Spatial Assessment of the Relationship between Social Vulnerability and Resilience to Flooding in the Core Niger Delta, Nigeria

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DOI: https://dx.doi.org/10.47772/IJRISS.2023.701048

Received: 19 September 2023; Accepted: 29 September 2023; Published: 01 November 2023

ABSTRACT

The study examined the spatial assessment of the relationship between social vulnerability and resilience to flooding in the Core Niger delta, Nigeria. The study made use of 400 copies of questionnaire to elicit information on the data on demographic and socio-economic characteristics; data on levels of social vulnerability in terms of exposure, susceptibility and adaptive capacity of the households to flood. The study employed the multistage sampling technique involving purposive, simple random and systematic sampling techniques. Descriptive statistics were employed for the data analysis while inferential statistics especially canonical correlation analysis (CCA) was employed to test hypothesis. Findings showed that singles and married individuals were the most common responses with 79.7% completed both elementary and secondary education. Findings also revealed that the canonical loadings for social vulnerability factors on the first canonical function revealed that level of exposure (0.575) and adaptive capacity (0.823) had high correlations, whereas only community resources/governance (0.551). The study therefore concluded that the relationship between social vulnerability and resilience to flooding in the Core Niger Delta are determined mostly by flood exposure, adaptive capacity and community resources/governance and it is recommended among others that government should organize workshops and seminars with relevant stakeholders in coastal communities to constantly educate them on the dangers of building structures in flood prone areas while residents must be advised to create ways to increase their flood-adaptive capabilities at the communal level.

Keywords: Spatial, Relationship, Social, Resilience, Vulnerability, Flood exposure, Canonical

INTRODUCTION

The concept of vulnerability is used across a variety of fields and disciplines, including disaster management, development, economics, sociology, anthropology, geography, health, global change, and environmental studies (Bergstrand et al., 2015). Resilience, in particular resistance to natural disasters, implies that the people of a certain area must turn to external resources and capabilities during times of crisis because they lack the internal resources and skills. Community engagement is influenced by the experiences and connections of people and communities before a crisis occurs (preparation, response, and recovery). Local resilience planning groups are capable of linking resources and capabilities outside the community with community-based activities. Connections are created, and community capacity is built, without any community, while also giving communities the chance to establish their own flood forums and response groups (Quinn, et al., 2018), Measuring the vulnerability of a society to risk and disasters has been a recent focus in risk and disaster research. Rufat et al. (2015) used a meta-analysis of 67 flood disaster studies (1997–2013) to explore case studies on social vulnerability to floods and assess the consequences of measurement on it, coming to the conclusion that social vulnerability to floods is primarily determined by

socioeconomic factors. This research discovered that demographic and socioeconomic factors, as well as one's health condition, are significant factors in determining one's likelihood of experiencing a big flood in Africa. Despite the fact that risk perception and coping capability were essential to the case studies, current social vulnerability research tends to ignore or underestimate these features. In studying the social vulnerability antecedents, processes, and consequences, it is clear that the impact of each social vulnerability driver depends on the stage of the crisis and location of the disaster. The study suggests that future quantitative assessments of societal vulnerability to floods should be built on the concepts of temporal context, measurability, and indicator interrelationships.

Liu and Li (2016) reported that a house social vulnerability index (HSVI) to flood risks was developed after considering the Rufat, et al., (2015) research. To build a model that could be used to evaluate the socioeconomic vulnerability of rural families in China's Henan province's western hilly districts, the team's main goal was to design and conduct the study. In accordance with the results of the research, it identified the most significant social vulnerability indicators as the percentage of permanent employment in other locations, hazard-related training, and illiteracy ratio. Also, rural households with different levels of vulnerability (high, moderate, and low) accounted for 14.9%, 68.1%, and 17.0% of the total rural population. According to the statistics, there is a link between socioeconomic vulnerability of the home and storm flood deaths. The study recommends that local residents' annual income and emergency preparation and response abilities be raised as well as emergency evacuation and emergency disaster procedures, developing an emergency plan, and conducting emergency drills and training, in order to improve the accuracy of the disaster monitoring and warning systems and establish a specific emergency management department and comprehensive rescue system. This research provides practical advice for those who live in rural communities or governments on preparing for, mitigating, and reacting to floods, as well as steps people can do to make their families less vulnerable and enhance their vulnerability to handle flooding threats.

The sociological effects of Pluvial Flooding in Lagos was studied by Nkwunonwu (2017) in Lagos, Nigeria. Pluvial flooding is on the increase, putting human populations and urban assets at risk as well as causing significant economic losses. Due to the lack of high-quality data sets, it's difficult to research the human effects of risk. To prevent flooding, Nkwunonwu (2017) constructed indexes of social vulnerability (SoVI) that measure community characteristics during rainy weather, and incorporated these measurements into predictive flood forecasting models. Social vulnerability was operationalized by exposure, susceptibility, and coping capability using the UNDP's Human Development Index (2014) methodology, which used nine variables to standardise, aggregate, and rank them. Studies discovered high levels of societal vulnerability to flooding in three Lagos local government districts: Alimoso, Agege, and Kosofe; as well as population vulnerabilities based on demographics. While every variable in the model was shown to be highly correlated with gender, socioeconomic position, and family structure, these different factors were found to have a notable influence on the whole of the model. Therefore, the research advocated for appropriate resource allocation and prioritisation, with special emphasis on building effective coping capability in areas with greater socioeconomic vulnerabilities due to the difficulties of urban pluvial flooding in Lagos.

Social vulnerability and community resilience can be viewed as separate but often linked concepts (Cutter et al., 2008). Vulnerability speaks to the inherent qualities of a social system that exist before events like disasters occur that contribute to the amount of risk of exposure as well as the degree of harm, while resilience is the conditions that help social systems to absorb, cope with, and adapt to hazards and disasters (Cutter et al., 2008). While multiple scholars note the conceptual links between these two indices, few have empirically investigated the relationship between community resilience and social vulnerability (Bersgtrand et al., 2015). This raises the question: are the most vulnerable communities also the least resilient? Or are there communities that are strong in one area, but weak in the other? There appears to be an implicit

assumption in the literature that communities low on community resiliency are also high on social vulnerability, but this has yet to be evaluated on nationwide scale. Mapping the relationship between social vulnerability and community resilience could provide important information in targeting resources and guiding the actions of decision-makers seeking to help communities avoid or weather losses from threats. Previous works considering the community resilience and social vulnerability did not consider an in-depth study and did not also consider the core Niger Delta in which the present study is assessing and the gap being filled by the present study. The study therefore examined the spatial assessment of the relationship between the social vulnerability and resilience to flooding in the core Niger Delta.

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. The entire South-south comprises AkwaIbom, Bayelsa, Cross River, Delta, Edo and Rivers States with a total spatial extent 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 et al., 1995). The region is divided into four ecological zones namely coastal inland zone, mangrove swamp zone, freshwater zone and lowland rain forest zone (Awosika et al., 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.

Types and sources ofdata

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 socio-economic 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.

Sampling techniques

The study employed the multistage sampling technique involving three steps. 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. This technique enabled copies of structure questionnaire to be successfully administered to households in the selected States. This technique was chosen and employed due to the poor arrangement and numbering of houses in the coastal areas. As such, in each chosen street, the second building was chosen for questionnaire administration after which the fourth was picked in that manner. The interval between each surveyed household was three. Also, only one household head (male or female) was selected for the survey.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue X October 2023

Sample size

In order to have a representative survey sample of the population across the selected states, the sample size was determined using Yamane's formula (1967). The Yamane, Taro's formula is as follows:

$$n = \frac{N}{1+N(e)^2} \quad \text{.....eqn (1)}$$

Where: n = sample size; N = Definite population of coastal communities in the selected states; e = level of precision or confidence level $(0.05)^2$

$$n = \frac{1{,}768{,}487}{1+1{,}768{,}487 \times (0.05)^2}$$

$$= \frac{1{,}768{,}487}{1+1{,}768{,}487 \times 0.0025}$$

$$\frac{1{,}768{,}487}{1+4421.22}$$

$$= \frac{1{,}768{,}487}{4422.22}$$

$$= 399.9$$

$$= 399.99$$

$$n \approx 400$$

Since the sample size is 400 for the vulnerable, frontline and coastal LGAs across the three States (Bayelsa, Rivers and Delta). But from field observation and experiences, not all questionnaire administered in the field would be retrieved back from the respondents and more so, some questionnaire may not be responded to. Therefore, the sample size was increased by multiplying the obtained figure by 2. The essence was to accommodate for these lapses. Hence, n = 2 × 400 = 800. The number of questionnaire copies administered to communities under States is shown in Table 1.

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

States	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

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue X October 2023

	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)

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, and multiple

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue X October 2023

regression analysis. The multiple regression analysis (MRA) was employed to show the relationship between socio-economic status of respondents and the social vulnerability level. It is modelled thus:

$Y = a + b_1X_1 + b_2X_2 \ldots + e \ldots$ .....Eqn (1)

Where:

Y = Dependent variable (household exposure to flood)

a = Y-intercept

$X_1 - X_5$ = Independent variables

X_1 = Sex

X_2 = Age

X_3 = Education

X_4 = Occupation

X_5 = Monthly income

$b_1 - b_5$ = Regression coefficients

e = Error term

At the core of the connection between social vulnerability and community resilience is the idea that one begets the other and therefore, categorical canonical correlation analysis (CCA) was used to check the validity of this concept (CCA).

Social vulnerability was assessed via households' responses to a questionnaire on exposure, susceptibility, and the adequacy of household response capabilities to floods. Flooding is a worry where my family lives, since my family is capable of recovering from floods. These three items on the questionnaire reflect three degrees of exposure, susceptibility, and adaptability capacity to flooding. Responses to 'I work with individuals in my community to tackle our challenges' include 'Community Flood Risk Management: My community has dealt with flood risk and I would want to be a leader in my community.' These sets of social vulnerability and core community resilience variables or indicators were selected due to their extreme levels of explanation. Three new community resilience factors and three new social vulnerability factors were identified, and their connections to each other are explained in detail as a consequence of this research.

Data transformation into dummies of 1 and 0 was performed on several items in the current investigation to make them suitable for parametric tests (Alkharusi, 2012; Deinne and Ajayi, 2017) such as multiple regression analysis and PCA. As a result, positive replies were given a 1 and negative ones were given a 0. For example, education was scored 1 for primary/secondary school and 0 for everything else; occupation was scored 1 for working (employed) and 0 for everything else; and so on. Also, items with responses ranging from strongly agree to strongly disagree on the Likert Scale were recoded into dummies of 1 for agree and 0 for disagree. As a result, replies of strongly agree and agree were assigned a value of 1, while others were assigned a value of 0. (Strongly disagree and disagree). Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) Version (22.0) for Windows and excel spreadsheet.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue X October 2023

RESULTS AND DISCUSSIONS

Socioeconomic Characteristics of Respondents

Table 1 examines the socio-economic and demographic characteristics of the households across the study area. Survey respondents' socioeconomic characteristics influence coastal cities' flood vulnerability and resilience, as well as their ability to adjust to chronic climate disasters. The socioeconomic position of the respondents is shown in Table 1. According to the gender split, men dominated the survey. 65.7 percent of respondents were males, while 34.3 percent were women. Most responses (86.2%) were aged 21 to 60, followed by those older than 7.4 years, while those less than 20 years old made up the smallest proportion (6.3%).

Singles and married individuals were the most common responses in all of the states examined. Most respondents (51.7 percent) had spouses or partners and lived in the coastal region with their families. 24.7% of respondents were single, while the remainder had one or more marital difficulties. Married individuals dominated the poll, according to the results. The educational level of the respondents ranged from elementary school to advanced degrees. Primary education was held by the majority of respondents in all states (40.5 percent), with secondary and higher education following closely behind with 39.2 and 20.3 percent respectively Rivers has the greatest proportion of people with a secondary education among the states examined. Compared to Bayelsa, Delta has more persons having a primary certificate. Most respondents (79.7%) completed both elementary and secondary education, the findings indicate. According to Table 1, the majority of respondents (57.8%) make $8,000 per month, followed by those earning $9,000 – $40,000 per month, and 10.3 percent earning $41, 000 – $80, 000 monthly; 5.5 percent earning 81, 000 – 120, 000 monthly; and 3.8 percent earning 121, 000 – 150, 000 monthly. Across the states, a similar pattern in monthly income was seen. In terms of occupation, the survey discovered that a higher number of respondents were in the service industry (47.6 percent) were not unemployed; 14.4% were involved in petty trading, farming, artisans, and other menial jobs to make ends meet; 13.8 percent were unemployed and not ready to work or seek work; 13.9 percent were employed but only part-time; and 10.3 percent were involved in petty trading, farming, artisans, and other menial jobs to make ends meet; and 13.8 % of the population was jobless and unable to find employment. According to data from throughout the states, the majority of the populace is unemployed and willing to work. Only 38.6% of all respondents are working part-time, full-time, or self-employed. 74.5 percent of respondents had spent or resided in the region for more than 20 years, according to statistics on years of residency; 13.1 percent had spent or lived in the area for 10 – 20 years; and 12.3 percent had spent or lived in the area for 10 years.

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

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue X October 2023

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
Occupation	Not currently employed and not looking for job	20.9	6.9	11.6	13.8
	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

Relationship between Social Vulnerability and Core Community Resilience

A substantial relationship between social vulnerability and core community resilience in the study region is presented in this section. Tables 3 through 6 show the findings. Table 3 contains data on which a significance test may be conducted. It was determined that the test had a meaningful outcome ($p<0.05$). There is thus a significant result from a canonical correlation test. A 5 percent confidence level confirms the significance of the three recovered canonical roots, variate or functions. The eigenvalue ratio, which provides a relative measure or variance on the importance of the three canonical correlations, is also included in 15. It is also known as canonical roots.

Because it explains the most variance in the data set, the first canonical variate/correlation is more meaningful than the second and third canonical variates, and so on. According to the findings, the first canonical variate also explains 23.6 percent (0.486 x 0.486) of the variation in the dependent canonical variable. The second canonical variate (0.087 x 0.087) explains 0.8 percent of the variance in the second dependent canonical variable, and the third canonical variate (0.087 x 0.087) explains 0.2 percent of the variance in the third dependent canonical variable. (0.040 x 0.040).Furthermore, Table 6 shows that among the three canonical correlations, only the first canonical variate is significant ($p<0.05$), suggesting that only

Furthermore, using the threshold of 0.5, the canonical loadings in Table 6 indicate that just the first canonical variate or root is utilized to infer the inherent connection between social vulnerability and core community resilience. The canonical loadings for social vulnerability factors on the first canonical function revealed that level of exposure (0.575) and adaptive capacity (0.823) had high correlations, whereas only community resources/governance (0.551) For core community resilience factors, the first canonical function exhibited a strong correlation. As a result, on the first canonical function, the quantity of exposure and adaptation capacity has a positive connection with community resources/governance. The second and third canonical functions were not obtained because the loadings on fundamental community resilience variables were less than 0.5. The finding in Table 6 simply shows that community resources and governance are positively associated to household exposure and adaptability ability.

Table 3: Multivariate Statistics and F Approximations: Test of Significance

Statistics	**Value appox.**	**F-value**	**d.f.**	**p-Values**
Wilks' Lambda	0.757	20.56	9	0.001
Pillai's Trace	0.246	18.67	9	0.001
Hotelling-Lawley Trace	0.319	22.15	9	0.001
Roy's Greatest Root	0.310	64.81	3	0.001

Table 4: Eigenvalues and Canonical Correlations

Root no.	**Eigenvalue**	**Pct.**	**Cum. Pct**	**Canon. Corr**	**Sq. Cor**
1	0.310	0.971	0.971	0.486	0.236
2	0.008	0.024	0.995	0.087	0.008
3	0.002	0.005	1.000	0.040	0.002

Table 5: Dimension Reduction Analysis

Root no.	**Wilks lambda**	**F-tests**	**d.f. error**	**d.f.**	**p-Value**
1	0.757	20.56	9	1523	0.001
2	0.991	1.45	4	1254	0.215
3	0.998	0.99	1	628	0.321

Table 6: Result of Canonical Correlation Analysis [a]

Variables	**Canonical loadings/structure**		
	1	**2**	**3**
Social vulnerability variables			
Level of exposure	-0.575	0.487	0.954
Level of susceptibility	-0.132	0.720	0.842
Adaptive capacity	0.828	0.662	0.124
Core community resilience variables			
Community cohesion	0.499	0.182	-0.120
Community resources/governance	0.551	-0.111	-0.367
Community goals	0.320	-0.162	0.385

[a]Variables underlined with canonical loadings ≥ ±0.50 are considered significant

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue X October 2023

Social cohesion/cooperation is the third key component that influences community cohesion and connectedness in flood disaster management. Societal cohesion, according to Townshend et al. (2015), has been proven to provide communities with some resilience. The prosperity of a community depends on its ability to work together to achieve a common goal. When it comes to environmental problems, a united community can speak with a more unified voice. The community will be able to work with government and private-sector groups to improve flood disaster management. They will be able to gather both local and distant financial resources, allowing them to implement flood-prevention measures that are appropriate for their location. Researchers found that individuals came together because of their strong ties to the community to deal with their losses and flooding. This new study shows that individuals recognise the significance of community unity at the initial stage of flooding, and that their feeling of community unity increases along with the danger intensity.

DISCUSSION AND SUMMARY OF FINDINGS

The findings revealed that level of exposure and adaptive capacity had high correlations with community resilience. For the flood exposure, it is expressed in Lee and Jung, (2014), Rolfe et al, (2020) and Tate et al. (2021) that it is always higher for social vulnerable populations especially for inland floods. Social vulnerability results when social, political and economic process combines to produce heightened susceptibility to hazards for some populations (Cutter et al. 2003; Emrich and Cutter 2011). Vulnerable groups often inhabit flood-prone areas due to societal barriers related to social stratification, and their exposure has been examined in the USA (Adeola and Picou 2012; Lee and Jung 2014) and around the world (Kaźmierczak and Cavan 2011; Rolfe et al. 2020). Spatial indicators are regularly applied to measure and model dimensions of social vulnerability with respect to age, race, poverty etc and can deepen the understanding of the social dimensions of flooding. It thus means that higher exposure can lead to greater susceptibility to impacts for socially vulnerable groups during flood disasters (Cutter et al., 2014). Numerous empirical studies have evaluated this notion using post-disaster damage and related socio-demographic information (Laska and Morrow 2006; Adeola and Picou 2012; Kamel 2012; Emrich et al. 2020). Collectively, these studies found multiple characteristics of vulnerable populations (e.g., race, poverty, unemployment, lower income) to be associated with more adverse outcomes.

The findings that flood exposure and adaptive capacity possessed high correlation with social vulnerability resilience is in consonance with Cinner et al, (2013) and Martins and Gasala (2020) in which it was deduced that in the environmental change context, vulnerability is typically measured as a component of sensitivity, exposure, and adaptive capacity. It was known that sensitivity is the state of susceptibility to harm from perturbations or long-term trends (Adger, 2006; Allison et al., 2009) and the sensitivity of socio-ecological system is usually defined as the intrinsic degree to which economic, political, cultural, and institutional factors are likely to be influenced by extrinsic stresses or hazards (Allison et al., 2009). Adaptive capacity is the ability of individuals to anticipate and respond to changes, or to cope, reduce and recover from the effects of the climatic stressor (Gallopin, 2006); which means, those with low adaptive capacity are expected to have difficulty adapting to change or seeing opportunities that climate change may create in the availability of resources and services (Cinner et al., 2013).

CONCLUSION AND RECOMMENDATIONS

The study concluded that the relationship between social vulnerability and resilience to flooding in the Core Niger Delta are determined by flood exposure, adaptive capacity and community resources/governance. It therefore recommended among others that government should organize workshops and seminars with relevant stakeholders in coastal communities to constantly educate them on the dangers of building structures in flood prone areas while residents must be advised to create ways to increase their flood-adaptive capabilities at the communal level. Furthermore, to alleviate the impacts of food shortage, effective

leadership at the community level must be created by engaging the entire family's assistance in flood-prevention measures (financial contribution and manual labour) especially those that are highly exposed to flooding with less adaptive measures. With community involvement, adequate flood control measures may be put in place, boosting home flood adaptive capability. For example, cash donations help the community to quickly mobilize to alleviate the disastrous effects of flooding before obtaining official aid. Communities can now handle flood consequences without having to rely on the government. The amount of exposure and adaptation ability to flood is influenced by community involvement, which is defined by community resources/governance.

REFERENCES

1. Adeola FO, Picou JS (2012) Race, social capital, and the health impacts of katrina: evidence from the Louisiana and Mississippi gulf coast. Hum Ecol Rev 19:10–24.
2. Adger, W. N. (2006). Vulnerability. Glob. Environ. Change 16, 268–281.
3. Allison, E. H., Perry, A. L., Badjeck, M. C., Adger, W. N., Brown, K., Conway, D., et al. (2009). Vulnerability of national economies to the impacts of climate change on fisheries. Fish Fish. 10, 173–196. doi: 10.1111/j.1467-2979.2008.00310.x
4. Bergstrand, K.; Mayer, B.; Brumback, B.; Zhang, Y. Assessing the Relationship between Social Vulnerability and Community Resilience to Hazards. Soc. Indic. Res. 2015, 122, 391–409
5. Cinner, J. E., Mcclanahan, T. R., Wamukota, A., Darling, E., Humphries, A., Hicks, C., et al. (2013). Social-Ecological Vulnerability of Coral Reef Fisheries to Climatic Shocks. Rome: FAO.
6. Cutter SL, Boruff BJ, and Shirley WL (2003) Social vulnerability to environmental hazards. SocSci Q 84:242–261. https ://doi.org/10.1111/1540-6237.84020 02
7. Cutter SL, Finch C (2008) Temporal and spatial changes in social vulnerability to natural hazards. Proc Natl AcadSci 105:2301–2306
8. Cutter SL, SchumannEmrich RLCT (2014) Exposure, social vulnerability and recovery disparities in New Jersey after Hurricane Sandy. J Extrem Events 1:1450002
9. Emrich CT, Tate E, Larson SE, and Zhou Y (2020) Measuring social equity in flood recovery funding. Environ Hazards 19:228–250. https ://doi.org/10.1080/17477 891.2019.16755 7
10. Gallopin, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. Glob. Environ. Change 16, 293–303. doi: 10.1016/j.gloenvcha.2006.02. 004
11. Kaźmierczak A, Cavan G (2011) Surface water flooding risk to urban communities: analysis of vulnerability, hazard and exposure. Landsc Urban Plan 103:185–197. https://doi.org/10.1016/j.landurbplan.2011.07.008
12. Laska S, Morrow BH (2006) Social vulnerabilities and Hurricane Katrina: an unnatural disaster in New Orleans. Mar TechnolSoc J 40:16–26
13. Lee D, Jung J (2014) The growth of low-income population in floodplains: a case study of Austin, TX. KSCE, J CivEng 18:683–693. https://doi.org/10.1007/s12205-014-0205-z
14. Martins IM and Gasalla M.A. (2020): Adaptive Capacity Level Shapes Social Vulnerability to Climate Change of Fishing Communities in the South Brazil Bight. Front. Mar. Sci. 7:481. doi: 10.3389/fmars.2020.00481
15. Nkwunonwo, U. C. (2017). Assessment of Social Vulnerability for Efficient Management of Urban Pluvial Flooding in the Lagos Metropolis of Nigeria. Journal of Environmental Studies (1): 11.
16. Nofal O. M. &. van de Lindt J. W. (2020): Understanding flood risk in the context of community resilience modeling for the built environment: research needs and trends, Sustainable and Resilient Infrastructure, DOI: 10.1080/23789689.2020.1722546
17. Rolfe MI, Pit SW, McKenzie JW et al (2020) Social vulnerability in a high-risk flood-affected rural region of NSW Australia. Nat Hazards. https ://doi.org/10.1007/s1106 9-020-03887 –z
18. Rufat S, Tate E, Burton CG, Maroof AS (2015) Social vulnerability to floods: review of case studies and implications for measurement. Int J Disaster Risk Reduct 14:470–486. https ://doi.org/10.1016/j.ijdrr.2015.09.013

19. Tate, E., Rahman, M.A., Emrich, C.T. et al. Flood exposure and social vulnerability in the United States. Nat Hazards106, 435–457 (2021). https://doi.org/10.1007/s11069-020-04470-2