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Vulnerability of the Urban Households to Flood Hazards in the Niger Delta, Nigeria

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Abstract
Urban growth and spatial expansion in the state capitals of the Niger Delta significantly impacts the urban ecosystem which intensifies flood hazard occurrence in the region. Accordingly, this study assessed the vulnerability of urban households to flood hazard in the Niger Delta by generating vulnerability indices and comparative analysis across the state capitals of the Niger Delta. A cross sectional survey was conducted among 386 households indicating that flood occurs frequently (96.6%) across the state capitals. Findings also revealed that poverty is the root cause of vulnerability across the state capitals as 98.9% of the household members live below the $2/ day minimum by the United Nations standard. In addition, our data shows that most residents across the state capitals are literate (65.4%); however, there is no form of hazard related training across the study area. These results highlight the underlying causes of flood vulnerability indicating that priority should be given to investments in order to manage and reduce the risk of people, property and the environment to flooding by building capacities through sensitization and training on flood risk reduction. Also, there is need to provide social capital towards promoting income generating activities to improve the financial status of residents in the state capitals of the Niger Delta, as well as the provision of flood insurance schemes.

Keywords: Urban growth, flood, vulnerability

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I. INTRODUCTION

The global population of people moving to the urban centers is rapidly increasing over the years. It has been established that more than 50% of the global population resides in urban areas, and it has been projected that by 2030 about 5 billion people shall reside in towns and cities across the world (Tacoli, 2012; Farrel, 2018) Other recent reports have predicted that the highest rate of urbanization shall be seen in India, China and Nigeria (Global Health Observatory, 2017). Considering the altering urban population in line with the global annual frequency of disasters impacted mainly by climate influenced variables and aggravated by human pressures, it highlights an imperative area of research. The impacts of climate change are being exhibited in the frequency and intensity of disasters such as floods, drought and cyclones which affect the population by damaging/destroying lives, and ravaging the environment (Few, 2003; IPCC, 2012). With the global increase of natural disasters and projected 70 million which are likely to be impacted it creates a cause for concern (Farrel, 2018). Interestingly, there is a variation in the way natural disasters impact on people and this is determined by the geography of the area, demographics and the health status (Aliyu, 2015). In essence it can be said that impacts of natural disasters are peculiar to every region in which they occur. Amidst the different types of disasters, some reports have highlighted that flood is the worst judging by its frequency and the area of coverage (Balica et al., 2009; Vojinovic & Abbot, 2012; EM- DAT, 2015).

Flooding has continued to be an annual menace worldwide as it is responsible for 55% of disaster mortality and it affects approximately 2.5 billion people across the world (White et al., 2005; UNISDR, 2011). Due to the frequency of the event, many areas are affected by flooding while they are yet to recover from the previous year's disaster. Though reports on flooding have absolutely improved, recent reports reveal that there is a rise in the frequency and severity of flood incidents (EM-DAT, 2011). Among the factors that contribute to rise in flood disasters is the increasing urbanization of watershed (Mc-Carthy, Canziana, Leary, Dokken& White, 2001). Urbanization is on the increase in the Niger Delta due to the presence of natural resources attracting people in search of a better life, it also escalates unsystematic expansion, development on floodplains and deforestation thus increasing flood risk.

For proper flood risk management which will minimize damages and losses from flood events to an acceptable level the focus should be on flood vulnerability because vulnerability to flood is the primary cause of flood disasters. The role of vulnerability in shaping our perception about flood risk management is very

essential (Klein, 2004). In view of these, a better understanding of urban settlement dwellers' vulnerability to flood risk in Nigerian cities is essential because vulnerability constantly varies reflecting the prevailing socio-economic, cultural and political conditions of the people.

Thus, based on the foregoing, this study adopted a quantitative approach to assess the vulnerability of urban households to flood hazard in the Niger Delta. The study is relevant because identifying vulnerabilities will help to tackle the root causes that lead to vulnerabilities thus building capacities and this in turn will reinforce disaster preparedness in the area. Therefore, this study is aimed at assessing the vulnerability of urban households to flood hazard in the Niger Delta.

II. MATERIALS AND METHODS

Study Area

The study area is the Niger-Delta located in the southern region of Nigeria and is positioned between latitudes $4^0 21' 43.2''N$ - $7^0 40' 52.8''$ N and longitudes $5^0 8' 42''E$ - $9^0 30'7.2''$ E and spatially covers an area of about 84,640km^2 which encompasses the following states; Bayelsa, Cross River, Rivers, Edo, Delta and Akwa Ibom as shown in Figure 1. Most parts of the Niger Delta (BRACED states) are intersected with creeks, estuaries and rivers form which it obtains its name from being positioned at the mouth of the Niger River which finally ends at the edge of the Atlantic ocean (UNDP, 2006; Musa et al., 2014).

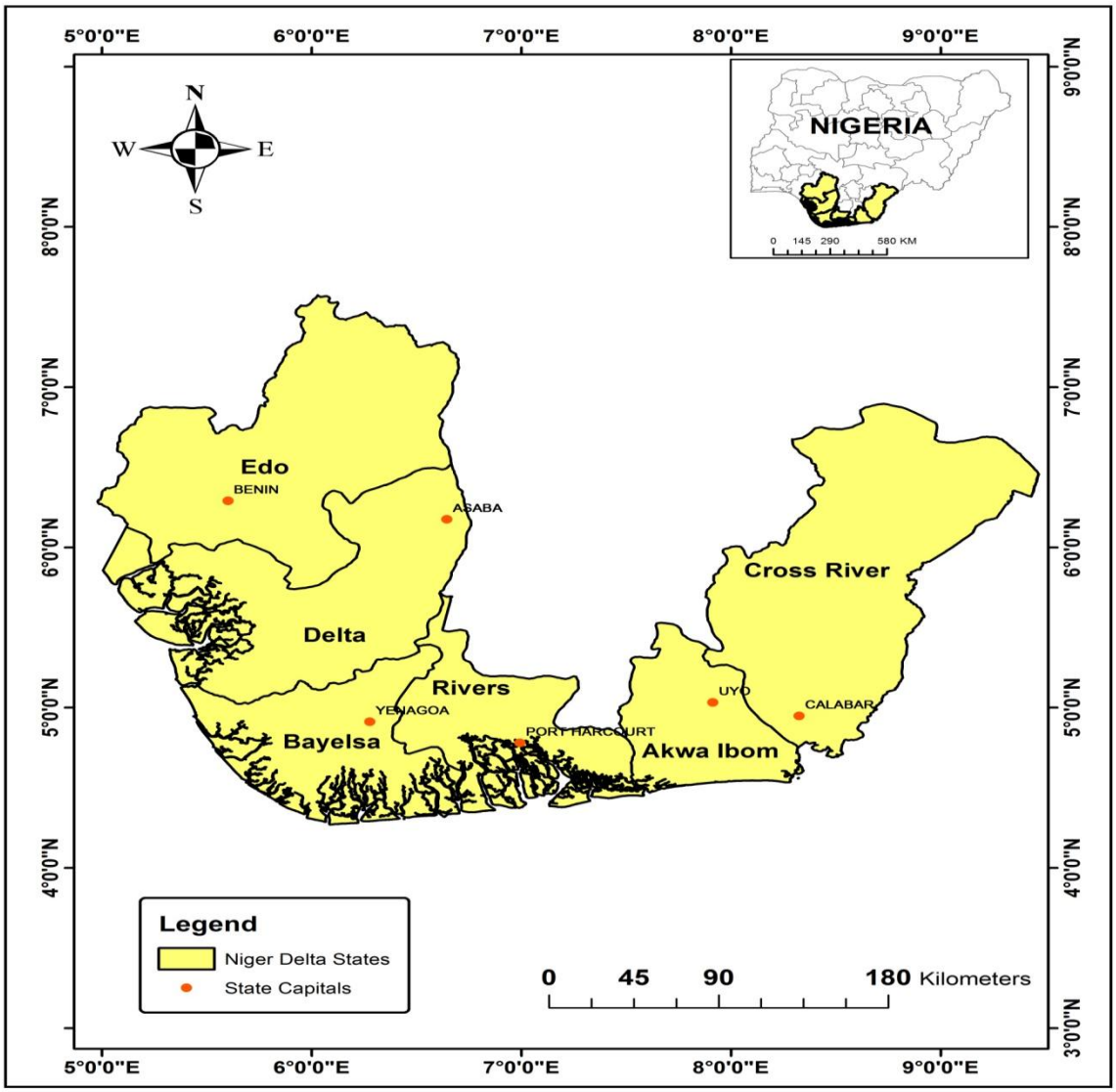

Figure 1: The Niger Delta BRACED States.
(Source: State Boundary Shapefile from Open street map, 2018).

The topography of the Niger Delta region is gently sloping lowland which is less than 10 degrees in most areas and the highest part of the lowland which is well drained form mosaic with altitude between 15 to 25 meters (Musa et al., 2014). Thus the area has a flat monotonous low relief interspersed by several wetlands.

The climate of the area differs; it could be classified as the hot equatorial in the southern lowlands and humid tropical in the northern highlands (Abam, 2001). The key climate variable is rainfall which has spatial variation in the study area. There are two seasons as in the other parts of the country which are the wet and dry seasons (NDDC, 2006).

The Niger Delta region is densely populated with over 30 million people and majority reside in the urban areas, it has more than forty ethnic groups some of which are Ijaw, Efik, kalabari, Annang, Urohobo and Itsekiri which speak close to 250 languages (Okhakhu, 2014)

Prior to the advent of crude oil and gas exploitation which paved way for urbanization, occupational focus in the region was on the agricultural sector. Farming, fishing and coastal trading were the main occupation of the people of the Niger Delta Region providing a means of livelihood and abundant revenue in the region (Okhakhu, 2014). Presently, industries dealing on oil and gas have dominated and created a wide range of other occupations associated with industrial activities and technology attracting workers to the region and increasing the population. However, according to Ukiwo (2009) unemployment is rated at about 8.8%, while underemployment level is about 26.2%. Due to the increase in population, some social challenges such as pipeline vandalisation and kidnapping confront the region (Watts, 2008). Some environmental challenges due to the "oil boom" that translated to urbanization of the region include increasing elements of pollution (air and water) and loss of biodiversity in the region (Okhakhu, 2014).

Flood Vulnerability index

Flood vulnerability indices help to categorize vulnerability thus leading to risk categorization. This study adopted an integrated assessment perspective which merges biophysical as well as socioeconomic components of vulnerability to arrive at flood vulnerability indices of the study area. The factors of vulnerability which are exposure, susceptibility and resilience were the main themes from which indicators were derived.

The deductive approach is utilized in this study .The theoretical indicators were obtained from a variety of studies some of which are Briguglio(2003); Connor and Hiroki(2005); Birkmann(2006),Balica (2007); Balica et al.(2009); Balica et al.(2012); Veenstra(2013) and Nabegu(2014). After which a preliminary survey was done to exclude irrelevant indicators. In selecting indicators, this study adopted the Balica(2009) criterion which includes; suitability, adhering to a conceptual framework, data availability and sensitivity to formats.

Indicators for the study were modified and adapted to suit the population from a broad range of existing literature (Tapsell et al., 2002; Cutter et al., 2003; Balica, 2007; Balica, Wright & Van der meulen, 2012; Balica et al., 2012; Lui & Li, 2016).

Several factors affect flood vulnerability, which implies that a broad range of indicators would be required to calculate the flood vulnerability of household in the study area. Unfortunately, using several indicators comes with challenges, some of which are unreachable data, complex calculation and poor operability (Cutter et al., 2003; Murphy and Scott, 2014). It is advisable to use minimal number of indicators (Liu et al., 2013). Nine flood vulnerability indicators were used in this study which are practicable and can be quantified smoothly (Cutter and Finch, 2008).

With the aid of a questionnaire and actual measurement the indicators chosen for the study are; proximity to water body, flood height, family size, health/ wellbeing, illiteracy ratio, frequency of flood , income per capita, access to hazard related information and hazard related training. Table 1 shows the factors of vulnerability, indicators, their definition measurements and relationships to vulnerability.

Table 1. Vulnerability indicators, definition and measurements

Vulnerability factor	**Indicator**	**Definition**	**Measurement (Proxy)**	**Relationship**
Exposure	Proximity to water body	Distance of house to a lake, stream or river	The shortest distance of any sampled house in the area to a water body	The shorter the distance of the house to any water body, the higher the vulnerability.
	Flood height	Height of previous flood	Previous flood water depth using ankle, knee and waist	The higher the flood height, the higher the vulnerability
	Family size	Total number of family members	Number of family members	The higher the family members the higher the vulnerability because more people are exposed to flood

Susceptibility	Health/ wellbeing	Household with chronic illness, pregnancy and disability	% of the population who have people with chronic illness, pregnancy and disability	The higher the percentage of household with chronic illness, pregnancy and disability the higher the vulnerability
	Illiteracy ratio (15+)	People over the age of 15 who cannot read or write compared to the family size	(Number of illiterates / family) × 100%	The higher the illiteracy ratio the higher the vulnerability due to the inability to access hazard information
	Frequency of flood	The number of times flooding has occurred in the area within the last 10 years	The percentage of the number of times flood has occurred in the area within the last 10 years	The higher the frequency of flood the higher the vulnerability.
Resilience	Income per capita	The average income earned per person in a family.	Total family income/ family size	The higher the income per capita the lower the vulnerability
	Access to hazard related information	The ability to receive flood risk information	Number of information receiving tools in a household	The more the number of information receiving tools the lower the vulnerability
	Hazard related training	People who have taken part in hazard related training or workshops in the last 5 years	% of people who have taken part in hazard related training in the past 5 years.	The higher the percentage of people with hazard related training the lower the vulnerability.

Source: Adapted and modified from existing literature (Tapsell et al., 2002; Cutter et al., 2000; Balica, 2007; Balica et al., 2012; Lui & Li, 2016).

Sampling technique

This study was undertaken in six randomly selected local government areas within the state capitals in the Niger delta using a cross-sectional survey research method. Data was collected using a well-structured questionnaire. The sample comprised 400 heads of households, living in the study area, obtained using the Yamane (1967) formula. Simple random sampling was used to select households for questionnaire administration. A total of 386 properly completed questionnaires were retrieved and used for the study. Table 2 shows the number of retrieved questionnaire according to the selected Local Government Areas (LGA) used for the study

Table 2: Distribution of household samples for quantitative survey.

States	LGA Selected	Administered questionnaire	Retrieved questionnaire	Percentage
Bayelsa	Yenogoa	74	68	92
Rivers	Port Harcourt	113	113	100
Akwa Ibom	Uyo	64	61	95
Cross River	Calabar Municipal	39	39	100
Edo	Oredo	79	76	96
Delta	Oshimili South	31	29	94
TOTAL	**Six (6)**	**400**	**386**	**96.5**

Source: Researcher's Computation (2019).

In addition, data Entry Screens were developed in Statistical Package for Social Sciences (SPSS) version 25.0 and Microsoft Excel 2010 version. Descriptive statistics were used to analyze the data to produce frequencies and percentages. Tables and charts were adopted to present the data collected.

III. RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

It is important to discuss the socioeconomic characteristics of the respondents because according to Mavhura, et al. (2013) communities with higher socioeconomic strength could cope better with flood impacts than communities with lower socioeconomic strength. The results for the socioeconomic characteristics of respondents are shown in Table 3. In the state capitals of the Niger delta, Male heads of household were greater than female heads of households at 75.9% and 24.1% respectively. This is an indication that males were the highest in the study area and this could be an advantage during flooding as men can be involved in physical activities required during flood mitigation and rescue processes. Majority of the heads of households across the study area were grouped within 51 years and 60 years which constituted about 26.4% of the entire population. According to Jonkman et al.(2009) elderly people cannot deal very well with flood as compared to the youths and this may serve as a hindrance to proper flood management and increase flood vulnerability of the households in the study area due to poor coordination.

Heads of households who were civil servants accounted for the highest percentage at 33.9% which implies that majority of the households expected monthly income from the government which may in turn reduce their vulnerability.

In the state capitals of the Niger Delta the people who live in apartments that they do not own accounted for 59.9% of the entire population. This may likely lead to an increase in flood vulnerability in the area because, according to Steinfuher and Kuhikle (2009) precautionary measures and structural flood mitigation were higher among home owners than people who rented houses. In addition, Kamel (2012) noted that owners of property were favored against renters during post flood housing programs.

Table 3: Socioeconomic characteristics of respondents

Variables	Frequencies(n =386)	Percentages (%)
Gender of head of household	**386**	**100**
Male	293	75.9
Female	93	24.1
Age of Head of Household	**386**	**100**
Below 20 years	2	0.5
20-30 years	21	5.4
31-40 years	84	21.8
41-50 years	92	23.8
51-60 years	102	26.4
Above 60 years	85	22.0
Occupation of head of household		
Civil servant	**386**	**100**
Business/ trading	131	33.9
Self employed	104	26.9
Farmer	80	20.7
others	16	4.2
	55	14.2
House ownership status	**386**	**100**
Owner	155	40.2
Rented	208	53.9
squatter	23	6

Source: Researcher's Computation (2019)

Flood Exposure Indices

The indicator, proximity to water body, measured through the nearest distance to a major river reveals that 83.2% of the population across the study area live between 1km- 5 km away from a major river, households living between 6km- 10km, 11km-15km and 16km-20km accounted for 8.8%, 4.1% and 3.9% respectively as shown in Figure 2.This implies that most of the households studied in the state capitals of the Niger delta were at high risk to fluvial flood.

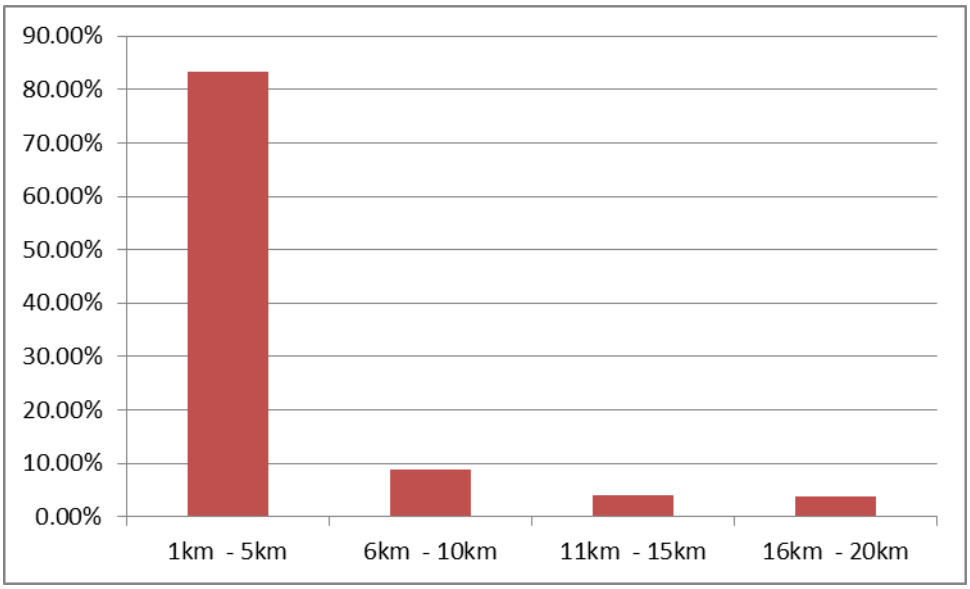

Figure 2: Nearest Distance to River (Researcher's Computation, 2019)

The results on the residents' perception of the flood height revealed that 32.4% indicated flood height reaching between knee and ankle, 34.2% responded that flood height was at knee while 23.1% and 10.4% responded that flood height was above knee and waist respectively (Fig. 3). Flood height reaching the knee length (34.2%) accounted for the highest percentage in the category as presented in Figure 3. As stated by Booysen (2001) flood level is directly proportional to the velocity and depth of inundation, implying that the probability of flood impact on the residents increases as the flood height increases and velocity increases. Thus flood that gets to knee could lead to the loss of lives of children, livestock, pets and cause severe damage of properties. This is an indication of high flood vulnerability in the study area.

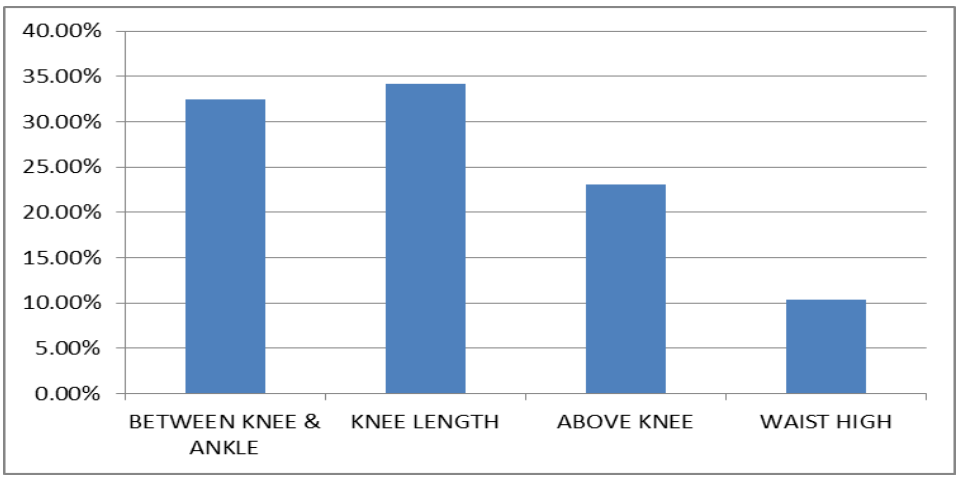

Figure 3: Flood height (Researcher's Computation, 2019)

The mean family size of respondents in Yenogoa, Port Harcourt , Uyo, Calabar, Benin and Asaba were 5.35, 5.58, 4.80, 6.64, 5.08 and 4.79 respectively (Fig. 4). This implies that in the state capitals of the Niger Delta, each household is composed of approximately five members. This indicates that because the number of members of household is high, the number of the people exposed to flood has also increased which in turn increases the vulnerability of the household to flooding.

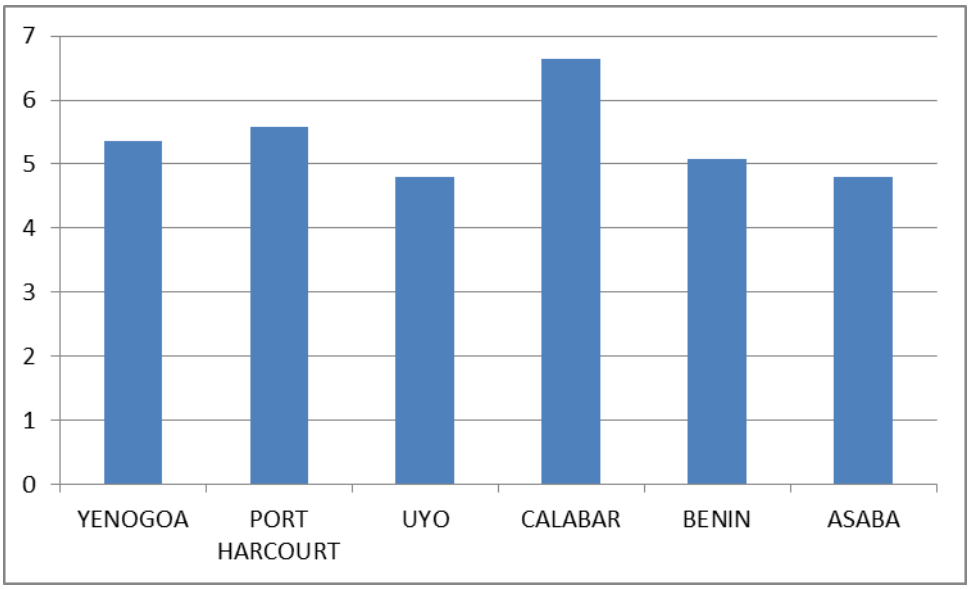

Figure 4: Family size (Researcher's Computation, 2019)

Susceptibility Indices

The health and wellbeing indicator was measured by the percentage of household members with chronic illness, pregnancy or disability. Figure 5 indicates that 64% of the entire population had no family member who was pregnant or had serious health challenges, while 36% of the entire population were either pregnant or had a serious health challenge. This implies that in the face of disaster the family members can try to concentrate on the situation without having to worry about health challenges which would further complicate the problem.

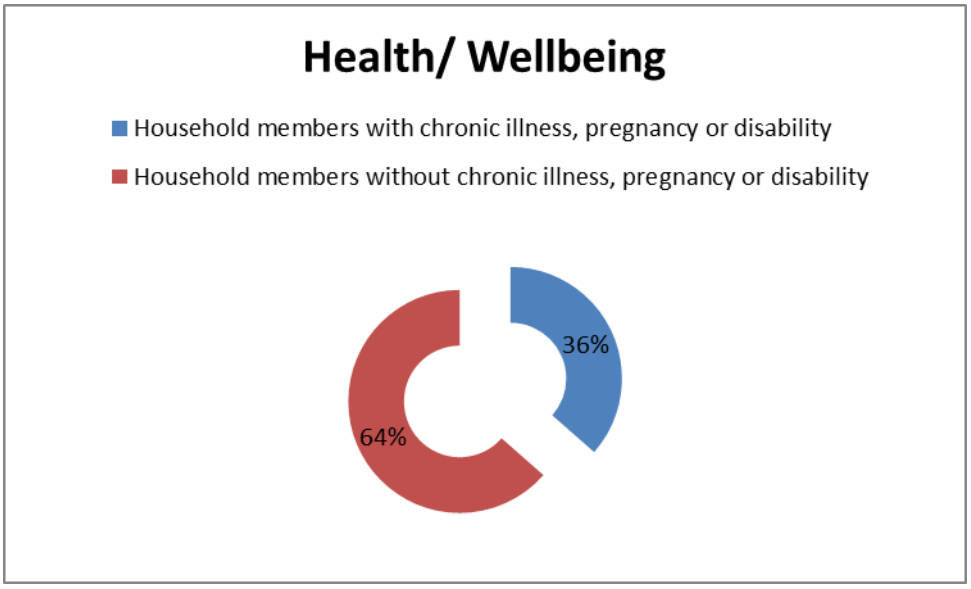

Figure 5: Health/ Wellbeing (Researcher's Computation, 2019)

The percentage of people who cannot read or write in English as compared to the family size is shown in Table 4. Calabar had the highest percentage of illiterates at 39.38%, followed by Benin, Port Harcourt, Asaba and Uyo with 36.75%, 36.13%, 33.09% and 32.78% respectively. Yenogaoa had the least percentage of illitrates with 28.57%. However, the illiteracy ratio for Yenogoa, Port Harcourt, Uyo, Calabar, Benin and Asaba were; 0.29, 0.36, 0.33, 0.39, 0.37 and 0.33 respectively as presented in Figure 6. Across the state capitals of the Niger Delta, the illiteracy ratio is low, which means that majority of the people living in the study area can read and write in English. With this aptitude it may become easy to increase flood risk awareness because it easier to comprehend information disseminated about flooding through prints as well as trainings, when they are available

Table 4: percentage of illiterates across the State Capitals of the Niger Delta
Source: Researcher's Computation (2019)

STATE CAPITALS	ABOVE 15 LITERATE		FAMILY SIZE		ILLITRATES	
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
YENOGOA	260	100	364	100	104	28.57
PORT HARCOURT	403	100	631	100	228	36.13
UYO	197	100	293	100	96	32.76
CALABAR	157	100	259	100	102	39.38
BENIN	241	100	381	100	140	36.75
ASABA	93	100	139	100	46	33.09
TOTAL	**1351**		**2067**		**716**	
PERCENTAGE TOTALS	**100**		**100**			

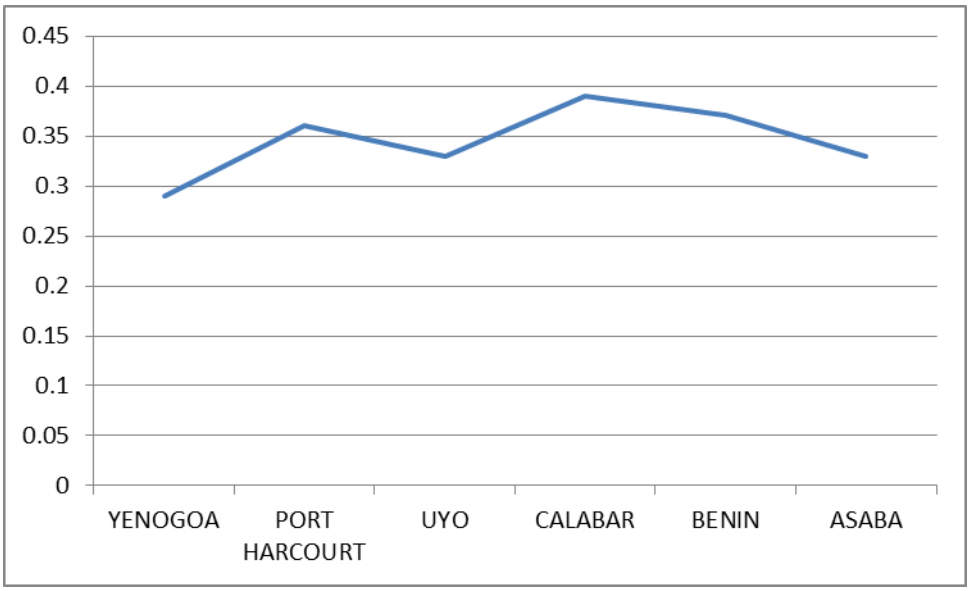

Figure 6: Illiteracy Ratio (Researcher's Computation, 2019)

As represented in Figure 7, 96.6% of the respondents agreed that flood occurs over seven times in ten years across the state capitals of the Niger Delta. However 0.0%, 0.0%, 0.5%, 0.8%, 1%, 1% responded that flood occurred, once, twice, three times, four times, five times and six times respectively within ten years across the entire study area. The more frequent flooding occurs in an area the greater the consequences in that area. Unfortunately in the state capitals of the Niger Delta, results reveal that flooding occurs more than seven times in ten years which implies that flood occurs almost every year. Since flooding in the area is an annual occurrence, the impact on the affected population will increase (if there is no increase preparedness) thus increasing their vulnerability.

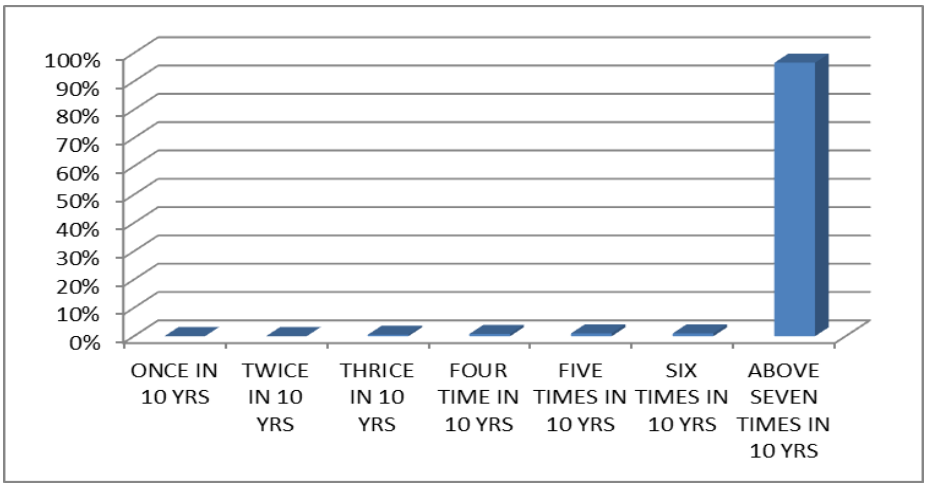

Figure 7: Frequency of Flood (Researcher's Computation, 2019)

Resilience indices

Figure 8 shows the income per capita, in the state capitals of the Niger Delta, the highest responses were households that earned 10,000 and below in a month at 94.5%, while households that earned between10,001 to 20,000, 20,001 to 30,000, 30,000 to 40,000 and above 40,000 naira were 4.4%, 0.5%,0.0% and 0.5% respectively. The result indicates that 98.9% of the average income earned per person in the month across the state capitals of the Niger Delta is below 21,000 Naira ($1 = #350, 700 * 30days = #21000) which is the poverty line going by the United Nations standard of 2 dollars per day and anyone who has an income below the poverty line is regarded as a poor person. This indicates that the households in the study area are poor. This can be explained by the pressure model that the root causes of vulnerability are other factors remote from the hazard event within the particular community in this case the Niger Delta State capitals (Blaike et al 2004). Judging from the results, residents of the Niger Delta state capitals are confronted with a very high level of poverty. Poverty has an impact on the standard of living of a population. Because of the low income of the households, members may not afford to cater well for their family needs as well as rent good houses which are flood proof thus exposing them to unsafe conditions and as noted by Mavhura et al.(2013) communities with lower income have a lower coping capacity to flood impact.

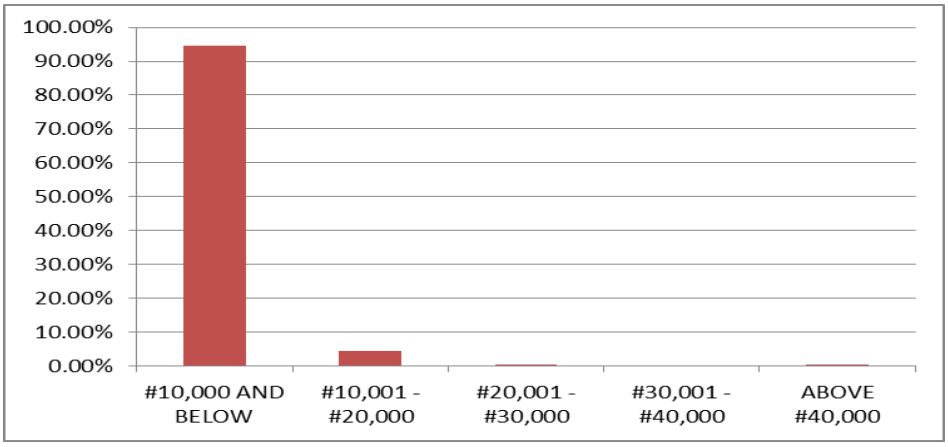

Figure 8: Income per Capita (Researcher's Computation, 2019)

Since it has already been established that most of the residents in the state capitals of the Niger Delta are literate, having access to hazard related information is vital because according to Adelekan (2011) findings, the lack of pre-flood information was responsible to the high risk to flood in his study in Abeokuta. However, the access to hazard related information is largely dependent on the number of available information receiving tools that residents possess. This includes television, telephone, mobile phones, radio and computers with internet. Results from the findings reveals that across the state capitals of the Niger Delta, household that had (0,1,2,3,4,5) information receiving tool accounted for 0.3%,3.6%,27.9%,47.4%,17.6% and 3.1% respectively as presented in Figure 9.This reveals that 68.1% of the households across the study area had a minimum of three information receiving tools which implies that residents have fair access to hazard related information which should increase flood awareness in the study area.

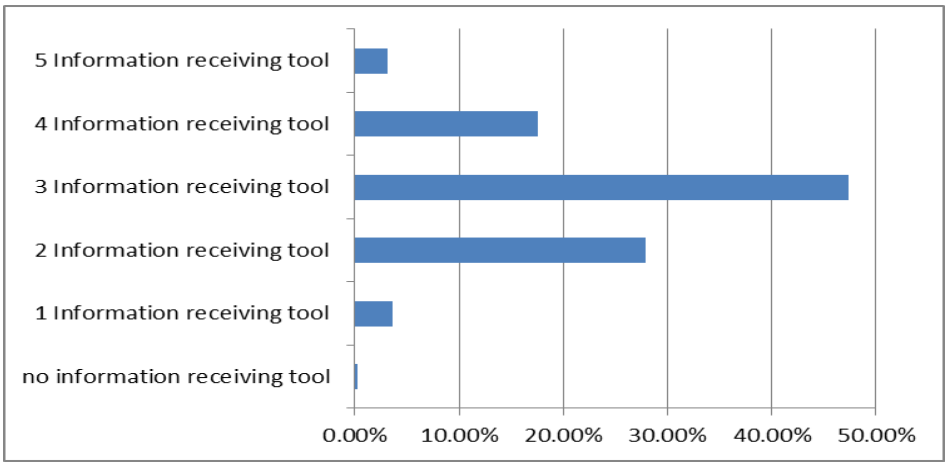

Figure 9: Number of information receiving tools (Researcher's Computation, 2019)

Our findings show that there is no hazard related training of any member of the household across the State capitals in the Niger Delta with 386 of the responses which accounts for 100% of the entire population. Flood management is beyond being aware, drills and trainings are required to increase the resilience and reduce vulnerability to flood hazard

IV. CONCLUSION

The study examined the vulnerability of the urban households to flood hazards in the Niger Delta. Our findings indicate that flood occurs frequently across the state capitals of the Niger Delta, poverty is one of the root causes of vulnerability across the state capitals of the Niger Delta because majority of the household members live below the 2 dollar per day minimum by the United Nations standard. Also, results from this study indicate that most residents across the state capitals of the Niger Delta are literate; however, there is no form of hazard related training across the study area. These results, highlight the underlying causes of flood vulnerability thus justifying that priority should be assigned to investments in order to manage and reduce the risk of people, property and the environment to flooding by building capacities in the region.

V. RECOMMENDATIONS

Based on the findings, the study recommends sensitization and training on flood risk reduction should be increased across the state capitals of the Niger Delta, provision of social capitals that promote income generating activities to improve the financial status of residents in the state capitals of the Niger Delta, as well as the provision of flood insurance schemes.

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