decent, and affordable housing therein. Residential homes provide protection from the environmental elements, especially during and after disasters. In a

bid to achieve affordability in housing many households, homeowners and residential property investors have fallen prey to flooding disaster. The private investors in residential property have contributed immensely in providing accommodation for so many households and also in making housing stock to be available (Ayotamuno and Obinna, 2017). In the real estate sector, residential property investment faces many challenges and prospects. Among the challenges are the high costs of land acquisition, construction, building materials amidst the recent increase in flooding risk. The World Bank (2017) indicated that floods are the most frequent and damaging of all the natural hazards globally. They therefore suggested that effective flood risk management is critical to protect people and their livelihoods from flood and to limit future loss. A high proportion of residents live in flood prone areas. Some are unaware of the initial flood problem or they select the area due to proximity to work or affordability. Several awareness campaigns have been initiated with the aim to inform residents of flooding. However, some residents continue to live in homes at risk from flooding due to sentimental values, whilst others simply cannot afford to move from the houses (Atufu and Holt, 2018). Some areas are well known to be prone to flooding while some areas became prone to flooding as a result of unplanned development. For instance, some areas are flooded today because of other houses that were built on floodplains. These houses and buildings thereby increase flooding in other areas which results to cost in terms of economic, social, emotional and otherwise (Pickerill, 2016). When estimating the cost of building development, especially in flood prone areas, it is necessary not to consider only the cost during its construction but also the consequential cost accruable to flood assuming flooding occurs. It is worth knowing that when such cost arises, both the

occupants and the property investors will have their prices to pay. It is then necessary to determine the underlying factor or factors that continually propel residential investors to build on flood prone areas and also keep the occupants who continually reside in such properties. This is with the intention to educate the housing sector leaders at the federal, state, and local levels on the actions they need to undertake across the sector.

### 1.1 Study Area

The study area is Port-Harcourt, the capital of Rivers State of Nigeria. Port-Harcourt is bounded by the coordinates: 4.5351°N, 6.5526°E and 4.4613°N, 6.5816°E. Rivers State is an oil producing state in the Niger Delta region of Nigeria and because of oil exploration and exploitation, there is continuous influx of people in the Port-Harcourt urban areas. Although Port-Harcourt is in the low-lying zone, with a dense network of rivers and creeks making it vulnerable to flooding, urbanization has aided the speedy increase of flood inundation of many neighbourhoods in Port-Harcourt, bringing many places which were not formerly threatened by flood to be at risk of flooding. Many buildings springing up in unplanned manners put pressure of flooding on areas not initially in flood plain. Among the places chosen for this research include: Rukpokwu, Eneka, Nkpolu, Rumuigbo and Rumuosi. These places have experienced yearly flooding since 2012. The study areas are majorly residential with some commercial properties servicing the areas.

### 1.2 Statement of the Problem

Most cities or urban areas today are undergoing various challenges emanating from urbanization. Affordable housing is lacking around most central business districts. Affordability of residential housing has been one of the targets of various housing policies. Research has shown that most of the negative impact of urbanization can be tackled through effective planning of housing in the urban areas. Private investors and homeowners have gone a long way to add to the housing stock but high rate of urbanization and influx of people kept on adding to the problem of housing deficit. Increase in influx of people has led to buildings springing up in unplanned areas and as such mostly inhabited by the medium and low income earners. The high cost of building

materials is also another factor that have contributed to high cost of residential housing rent making housing not be affordable to low income and medium income earners. With the trending flooding disasters, many of the residential areas have found to be prone to flooding risk and still many houses keep on springing up in the areas known as flood plains. Despite this risk, many people still occupy these houses and/or return back to the residential houses beset by flooding after the flood had subsided. Our concern here is to ascertain what informs the choice of building and residing in flood prone areas by investors and/or occupiers. In the course of this study, the following questions were raised: What are the circumstances towards building in flood prone areas? Are the occupants aware of flood risk and its impact in their area of residence? Is there any relationship between development of residential houses and inhabitation of houses in flood prone areas?

## II. LITERATURE REVIEW

### 2.1 Flood and Urban Residential Building Development

Flooding is unarguably the most common of all the natural hazards and it perhaps also affects more people than all other types of natural disasters put together (Salami, von Meding&Giggins, 2017). Oladokun and Proverbs (2016) noted that flooding has become a major hazard in Nigeria in the recent years and they blamed it on population growth, rapid urbanization, etc. The rise in flood incidents is an indication to the high vulnerability rate of urban dwellers and properties. Although flooding is a natural disaster, it is also propelled by factors other than areas being in flood plains. The necessity and pressure to increase the supply of residential properties had led to the development on the areas regarded as flood plains for want of land and as well in cheap supply. Flood plains are defined by Dude, Mtapuri and Matunhu (2018) as integral and natural parts of the river system which formed as a result of the occasional need to contain unusually large volumes of water. Controlling or limiting flooding through barriers means interfering with the natural process and as a consequence, other areas are being put to the risk of flooding. Waterfront locations are associated with significant economic benefits and are

adorned with aesthetics naturally which also serves as tourism attractions. Human settlement occurs in areas that facilitate transport links but in the case of Port-Harcourt, it is facilitated by availability of natural resources and increase in commercialization. The increase in urbanization has necessitated the need for residential properties to meet the rise in accommodation needs. As a result more areas of land have become impermeable, due to the amount of development and various types of landscaping, contributing to the flooding menace in most urban areas. Many residential property developments are carried out by private investors/owners who may not have gotten building approval or who encounter other challenges; leading to building in an unplanned areas or even putting pressure to the existing infrastructure which then increases the risk of flooding in the neighbourhood. The harm caused by flood is on the increase while among the underlying factors or drivers to flood risk include housing development or changes in land use. Mohd, Saraf, Pin, Hasbullah, Nordin & Ismail (2016) opined that increasing population has resulted in an increase in the number of property ownerships causing a greater percentage of a country's land area, often in areas that were previously not fit for urban development and human settlement to have been taken up to cater for the need for accommodation.

## 2.2 Housing Affordability

Residential housing provision and affordability have remained age-long issues and considerations in many countries' housing policies. The mirage is whether such motives have been met. Samuel, Yakubu, Ologunorisa and Kola-Olusanya (2017) identified that African cities are more prone to flooding not only because of their vulnerable locations but also because they lack requisite infrastructure or physical planning and are largely populated by the poor who live in vulnerable locations and lack the capacity to anticipate, cope, resist and recover from flood events. The United Nations' Department of Economic and Social Affairs (2018) had projected that by the year 2050, 68% of the world population would be living in urban areas. Urbanization is the gradual shift in residence of the human population from rural to urban areas. It can be said to be the process by which towns and cities are formed and become bigger as more people begin to live and work in central areas.

Richard and Kazmierczack (2009) stated that tenanted properties form a significant proportion of housing stock in flood risk areas. Sustainable urbanization is being suggested so as to ensure a safe urban growth. One of the areas to achieve this is the need to house the urban poor and the vulnerable group. But on the contrary, there is need for more housing developments as a result of population increase. Also, the presence of flooding menace has rather aggravated the level of vulnerability of people and housing in different locations.

## 2.3 Investment Decision and Private Residential Property Investors

As homelessness increases and house prices rise beyond the reach of the majority, the need for building homes that are both affordable and ecological becomes very necessary. The increase in housing problem in Nigeria has been attributed to increase in urbanization. As pointed out by Aliyu and Amadu (2017), urbanization has negatively impacted on the housing sector of developing countries such as Nigeria. Several intervention have been taken both by government and private investors yet a great proportion of the residents of urban areas still dwell in substandard houses located in deplorable areas or in flood ravaged areas. The inadequacy of housing supply for the low income group have resulted in high real estate values, deplorable urban services and pressurized available infrastructure and lack of planning policy implementation. This issue of imbalance in housing supply and demand has motivated the private sector to assist in housing provision and also encouraged individuals to own houses privately which have resulted in unplanned developed areas.

The reason for high demand of housing and its limited supply in Nigeria were given by Oni-Jimoh and Liyanage (2018) to include the following factors namely:

- i. High cost and lack of easy access to land,
- ii. High cost of building materials,
- iii. High cost and long processing duration of property registration,
- iv. Inability of earlier policies and programmes to adequately resolve the backlog of housing problems,

- v. Absence of proper monitoring and evaluation of public housing policies and programmes,
- vi. Low capacity of public housing agencies, and
- vii. Poor government administration, inadequate funding, insufficient infrastructural amenities and inadequate housing finance.

Investment decision is taken by investors to meet certain objectives among which include maximization of investment returns. Considering the possibility of gaining profit and the high level of accommodation demand, investing in the residential sector becomes a promising business. On the other hand, certain factors are being neglected which consequences put both the investors and the occupants at risk of flooding. Truly, it is pertinent to increase the housing stock and also in affordable prices but where such developments encounter flooding, a higher problem may have been created which may aggravate to the extent of a national disaster.

#### 2.4 Disaster related housing challenges

A significant long-term issue that can impact both individual and community recovery and well-being is the loss of affordable housing (sometimes referred to as disaster gentrification). When flooding occurs, available housing is placed at risk. Flooding has the power to sack the residents of an area and cause the loss of affordable housing. It is worth knowing that low-cost housing, including rental properties, tends to be concentrated in older buildings and in more vulnerable locations. The loss of affordable housing, coupled with an increase in demand for such housing has created a dearth of housing options for lower-income residents. De Silva and Kawasaki (2018) stated that poor households tend to suffer most from disaster as tend to live in hazard prone areas because they cannot afford to live in a better area and they record relatively higher losses.

#### 2.5 Factors affecting choice of place of residence

In choosing a place of residence, residential occupants have different feature they consider before making a final decision. Some of those factors could be positive or negative, economic, political, social or religious. In accordance with the purpose of migration from rural areas to urban areas, one can decide on which place to reside. Also, the level of

income and availability of houses for renting equally amounts to factors that aid decision in such regard. The economy of a country shapes peoples' choice and affordability determines the extent an individual can accept to pay.

#### 2.6 Review of Related Literature

In Nigerian cities, there is need for affordable housing because of economic recession which has affected peoples' incomes not to be in line with the economic growth. Most employers want cheap labours that they can pay little salary where as these employees must be housed but their income cannot afford a residence that meets acceptable housing standard, the option becomes taking accommodation in sub-standard areas. Nigeria as a country in West Africa is classified as a low-middle income country, (Oni-Jimoh, Liyanage, Oyebanji and Gerges, 2009). Affordability is related with people of low socioeconomic status while vulnerable individuals are characterized by their socioeconomic attributes and by their inhabited communities' societal dynamics (Roder, Sofia, Wu and Tarolli, 2017). Findings from Disaster Technical Assistance Center, supplemental research bulletin on the topic " Greater impact: How disasters affect people of low socioeconomic status (2017) showed that people around the world who are of low socioeconomic status are more likely to live in housing that is vulnerable to disasters. Quoting Fothergill and Peek (2004), they suggested that housing policy officials should develop policies that foster increased safety of all housing, including low-income housing, without making housing unaffordable for low-income people. Such policies could be those that can provide support in form of subsidies to landlords or private investors. In a bid to solve the problems of urbanization, Oni-Jimoh et al (2009) advocated the following: provision of sustainable and affordable housing, provision of essential infrastructure, provision of job opportunities, embarking on an effective land policy to reduce emergence of slums. Chiadikaobi, Omoboriowo, Chiaghanam, Opatola and Oyebanji (2011) showed that risk of flooding increases with increase in rainfall intensity and the flooding risk is going to be on the increase because of high rate of urbanization in Port Harcourt and accommodation demands. They thereby emphasized the need for the demarcation of flood prone areas. Coren (2016) argued the myth that affordable

housing lowers values of properties in the neighbourhood and arrived at a conclusion that most new affordable housing does not have a negative impact on home values especially where house rents are expensive or in short supply, instead, affordability is a problem of scarcity. It can also be considered that existence of restrictive zoning laws can prevent housing supply from responding to demand, and as a result drives up prices. In an economy where governments respond with price controls to tackle the problem of affordability and housing supply, can also impact on house prices on the open market. Building affordable homes in unplanned areas has many implications which can include driving of low-income earners out of urban centers and exposing them to disasters like flooding. Even the distances from their homes to their jobs are also increased making life generally to be more expensive. De Silva and Kawasaki (2018) on socioeconomic vulnerability to disaster risk: a case study of flood and drought impact in a Sri Lankan community showed that households that depend heavily on natural resources for their livelihood together with those with low income suffer greater losses from flood than those with high income. One of the falls out of urbanization is flooding which emerges as a result of unplanned development. Most people moving from rural areas to urban areas who cannot afford the high rents in urban areas indulges in developing unethical buildings that lack housing standards majorly outside the main city centers. Such activity has the potential of breeding slums as one of the determinants of slum environment is the evidence of unplanned development and lack of building regulations. These factors contribute to such places vulnerability to flooding. Dude, Mtapuri, and Matunhu, (2018), added that lack of decent shelter by the poor contributes to their vulnerability to flooding. In order to achieve affordability, the poor are pushed to build houses in flood prone areas as well as obtaining accommodation in flood beset zones. De Silver and Kawasaki (2018) discovered that households who depend heavily on natural resources and as well belong to the low income class are highly affected by flood because of their level of vulnerability to flood causing elements. From China's perspective, impact of population migration on urban housing prices was studied by Lin, Ma, Zhao, Hu and Wei (2018), it was found that population inflow is significantly

correlated with urban housing prices on the national level and suggested affordable housing system so as to achieve sustainable urbanization.

Among the related literature search, which found literatures concerning housing affordability, flooding impact on household and their preparedness, causes of flooding, need for affordable houses, migration and the effects on neighbourhood infrastructure, no literature was found on what informs the building and occupation of residences in flood prone areas despite the awareness of such flooding risk. In other to fill this gap and draw the attention of the policy makers, this research sought to make an empirical investigation in this study using Port Harcourt as a study area.

### III. METHODOLOGY

The research was carried out between August and September 2018. This study's data originated as part of the larger data for the analysis of the impact of flooding on residential property investment returns in the Niger Delta region of Nigeria. The aim of the study was to investigate the accelerating factor towards continued rise in residential properties and their occupation in flood prone areas of Port-Harcourt. The research was survey design and was carried out through probability sampling of the residents of the flood prone areas using questionnaire. A total number of 40 household heads from each of the designated areas were sampled. Systematic random sampling technique was employed in selection of households. The collected data were analyzed using descriptive statistical techniques with the aid of Statistical Package for the Social Science (SPSS) version 25.

### IV. DATA ANALYSIS

This section presents the analysis of the data obtained from field survey. A total number of 200 research questionnaires were administered on the respondents while 158 were retrieved and used for the data analysis. The data presentation and analysis were guided by the research objectives of this study.

#### 4.1 Questionnaire Distribution

The study involved questionnaire survey and an account of the questionnaire distribution should be

rendered as a guide for the analysis of data. The Table 1 below presents the questionnaire distribution and retrieval.

Table 1: Questionnaire Distribution in the Study Area

S/N	Name of Community	Questionnaire Distributed	Questionnaire Retrieved
1	Rukpokwu	40	30
2	Eneka	40	30
3	Nkpolu	40	32
4	Rumuigbo	40	31
5	Rumuosi	40	35
Total		200	158

The questionnaire distribution and retrieval rate were shown in the Table 1 above. A response rate 79% (158) was achieved from the five communities.

#### 4.2 The Level of Education of the respondents

The level of education attained by the respondents was among the personal data of the respondents surveyed. This is to ensure that they are knowledgeable and that valid response shall be obtained. These were shown in the Table 2 below.

Table 2: The Level of Education of the respondents

Highest Education Level	Total	Percentage
Primary	40	25
Secondary	52	33
Tertiary	60	38
None	6	4

The study inquired of the level of education of the respondents which showed that the respondents were educated while those with tertiary education were more represented as seen in the Table 2 above.

#### 4.3 Length of Time of Residence of the Respondents in the Study Area

The length of time a person stays in place determines the quality of information obtainable from such individual. In this respect, the respondents were

asked to indicate the length of time they have resided in the study area and below is a table indicating their response.

Table 3: Length of Time of Residence in the Area

Length of Time (yrs)	Total	Percentage (%)
0 -2	62	39
3 – 5	55	35
6 – 10	37	23
More than 10	4	2

The Table 3 above presents the response to the question on the length of time of the respondents' resident in the study area posed to ascertain the level of experience of flooding knowledge and ensure the certainty of their response to the objective specific questions. 39 percent of the respondents have resided there for 2 years and below which is an indication of recent influx of property owners, 35 percent have resided for 3 to 5 years, and 23 percent are there for the period of 6 to 10 years while only 2 percent have been residing there for more than 10 years.

#### 4.4 Capacity of the Respondents' Dwelling Occupation

Residential housing occupation could be owner-occupier or tenant occupier. In this study respondents were asked to indicate the capacity on which they are dwelling in study area. The Table 4 below gives the details.

Table 4: Capacity of the Respondents' Dwelling Occupation

	Number	Percentage
Landlord/Owner Occupier	86	54
Tenant	72	46
Total	158	100

The Table 4 above shows that there are more owner occupiers in the study area. This is an indication that the study area is a developing area where majority of people with the intention of getting their own residential property are now focusing. The data survey showed that among the respondents, 86 (54%) were owner-occupiers while 72 (46%) were tenants.

4.5 Season of Purchase of land/Property

The consideration of why many people are victims of residential flooding was traced to the time of purchase or commencement of tenancy to know if they were really aware of the flooding initially. The response is as given in the Table 5 below.

Table 5: Month/Time of Purchase of land/Property

Season of the Year	Response	Percent
Dry Season	46	53
Rainy Season	40	47
Total	86	100

The result in the Table 5 above showed that 53% of the respondent landlords purchased the land negligent of the flooding risk. It is therefore good to consult the professionals who will properly advise and guide the purchaser according to his investment objective. Flooding menace should be part of the property investigation before purchase and can be checked during the rainy season.

4.6 Season or Time of Tenancy Commencement

The tenant-occupiers were also presented with the question on the season or time of the year wherein his or her tenancy commenced with the same aim of determining if the commencement time is a factor of his or her vulnerability. The response result is as given in Table 6.

Table 6: Month/Time of Tenancy Commencement

Season of the Year	Response	Percent
Dry Season	43	60
Rainy Season	29	40
Total	72	100

In Table 6 above, a similar result was seen for the tenants in the study area. Most of tenants had their tenancy commenced during the dry season but because the season would not allow them to know exactly the extent of flooding in the area, most of them became vulnerable.

4.7 Reason for Purchase of Property at Flood Prone Areas

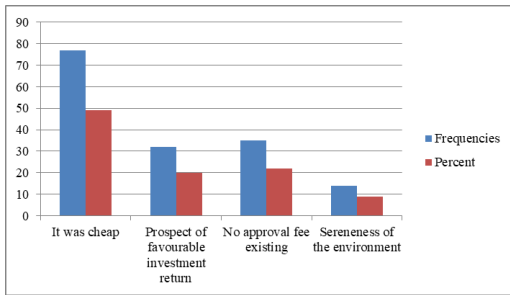
The decision to invest and where to invest are two relevant questions that every investor should handle with care. Purchase of property situate in flood prone areas are motivated several factors. The respondents in this research were asked to indicate the reason(s) for the purchase of property in the area prone to flooding; the Table 7 has the details.

Table 7: Reason for Purchase of Property at Flood Prone Areas

Responses	Frequencies	Percent
It was cheap	77	49
Prospect of favourable investment return	32	20
No approval fee drive existing	35	22
Sereneness of the environment	14	9
Total	158	100

Landed properties are usually expensive and only those who are wealthy can purchase it at ease. The low or middle class citizens who have the motive of buying a landed property will have to sacrifice a lot before good amount of capital can be gathered for such venture. In this case there will be that urge to look out for land with cheap prices. Development as well is another capital intensive project that most times, the developer will look out for possible ways of cutting cost. With the high cost of obtaining building approval and delays, the rightful procedures have been avoided leading to unplanned built environment. In the Table 7 above, cheapness and possibility of avoidance of approval fee were the main reasons given for such development. Cheapness is related to affordability which is a characteristic of the low income class citizens. Other reasons given were those of sereneness and prospect of returns from the provision of residential accommodation for the ever growing population.

The bar chart below is a graphical representation of the reasons for purchase of property in flood prone areas.



#### 4.8 Flooding Awareness

Awareness of flooding helps to shape the investors’ or real estate users’ decision towards location and the use of real estate product. Flooding awareness of a place or location can be obtained through various means. The respondents, grouped in landlords and tenants capacity, were asked to indicate if they were aware of flooding initially before locating or taking occupation of residential housing in the study area and the responses are given in the Table 8 below.

Table 8: Flooding Awareness

Responses	Frequency	
	Landlord	Tenant
Yes	53(62%)	35(49%)
No	33(38%)	37(51%)
Total	86(100%)	72(100%)

From the Table 8 above, most of the landlords and tenants were aware of the risk of flooding in the environment. It can then be analyzed that residing in flood prone areas has a link with affordability since the rents passing in such areas are cheaper than what is obtainable in the flood free areas.

#### 4.9 Relationship between development of residential houses and inhabitation of houses in flood prone areas

In order to ascertain the relationship between development of residential houses and inhabitation of houses in flood prone areas, tenants’ reason for renting apartments in flood prone areas and reasons considered by landlords before the decision to develop/return to the flood beset property was

sought. The results were as given in figures 1, 2 and 3 below.

In the questionnaire survey, a question was also raised to ascertain the reasons from the tenants’ perspective, why they rented apartments in flood prone areas since they were aware of impending flooding. Their responses were as given in the figure 1 below which varied among cheaper rent, location of the property, security and serenity of the environment, while cheaper rent was accorded the highest response.

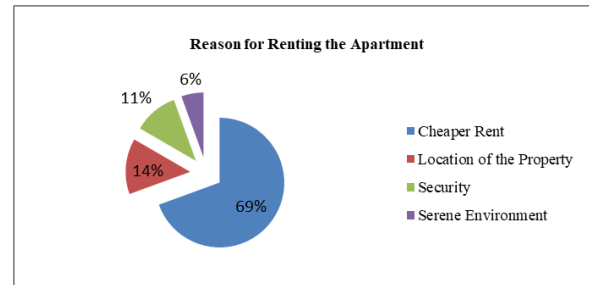


Figure 1: Pie Chart showing Reasons for Tenants Renting of Apartments in Flood Prone Areas

A similar response was gotten from the tenants when posed with a question asking them what was their reason for renting apartments in flood prone areas as shown in figure 1 above. The response was still on cheapness of rent as they were not able to afford rent in the main city and places that are flood free.

Reasons considered by landlords before the decision to return to the flood beset property. The landlords’ decision to continue to reside in properties with risk of flooding is motivated by certain factors. The Figure 2 below showed responses from the landlords on the cogent reasons why they decided to reside in the flood beset properties. Among the reasons given were high cost of rent at flood free areas, personal house, location of the property and cheapness of land price, which is the major reason for continual residence at flood prone residential properties.



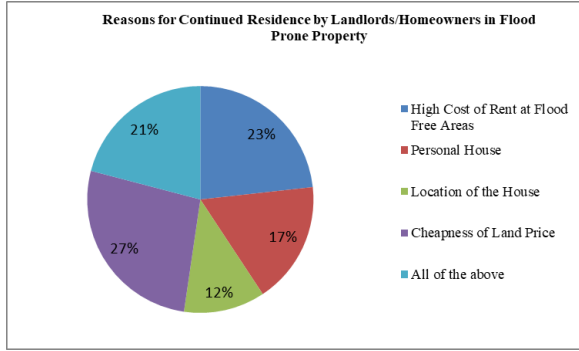


Figure 2: Reasons considered by landlords before the decision to return to the flood beset property

Inasmuch as landlords/homeowners were presented with question bothering on the reasons for residing in properties prone to flooding, tenants were also surveyed similarly to also know their own reason for re-occupation after flooding i.e. reasons considered by tenants before the decision to return to the flood beset property.

The Figure 3 below contains the responses from tenants residing in the flood proven study areas which shows that the driving force for residential occupation in the area is that of cheapness of the rent. The pie chart below graphically presents the result.

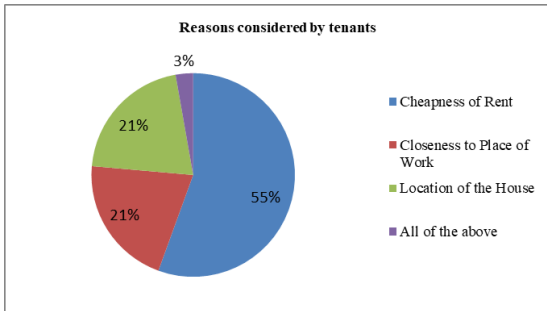


Figure 3: Pie Chart showing the Reasons Considered by Tenant for Re-occupation of Apartments after Flooding

## V. CONCLUSION AND RECOMMENDATION

The foregoing has been a study on the developmental acceleration of residential properties in the flood prone areas using some neighbourhoods in Port-Harcourt metropolis as study areas. It can be deduced that most of the places studied were not initially flooded but the increase in urbanization has pressurized the existing infrastructure coupled with

lack of drainages to making them vulnerable to flooding. In an effort to provide housing for the teeming population and solve the problem of housing, low income earners have sought for cheap lands for development of residential houses which are only available at flood prone zones. It can then be concluded that the major encouraging factor that influences continuing inhabitation of flood prone residential properties is affordability (cheap land and house rents).

The government should through appropriate agencies revisit the contents of housing policy and device viable mechanism for providing low income housing and as well create adequate awareness of the risk of building in the flood plains. The provision of structural flood risk management measures is also necessary so that the effort of the occupants of such flood prone areas can be optimized to yield desired dividends.

- Conflict of Interest

The authors hereby declare that there is no conflict of interest. There are no financial or personal interests which have inappropriately influenced the writing of this article.

- Authors' contributions

Gerald-Ugwu, G. C drafted the original manuscript, acquired and analysed the data and made interpretations. This work is part of the PhD dissertation on the impact of flooding on residential property investment returns under the supervision of Prof.Egolum, C.C, and Prof.Emoh, F. I., the co-supervisor. Both of the supervisors guided the methodology and critically revised the original manuscript and made the final approval of the version to be published.

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