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Assessment of Social Vulnerability to Flood among Coastal Households in South-South, Nigeria

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--***ABSTRACT***--
The study evaluated the extent of social vulnerability to flood among coastal households in south-southern Nigeria. Simple random sampling technique was employed to select Rivers, Delta and Bayelsa States as principal flood prone areas based on NEMA report of 2012 and 2018 and systematic sampling technique was used to administer 800/632 copies of structured questionnaire to households across the selected States. Data obtained from the administered questionnaire were analyzed using simple percentages and principal components analysis (PCA). Results showed that 93.7% of the respondents were within the ages of 21 years and above and 87.2% earned <₦18, 000 - ₦80, 000 monthly. PCA result identified living in flood prone areas (23.5%), availability of houses with good quality materials (21%) and exposure of houses to salt-water intrusion and inundation (20%) as principal factors responsible for households' exposure to flood. The PCA result also identified persistent flood incidence (44.2%) and unavailability of flood protection measures (17.8%) as factors responsible for household susceptible to flood, Based on the results obtained, the study suggested the need for government to intervene in flood mitigation in the area through structural measures in some high flood prone areas in order to enhance their adaptation to flood.

Keywords: *coastal, exposure, social vulnerability, susceptibility, principal components, analysis, south-south region*

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I. INTRODUCTION

Globally, the phenomenon of climate change and its associated weather extremes have made vulnerability and resilience fundamental front burner issues in environmental debates. The degree to which people are affected by a hazard does not lie in the physical and environmental components only, but also on social and economic dimensions. Thus, the socio-economic condition of a people or community is determined by the vulnerability and resilience of the people or the community (Nkwunonwu, 2017). As a result, disaster risk management has gained significant attention, especially with increasing awareness of the risks and increasing impact of natural and other hazards in the world. Vulnerability, the potential for loss of life or property from disaster has biophysical or social dimensions. Evaluation of social vulnerability has been an issue of concern in recent risk and disaster management studies (Rufat, Tate, Christopher, Burton, & Maroof, 2015). Lawal and Mmom (2015) stated that social vulnerability implies societal attributes which have adverse impacts on disaster outcomes.

The concept of social vulnerability connecting to risk has been extensively discussed in the literature (Tucker, Daoud, Oates, Few & Conway, 2015; De Lange, Sala, Vighi & Faber, 2010). It simply implies the possibility that losses will occur, but with considerations to social-economic and demographic factors in time and space (Cutter et al., 2008). Birkmann held a view of this losses being as a result of a lack of social capacity to withstand stressors within the neighbourhood of a social systems (Birkmann, 2006a), while Changnon suggested that the drivers of these losses are endogenous to the system, making the system susceptible to stressors (Changnon, 2005). Vulnerability is complex and has many dimensions. It is driven by several factors at different levels, from local to global, and it is dynamic as it alters under the pressure of these driving forces (Twigg, 2004). Vulnerability is not confined to poverty, but existing studies have shown that the poor tend to suffer worst from disasters (UNISDR, 2008).

Vulnerability assessment is increasingly considered as a key step towards effective disaster risk reduction (Birkmann, 2006a; 2006b). Therefore, the impact of flood disasters on (1) social, (2) economic, (3) physical and (4) environmental conditions should be examined through necessary indicators. Vulnerability assessment has become a necessary approach in understanding the exposure, susceptibility and adaptation capacities of coastal communities to environmental problems like flooding. This is because people in this environment are more prone to environmental disasters. Nicholls (2008) noted that most coastal communities in the world are facing complex inter-related problems associated with greater intensity and frequency of climate extremes such as flooding. Increasing trends and exposure to disasters driven largely by human activities across coastal communities have given society cause to worry. It is a well-known fact that populations are moving to the coastline on a global scale due to its long-standing attraction for human settlements, and the development there is faster than in inland locations.

In the south-southern geopolitical zone of Nigeria, flooding has become a serious environmental problem affecting households residing close to the coast. Previous studies on coastal floods have focused on river inundation as a result of rise in sea levels (Etiosa, 2007). Also, recent studies like those of Mirza (2011) and Islam et al (2009) examined the causes, consequences, and coping strategies of floods in Nigeria. However, relatively few studies have been conducted on social vulnerability in terms of susceptibility and exposure of coastal communities to flooding at spatial scale. With evidence of recurrent flood disasters in recent time, this study increases our understanding on the extent of social vulnerability across three selected states in south-southern Nigeria and the results obtained give useful information on the fundamental factors of social vulnerability and suggest ways for government and individuals to adopt or put in place in reducing vulnerability and increasing resilience of coastal communities to flood disasters.

II. MATERIALS AND METHODS

Study area

The study area comprises households in Rivers, Delta and Bayelsa States. These states are located in the South – South region of Nigeria (Figure 1). It comprises six states of Akwa Ibom, Bayelsa, Cross River, Delta, Edo and Rivers State having a total area of 84,643 km^2. The South – South region of Nigeria is the second largest delta in the world with a coastline which spans about 450 kilometres and of course the richest wetland in the world (Awosika, 1995). The region is divided into four ecological zones namely coastal inland zone, mangrove swamp zone, freshwater zone and lowland rain forest zone (Awosika, 1995). The region is influenced by the localized convection of the West African monsoon with less contribution from the mesoscale and synoptic system of the Sahel. The monsoon rainy (wet) season over the area begins in May, as result of the seasonal northward movement of the Inter-Tropical Convergence Zone (ITCZ), with cessation in October. Fishing and agriculture are the two major traditional occupations of the Niger Delta peoples.

Nature and Sources of data

Primary data were basically used. Primary data were collected through the administration of questionnaire copies to households in coastal areas across the selected states. The data collected include: data on demographic and socioeconomic characteristics; data on levels of social vulnerability in terms of exposure, susceptibility and adaptive capacity of the households to flood. These data were categorical variables that show of how households across the selected States are exposed to flood, susceptible to flood and whether or not they have the adaptive capacity to cope with flood.

Sample Size and Sampling Techniques

In order to sample or survey a representative of the population across the selected states, the sample size of 800 was determined using Yamane's formula (1967). The sample size was increased by multiplying the obtained figure of 400 by 2 to accommodate the possible field operational lapses of unretrieved and wrongly completed questionnaire from these vulnerable frontline and coastal LGAs across the three States (Bayelsa, Rivers and Delta). (See appendix). The multistage sampling technique involving three steps was deployed for the study. The steps involved the interplay of purposive, simple random and systematic sampling technique. In the first step, purposive sampling technique was employed to select basically States in the south-southern region seriously affected by the 2012 and 2018 floods and the affected States were Rivers, Bayelsa, Delta and Edo States. The justification for the selection of these states (Rivers, Bayelsa, Delta and Edo) is that they were declared national disaster states on the account of flood by the NEMA in 2012 and 2018. More so, the States experience annual constant flooding. In the second step, simple random sampling technique was then used to select three states out of the four; the three randomly selected states were Rivers, Delta and Bayelsa States. In the third step, systematic sampling technique was employed during questionnaire administration to enable copies to be successfully administered to households in the selected States.

Methods of data collection

Structured questionnaire copies were personally administered to the target population with the help of seven trained field assistants. After the purpose of the survey had been explained to the respective respondents and consent for the survey was given, copies of questionnaire were administered to the respondents. To avoid questionnaire loss, respondents were convinced to instantly respond to the questions. For quality assurance, the completed and returned copies of the questionnaire were carefully preserved to avoid loss and destruction. After questionnaire administration, out of the 800 copies administered, 653 copies were retrieved and out of this number, 632 copies were successfully collected and used for the analysis. Other copies were voided for double entries.

Methods of data analysis

Data obtained from the administered questionnaire were analyzed using simple percentages, charts and principal components analysis (PCA). PCA was performed in the study to reduce the sets of social vulnerability indicators in order to extract a small number of latent components for analyzing exposure and adaptation to flood. Through this statistical tool, significant factors of exposure, susceptibility and adaptation to flood were identified and used for further explanations. The selection of few but significant factors was achieved by extracting only factors with eigenvalues ±≥1 after Varimax rotation. Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) Version (22.0) for Windows and excel spreadsheet.

III. RESULTS

Socioeconomic characteristics of respondents

This part of the analysis gives answer to the first research objective which is to *examine the socio-economic and demographic characteristics of the households across the study area*. The result obtained is presented in Table 2. The socioeconomic characteristics of respondents to a large extent have substantial influence on coastal communities' level of vulnerability and resilience to flood and how they adapt to persistent climate phenomena. Information on the socioeconomic characteristics of respondents is shown in Table 2. The sex of respondents showed that males dominated the survey. This is because over 65.7% of the respondents surveyed across the selected states were males, while 34.3% were females. At the respective states, similar pattern of male dominance was observed. A cursory look at the study showed near equal sex proportion in Bayelsa State and the possible reason could be in high involvement of women in coastal activities. However, the dominance of males is anticipated as males are heads of families and tend to be at the centre of flood events in terms of providing for the family and making plans to manage flood. Similar result was reported in Lagos, Nigeria by Nkwunonwo (2017) with greater ratio of males to females.

Information on the age of respondents shows a similar pattern (Figure 1). It showed that across the selected states, respondents within the ages of 21 – 60yrs dominated the survey (86.2%), followed by those above 7.4 years old, while those <20yrs had the lowest proportion of respondents of 6.3%. The general pattern therefore shows that majority of the respondents (93.7%) fall within the ages of 21 years and above. It means therefore that the age of respondents residing in coastal communities is predominantly dominated by adults. Similar age pattern of 31yrs and above was reported among riverine communities by Samuel et al., (2017) in Kogi State. The age range pattern observed has a far-reaching implication on the study; in that the adults would be able to communicate their experience in the area in relation to climate change. The age pattern being predominantly adults also signal high level of vulnerability to flood events. In an earlier and related study, Nkwunonwo (2017) found older people to be more vulnerable to flood.

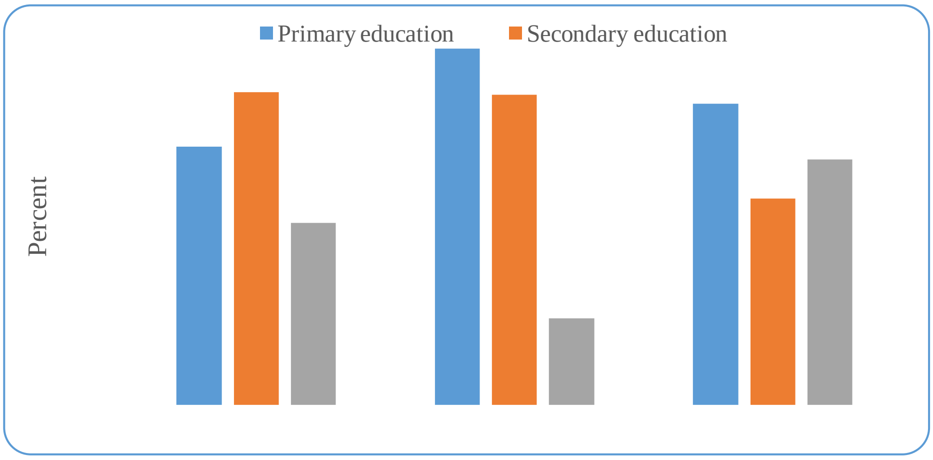

Figure 1: Age of respondents across selected states

The educational status revealed that the respondents had different qualifications, ranging from primary education to tertiary education. It showed that across the states, a significant proportion (40.5%) of the respondents had primary education, followed closely by secondary education and tertiary education with 39.2 and 20.3% respectively. Looking at the respective states, it showed that Rivers State had more of people with secondary; Delta State had more of primary certificate, while Bayelsa had more of people with tertiary education. From the result, it is apparent that a good number of the respondents precisely 79.7% have primary and secondary. The result simply nevertheless indicates high literacy level which would to a large extent influence the people's level of knowledge of flood in the area. In a related study, Samuel et al., (2017) reported that 68% of the respondents had primary and secondary education in Kogi State. The educational status of respondents could also influence their level of adoption of flood measures.

On the monthly income of respondents, results obtained showed that across the states, a good number (57.8%) of the respondents earned <₦18, 000 monthly, followed closely by those that earned ₦19, 000 - ₦40, 000 per month, and 10.3% earned ₦41, 000 - ₦80, 000monthly; 5.5% earned ₦81, 000 - ₦120, 000monthly; 3.8% earned ₦121, 000 - ₦150, 000monthly, while a low proportion of the respondents earned >₦150, 000 per month. Similar pattern in monthly income was observed across the respective states. The general pattern of income therefore implies that people in the coastal communities earn different amount of money from their involvement in economic activities with a significant proportion earning <₦18, 000 - ₦80, 000 monthly suggesting that the area is predominantly occupied by low-income earners. Similar result among riverine communities in Kogi State was reported by Samuel et al., (2017); the study reported that 94.6% of the respondents earned ₦10, 000 - ₦50, 000 monthly.

Information on the years of residence showed that across the states, a good number (74.5%) of the respondents had spent or resided in the area for more than 20 years; 13.1% had resided in the area for10 – 20 years, while 12.3% had been or lived in the area for 10yrs. It is therefore apparent from the results obtained that majority (87.7%) of the respondents in the area have resided for 10 years and above in the area. It therefore means that a significant percentage of the respondents have good knowledge of their environment and as such would be able to explain how they adapt to flood in their respective communities.

Table 1: Socioeconomic profile of respondents

Variables	Categories	States			Total %
		Rivers (277) (%)	Delta (260) (%)	Bayelsa (95) (%)	
Sex	Male	68.2	66.5	55.8	65.7
	Female	31.8	33.5	44.2	34.3
Age	Less than 20 years	7.6	3.8	9.5	6.3
	21-60 years	86.3	86.5	85.3	86.2
	Above 60 years	6.1	9.6	5.3	7.4
Marital status	Married	41.2	64.2	48.4	51.7
	Separated	11.9	11.2	12.6	11.7
	Divorced	9.0	2.7	7.4	6.2
	Widowed	3.6	5.8	3.2	4.4
	Never married	32.9	15.8	25.3	24.7
	Other	1.4	0.4	3.2	1.3
Education	Primary education	34.3	47.3	40.0	40.5
	Secondary education	41.5	41.2	27.4	39.2
	Tertiary education	24.2	11.5	32.6	20.3
Monthly income	Less than ₦18,000	52.7	68.5	43.2	57.8
	₦19,000 - ₦40,000	17.7	20.8	18.9	19.1
	₦41,000 - ₦80,000	11.6	6.5	16.8	10.3
	₦81,000 - ₦120,000	6.1	2.3	12.6	5.5
	₦121,000 - ₦150,000	4.3	1.9	7.4	3.8
	>₦150,000	7.6	0	1.1	3.5
	Not currently employed and not looking	20.9	6.9	11.6	13.8

Occupation	for job				
	Not currently employed but looking for job	38.6	59.6	41.1	47.6
	Working part time	18.4	9.6	12.6	13.9
	Working full time	5.8	10.0	24.2	10.3
	Others	16.2	13.8	10.5	14.4
Years of residence	More than 20 years	79.1	73.5	64.2	74.5
	Between 10 and 20 years	12.6	11.9	17.9	13.1
	Fewer than 10 years	8.3	14.6	17.9	12.3

Households level of exposure to flood

The perception of households on their level of exposure to flood was determined using principal components analysis (PCA). The statistical tool was employed due to the number of variables used to measure the household exposure to flood. The result obtained is shown in Table 3. PCA result of 10 variables used to measure household exposure to flood resulted in the extraction of three components that accounted for 64.5 percent of the variation in the data set. Using component loadings $\pm\geq 0.8$, PC_1 (principal component One) had strong and positive loadings on *my family live in a flood prone area*(0.873) and *people in my community live in flood prone areas*(0.838). The positive loadings simply mean increase in flooding in the area with the increase in residing along flood prone areas. PC_1 was responsible for 23.5 percent of total variance in household exposure to flood and represented living in flood prone areas. On PC_2, only one variable loaded on it; the variable was *my community has houses built with good quality materials* (0.840). PC_2 was responsible for 21 percent of the total variance in the variable set and represented availability of houses with good quality materials.

Likewise, PC_3 had a variable that positively loaded on it; the variable *was residency and houses in my community are exposed to salt-water intrusion and inundation* (0.800). PC_3 was responsible for 20 percent of the total variance in the variable set and represented exposure of houses to salt-water intrusion and inundation. From the result in Table 3, it is apparent that living in flood prone areas, availability of houses with good quality materials and exposure of houses to salt-water intrusion and inundation are the three principal factors responsible for households' exposure to flood in the area. These three factors to a large extent affect or contribute to household level of exposure to flood in the area and have are culpable factors influencing flood occurrence and severity.

The first extracted component which has the large explanation to household exposure to flood implies that households are exposed to flood in the area as long as they keep living in flood prone areas. This is expected as building of houses in flood prone area means the builders are already prepared for flood and it goes to show the need for more environmental campaign on the dangers of building houses and living in areas known to be susceptible to flood. This agrees with the submission of Maciag (2018) that if people continue to allow development in a floodplain, they should prepare to have the strongest stormwater standards. In most cases, people living in such areas are poor who could not afford quality houses in the city. They therefore see such areas as being habitable. This agrees with the findings of Kawasakia et al., (2020) where living in flood prone environment was observed to be the cause of flood among Myanmar households. In line with this, a good number of people living in flood prone area are usually poor and this is affirmed by the income status of households in the present study. This is consistent with the study of Satterthwaite et al., (2007), where poor people are reported to often live in risky environments, such as on floodplains or in urban areas at high risk of flood. Also, according to Byrant (1991), floods are usually exacerbated by human activities such as the construction of houses in areas that are prone to flooding.

In another study, Kawasakia et al., (2020) stated that people who cannot afford good housing tend to live in flood-prone areas, where education levels are low. Availability of houses with good quality materials is the second factor identified to explain household level of exposure to flood. A look at the response rate showed that across the selected states, majority (56.7%) of the respondents stated that houses in their respective areas are not built with good materials. It showed that 53.1%, 61% and 57.9% of the respondents in Rivers, Delta and Bayelsa State strong affirmed the absence of good quality houses. This means that households in the area are easily affected by flood as a result of the poor-quality materials used. This is expected as a good number of the houses are built using bamboos which are fragile and not strong enough to content flood water or strong stormwater. During strong storm, the buildings are easily destroyed and materials are carried along the stormwater or suspended. This lends support to the findings of Kawasakia et al., (2020) where they established a positive link between lower housing levels and flood severity. They study stated that in houses with bamboo have fragile floors and easily destroyed by flood.

Exposure of houses to saltwater intrusion and inundation is another factor that has increased household exposure to flood. It is apparent that floods in the area usually inundate houses and introduce salt-water into the environment. The intrusion of salt-water has severe environmental consequence such as groundwater pollution and destruction of plants and animals. In line with this, Purnama and Marfai, (2012) stated that saltwater intrusion makes water saline which brings about groundwater contamination. The study stated that saltwater intrusion is mostly caused by human activities. Thus, blocking of water channels and building in flood prone areas result in saltwater intrusion which impact on human life and livelihood. The result in Table 3 therefore identified living in flood prone areas, availability of houses with good quality materials and exposure of houses to saltwater intrusion and inundation as household level of exposure to flood in the area.

Table 3: PCA result showing the exposure of households to flood[a]

Variables	Components		
	PC_1	PC_2	PC3
My family live in a flood prone area	0.873	-0.063	0.065
People in my community live in flood prone areas	0.838	0.011	0.222
People in my community have been living on the floodplain for a long time	0.763	0.028	0.340
Good housing is available for people who live in my community.	0.054	0.901	-0.040
My community has houses built with good quality materials	-0.042	0.840	0.055
My community is a safe place to live and work.	-0.029	0.751	0.095
Residency and houses in my community are exposed to salt-water intrusion and inundation	-0.028	0.117	0.800
The housing arrangement in my community is closely packed	0.240	-0.017	0.686
People in my community live along the coastlines.	0.251	0.022	0.678
Residency and houses in my community are exposed to high water elevation	0.420	0.015	0.553
Eigenvalues	**2.35**	**2.1**	**2.0**
% variance	**23.51**	**21.0**	**19.97**
Cumulative exp.	**23.51**	**44.5**	**64.47**

[a]the underlined with coefficients ±≥0.8 are considered significant

Susceptibility level of households to flood

Households' perception on their susceptibility level to floodwas determined using principal components analysis. The result obtained is shown in Table 4. PCA result of 9 susceptibility level to floodvariables resulted in the extraction of two components that accounted for 62 percent of the variation in the data set. PC_1 had strong and positive loadings on *flood is more or less a problem in my community* (0.816), *people in my community are susceptible to flood* (0.810) and *my community is negatively affected by flood* (0.800). The positive loadings simply suggest increase in flood incidence in the area. PC_1 was responsible for 44.2 percent of total variance in household susceptible to flood and represented persistent flood incidence. On PC_2, two variables loaded on it; the variables were *people in my community use flood maps for spatial planning* (0.892) and *there are flood protection measures in my community* (0.841). PC_2 was responsible for 17.8 percent of the total variance in the variable set and represented availability of flood protection measures. The result in Table 4 therefore identifies persistent flood incidence and unavailability of flood protection measures as the two main factors responsible for household susceptible to flood.

The first extracted component, persistent flood incidence clearly indicates that flood is a serious environmental problem across the selected states. This is affirmed by the response rate 83%, 87.7% and 80% of respondents in Rivers, Delta and Bayelsa States respectively. The persistence of flooding in the area has serious negative impact and these impacts are expressed in food of the destruction of farmlands, loss of livestock, destruction of crops and properties, surface and ground water pollution as well as the introduction of pest and diseases. Livestock are killed from drowning, while non-tolerant plants and crops die through suffocation. Similar result was reported by Rabalao (2010).In addition, the persistent flood affects social and economic activities in the area. When this occurs, mobility is hindered and access to some areas is restricted mostly those that are accessed through footpath. The flood also destroys converts which hinders movement. In line with this, The State of Queensland report of 2011 stated that flooding affects communication links and infrastructure such as power plants, roads and bridges. These infrastructures are damaged and disrupted and economic activities come to a standstill, resulting in dislocation and the disruption of normal life for a period much beyond the duration of the flooding.

Economically, it affects market activities resulting in the destruction of perishable goods as well as hinders farming activities. Sources of household income are also hampered increasing household poverty and hunger. These assertions are affirmed by the report of flood by The State of Queensland (2011) which showed that the instantaneous impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases. It also showed that flooding can inhibit regular agricultural activity which can lead to loss of livelihoods. The spillover effects of the loss of livelihoods can be felt in business and commercial activities even in adjacent non-flooded areas. The second factor that substantially explains household susceptibility level to flood is the unavailability of flood protection measures. A look at the response rate on the availability of flood maps across the states showed the non-use of flood map for spatial planning. This is so as majority of the respondents (77.4%) across the three states alleged that flood maps are not used for spatial planning.

Similar response was observed across the states, 85.5%, 73.1% and 74.8% of respondents in Rivers, Delta and Bayelsa States respectively strongly stated that flood maps are not used for spatial planning in their respective communities. When flood protection measures are not in place and made functional, flood incidences and effects cannot be managed or put into control. For instance, the unavailability of early warning system will not enable flood prone communities to adequately prepare for flood and through this approach; they will be unable to reduce the impact of flooding on social and economic activities. Unavailability will also not provide land use restrictions to residents which increase their susceptibility level to flood. In support of this result, Di Baldassarre et al., (2010) stated that flood maps serve as critical policymaking tools in land use planning, flood mitigation, general public awareness and emergency management. The use of flood maps for spatial planning goes a long way to control the devastating impacts of flooding. This is because, households will be properly guided on areas that are very or highly susceptible to flood and they will try to avoid such areas.

The availability and use of flood maps also help restrict the building of houses in areas already marked as flood prone. The restriction of structures and other activities in such areas will reduce household's susceptibility level to flood. The impacts of flooding are however more devastating if flood maps are not used for spatial planning mostly to restrict anthropogenic activities in flood prone areas. The assertions above agree with those of the report on flood by the Natural Resources Canada (2018) that flood maps identify the boundaries of actual or potential flood events based on probability and likelihood and can be used to help identify the specific impacts of flood events on, for example, structures, people and assets. It also serves as a basis for land use planning and land use restrictions. Flood maps are therefore valuable tools for representing the spatial distribution of flood hazard, vulnerability or risk (Leedalet al., 2010 cited in Di Baldassarre et al., 2010). The result in Table 4 therefore identified persistent flood incidence and unavailability of flood protection measures as household susceptibility level to flood in the area. These two factors substantially explain household vulnerability or weakness to flood and further suggest that they need to be adequately addressed to effectively reduce flood incidence and impacts.

Table 4: PCA result showing householdsusceptibility level to flood[a]

Variables	components	
	PC_1	PC_2
Flood is more or less a problem in my community	0.816	-0.027
People in my community are susceptible to flood	0.810	-0.071
My community is negatively affected by flood	0.800	0.083
The relationship of individuals, households and community to resources is impacted negatively by flood	0.788	0.101
People in my community are easily impacted by flood	0.782	-0.066
My community is sensitive to flood	0.641	-0.008
My community members lose their income/job/business in case of flood	0.609	0.266
People in my community use flood maps for spatial planning	0.043	0.892
There are flood protection measures in my community	-0.005	0.841
Eigenvalues	**3.98**	**1.60**
% variance	**44.21**	**17.8**
Cumulative exp.	**44.21**	**62.0**

[a]the underlined with coefficients ±≥0.8 are considered significant

IV. CONCLUSION AND RECOMMENDATIONS

The study has shown that flood is an environmental problem in the area and it seriously impacts on households' way of living. The study shows that living in flood prone areas, availability of houses with good quality materials and exposure of houses to salt-water intrusion and inundation are the principal factors that expose households to flood in the area. This means that by building houses in flood prone areas and making use of fragile materials in building already make the occupants exposed to flood associated risk; and one of such risks is the intrusion of salt-water into the living environment which results in surface and subsurface water pollution among others. In addition, the use of poor quality building materials makes residents of the area easily affected by flood which usually result in enormous loss of lives and properties as reported in the 2012 and 2018 floods.

The study also shows that households are susceptible to flooding due to persistent flood incidence and the unavailability of flood protection measures. The nature of the area and its geography which is characterized by heavy rainstorms makes it a flood prone area and this makes households in the area likely victims of flood incidence. Also, households in the area do not have in place flood protection measures which make them susceptible to floods. The absence and use of flood maps and early warning do not allow households in flood prone areas to adequately prepare for flood mitigation; this makes them unprepared and thereby vulnerable to flooding.

Based on the results obtained, the study suggests the need for government to intervene in flood mitigation in the area. This could be achieved by putting in place structural measures such as the placement of breakwater along part of the coast and demolition of buildings in some high flood prone areas. These measures will go a long way in reducing the devastating impacts of flooding since households in the area are particularly low-income earners. Also, there is need for strict restriction on the intrusion of areas marked as flood prone. This can be controlled through the employment of community guards to help prevent the building of houses in flood prone areas.

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Table 1: Sample size for LGAs, their projected and household population

State	Name of LGA	Projected Population to 2018	Household Population per LGA	Number of Questionnaire per LGA
Bayelsa	Ekeremor	379,914	63,319	29
	Brass	259,479	4,246	20
	Kolokum/Opukuma	111,705	18,617	8
	Nembe	184,562	30,760	14
	Ogbia	25,108	42,185	19
	Sagbama	263,343	43,890	20
Rivers	Abua/Odual	421,819	70,303	32
	Ahoada East	248,428	41,404	19
	Ahoda West	37,226	62,044	28
	Andoni	325,500	54,250	25
	Asari – Toru	328,283	54,714	25
	Bonny	321,108	53,518	24
	Degama	372,614	62,102	28
	Eleme	284,081	47,346	21
	Emuoha	300,307	50,051	23
	Khana	437,524	72,921	33
	Obio/Akpor	690,585	115,097	52
	Opobo/Nkoro	228,278	38,046	17
	Tai	179,697	29,949	14
Delta	Bomadi	125,527	20,921	9
	Burutu	303,509	50,585	23
	Ethiope East	293,243	48,874	22
	Ethiope West	295,826	49,304	22
	Isoko North	209,501	34,917	16
	Isoko South	343,159	57,193	26
	Ndokwa East	150,639	25,106	11
	Ndokwa West	218,936	36,489	17
	Okpe	187,376	31,229	14
	Oshimili North	172,990	28,831	13
	Oshimili South	218,948	36,491	17
	Patani	98,346	16,391	7
	Sapele	254,323	42,387	19
	Ughelli North	467,991	77,999	35
	Ughelli South	310,311	51,719	23
	Ukwuani	173,711	28,951	13
	Warri North	198,688	33,115	15
	Warri South	455,270	75,878	34
	Warri South-West	170,069	28,345	13
		10,047,924	**1,729,487**	**800**

Source: National Population Commission (2006)