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VULNERABILITY TO FLOODING OF COMMUNITIES ALONG EPIE CREEK, YENAGOA, BAYELSA STATE

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Abstract

The study on the vulnerability to flooding of inhabitants of Epie Creek area was investigated. The study considered some physical factors which can expose inhabitants of an area to flooding. Hence, data on flood height reached on buildings and the elevation above MSL and the spatial variation in the dimension of flood waters around peoples' dwelling places with reference to the stream channel (Epie Creek) was evaluated using inferential and descriptive statistics. The results of the analyses showed that areas within Ekeki, Amarata and Onopa are identified to be more at risk of flooding due to the height of flood waters reached on buildings. But the results of the elevation of the area slightly differs as areas within Yenezue-Epie-Okaka and Etegwe-Okutukutu are found to be relatively lower (9.5m) than other areas and are expected to be more vulnerable to flooding. Thus, there was no significant correlation between flood height and the elevation of the area above MSL. Hence, the flood height reached on buildings at different location is not directly caused by elevation. On the flood dimension in the area, the study has shown that 'proximity'is a major factor that exposes the inhabitants of Epie Creek to flooding especially for those whose dwellings are located close to the channel. Hence, the study recommends the total relocation of people living very close to the Epie channel to allow for better planning of the area.

Keywords: Risk, Vulnerable, Proximity, Expose, Flooding.

Introduction.

Vulnerability has been defined as the degree to which a system (or part of it) reacts adversely to the occurrence of a hazardous event (Proag, 2014). The term has also been viewed to mean the propensity (ability/capacity) of an exposed

element such as human beings; their livelihood(s) and assets to suffer adverse effects when impacted upon by hazard event (Cardona, et al, 2012). Thus, from the definitions above, it is obvious that,an element or a system can be vulnerable to a particular hazard whenits capacity or ability to cope with the hazard is not enough and hence; resulting to a collapse of the system. Thus, Lungren and Jonsson (2012) have clearly described the term 'vulnerability' to mean the capacity of the element or system to anticipate, cope with and/or recover from disasters which usually unequally distributed in the environment.

Considering the above explanations therefore, it is expedient to state that, vulnerability is a measure of a system's ability or capacity to anticipate the presence of the hazard (potential disaster), ability to cope with the hazard when disaster strikes and; the ability or capacity to recover or recuperates from the effect(s) of the disaster. Therefore, once a system's ability to anticipate or predict potential disaster is high, it would enable it prepare to withstand the effects that may arise.

It is worthy to note that man cannot be free from one form of a hazard or the other because; every location on the earth's surface has a unique type of hazard that may pose difficulties within that environment. For instance, those living in mountainous areas are mostly exposed to landslides and other erosion effects. Those living close to the seashores are exposed to ocean surge, tsunami, hurricane and so on. In the same way, those who live within floodplains of rivers are exposed to flooding and other erosion and depositional effects.

Flood is the most common natural disaster which can occur anywhere but the hazard is mostly endemic where water flows such as along the banks of rivers, lakes and other forms of streamflow. Thus, flood as a natural disaster has been described to occur when the volume of flowing along a defined path (such as river channel) exceeds its confinement thereby overflowing the banks to cover the adjacent lands (Digha & Obiene, 2012). Hence, Liao (2012) has noted that, flood are natural hazards which posses challenges to towns and cities located along rivers. It went further to state that despite the fact that most cities in developed

countries have built strong flood protection structures (e.g, Bangkok, Thailand, New Orleans, e.t.c), but are yet to escape from the effects of the hazard due to their location.

From the above explanation and as pointed out in Umeuduji (2017); it is obvious that people living close to source of water (such as rivers and lakes) are more at risk to flooding despite the lots of opportunities opened to those that inhabits such environment. Thus, it is expedient that those who live close to rivers are to prepare to adapt to flood hazard. But studies have revealed that hazard is contextual. That is to say, it differs from place to place and even within a particular environment; the vulnerability of people differs from point to point depending on the capacity of those who are exposed to the hazard (Kelman, 2007; Adelekan, 2010).

People's vulnerability have been said to differ from person to person and from location to location which depends on the 'resilience' of the people being affected. Thus, the resilience of a system has been defined as the measures adopted by the system to enable it adapt or survive in the hazard prone area. According to Adelekan, (2010) vulnerability indicators to flood hazards can be grouped into; i) physical (rainfall characteristics, landscape of the area, e.t.c); ii) Social/economic(income level, land-use, resident type, e.t.c), iii) resilience (preparedness, coping/recovery e.t.c). Most studies have focused on the various indicators of vulnerability (e.g Digha & Obiene, 2009; Kenji, 2004; Efobi &Christopher, 2013; Collins, 2014) but much attention has not been given to the contributions of the physical landscape and the proximity of peoples' residence to the source of water. Thus, this study was aimed at assessing those physical factors that exposes the inhabitants of the area to flooding.

Methodology

The study area comprises communities along Epie Creek which is located within the Yenagoa Metropolis. The area covers betweenLatitude 4^0 50^1N to 5^0 05^1N and $6^0 15^1$E to $6^0 30^1$E (Izonfuo & Bariweni, 2001). The Epie Creek is drained partly by

the Orashi River and the Tailor Creek. The Epie Creek flows across 16 communities and empties into the Ekole River (Bayelsa State). Historically, like other bigger towns and cities worldwide, all the communities of Epie origin are located linearly along this channel (Epie Creek).Before now, the major occupation of the people in the area was farming and fishing owing to the presence of water and the fertile lands adjacent to the stream channel. Due to the annual flooding experienced in the area, major crops cultivated include; cassava, water yam, cocoyam, maizeandvegetables.

Just like other areas within the central Niger Delta of Nigeria, the study area is flood prone owing to the presence of the river channel (Epie Creek) and its tributaries. The tributaries of Epie Creek are found to connect the back-swamps which are located a few distances from the main channel. A careful observation of the terrain shows that, the back-swamps have served as natural water reservoir which stores large volumes of water and discharge the excess into the main trunk during the wet season. Hence, the only land area that may seem to be dry is found between the main stream channel and the back-swamps.

It was also observed that, the geomorphology of the study area was naturally sculptured to drain excess water from the strip of land inhabited by the people (which is not normally submerged by water) thereby keeping it safe from being flooded. Hence, all those who first occupied this area were relatively safe from the effects of flood. This remained the situation of the area until few years after the creation of Bayelsa state when development started creeping into the deep swamps due to urbanization. Today, urbanization has encroached major parts of the back-swamps thereby disconnecting the link between the natural reservoirs and the main stream channel (Epie Creek). This situation alongside other urbanization problems has led to the silting of the main trunk which has exacerbated the flood situation of the area.

Since Vulnerability is contextual, therefore, this study has carried out investigation on the level of vulnerability at different location taken reference from the main stream channel. The study also focused on the flood extent and

depth at the different location and how the inhabitants are able to cope with the effect of floods during and after the event. This was investigated through careful observation and the use of a well structured questionnaire design to sample opinion from 857 inhabitants covering the 16 communities across the study area.

STUDY AREA

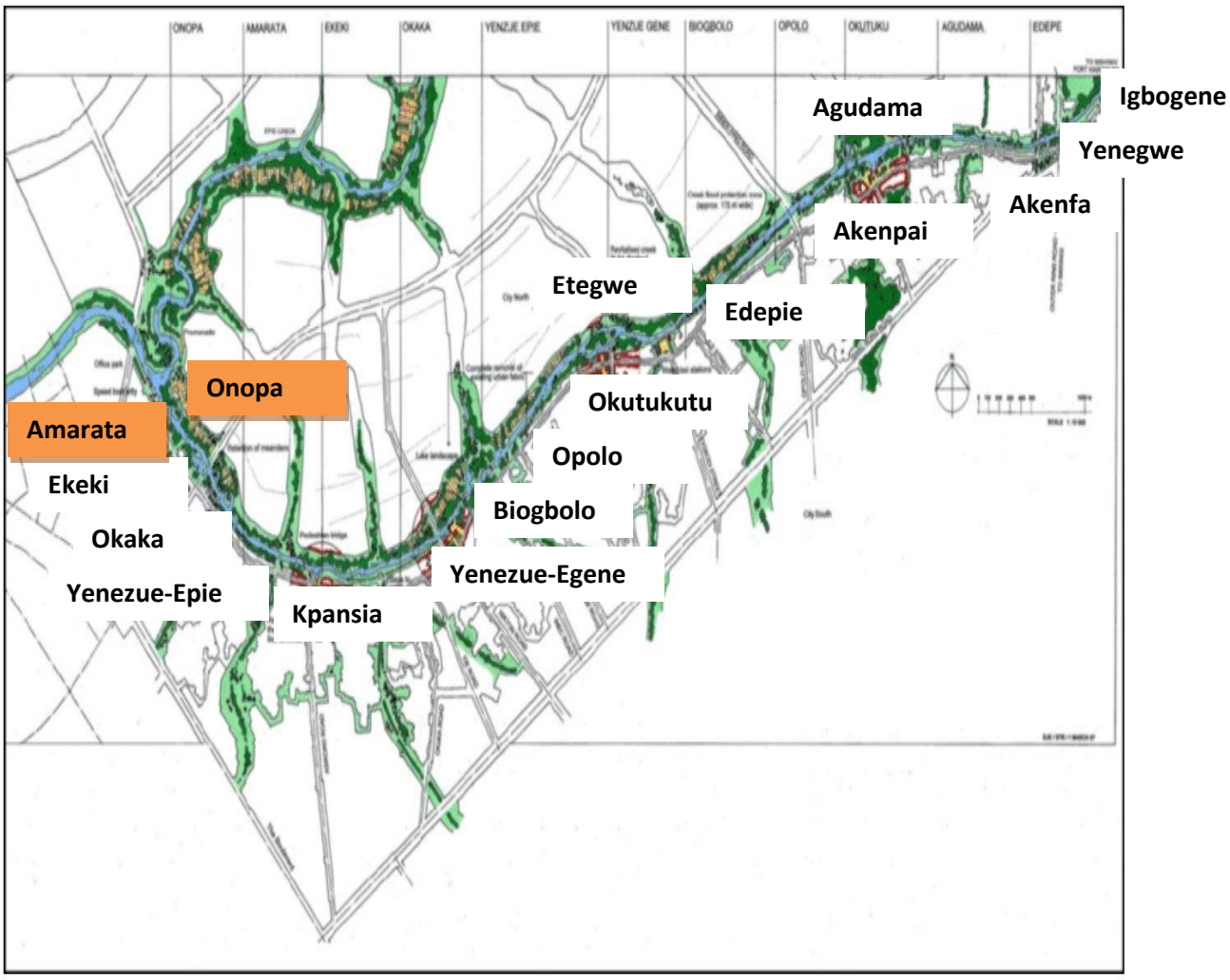


Fig. 1. Map Showing Communities along Epie Creek

Results and Discussion

Vulnerability of the inhabitants of the area.

i). Flood height/Elevation of the Area: two factors were considered which include; *flood height reached during 2022 flood event and the elevation of the area above mean sea level (MSL)* as shown in table 1.Results showed that the flood height ranges between 1.6m and 3.2m. Thus, areas within Ekeki, Amarata and Onopa were found to be more at risk of flooding followed by areas within Opolo to Biogbolo due to the relatively higher level of flood water than other areas (See Fig 2).

On the elevation, results have shown that the area stands between 9m and 12m above MSL where areas within Yenezue-Epie-Okaka and Etegwe-Okutukutu are found to be relatively lower (9.5m) than areas within Igbogene-Yenegwe (13m), Akenfa-Agudama (12m) and Opolo Biogbolo (11.5m)above MSL.But on the whole, the elevation of the area has been seen to decrease downstream from Igbogene to Onopa as shown in figure 3.

The results of the study have shown that elevation above mean sea level is a major factor that exposed the communities along Epie Creek to flooding. This is because, the areas with higher record of flood height depicts areas with lower elevation above MSL. Data on the flood height reached on buildings and that of elevation of the area above MSL were correlated using the product moment correlation coefficient (r_{xy}). This was carried out by adopting the formula as suggested in Aguwa and Onyenaobiya (2014) and presented in equation 1;

$$r_{xy} = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{\{n\sum X^2 - (\sum X)^2\}\{n\sum Y^2 - (\sum Y)^2\}}} \quad 1.$$

(***Where; X=Height of flood reached on buildings, and Y=Elevation of the area***)

The results of the correlation analysis showed a positive relationship (***r_{xy} =0.098)*** between the two sets of variables X and Y. A test of significance relationship using the t-test (tcal= r√***n-2/1-r)*** showed a no significant correlationbetween the two sets of variables (X, Y). This result further showed that the elevation of the area does not decrease or increase down /up the stream but alternates. This can be confirmed from the figure 2 where, the surface elevation of the area was seen to decrease from Igbogene to Etegwe but elevation starts to rise from Opolo and drops back within Yenezue-Epie/Okaka.

The same scenario was observed for the data on the height of flood water on buildings where, the flood height was found to be relatively constant but drops within Etegwe/Okutukutu area but increases within Opolo but drops again within Yenezuegene to Okaka area.This further implies that, the level of flood (height) in the area is not directly determined by the elevation of the area above MSL. This means that the vulnerability to flooding of the area(in terms of flood height) is not directly caused by the low surface elevation with reference to MSL but other intervening variables may be responsible. Thus, while both variables can influence the vulnerability of inhabitants of the area to flooding, one may not directly be the cause to the other.

Table. 1. Flood Height Reached on Buildings and Elevation above MSL of Communities along Epie Creek

Community	Igbogene/Yenegwe	Akenfa/Agudama	Akenpai/Edepie	Etegwe/Okutukutu	Opolo/Biogbolo	Yenezue-gene/Kpansia	Yenezue-Epie/Okaka	Ekeki/Onopa
Flood height on building (m)	**2.01**	**2.15**	**2.18**	**1.62**	**2.82**	**2.20**	**2.28**	**3.16**

Elevation above MSL (m)	**13.00**	**12.00**	**10.50**	**9.50**	**11.50**	**10.50**	**9.50**	**10.60**

(Source: Author's Fieldwork, 2024)

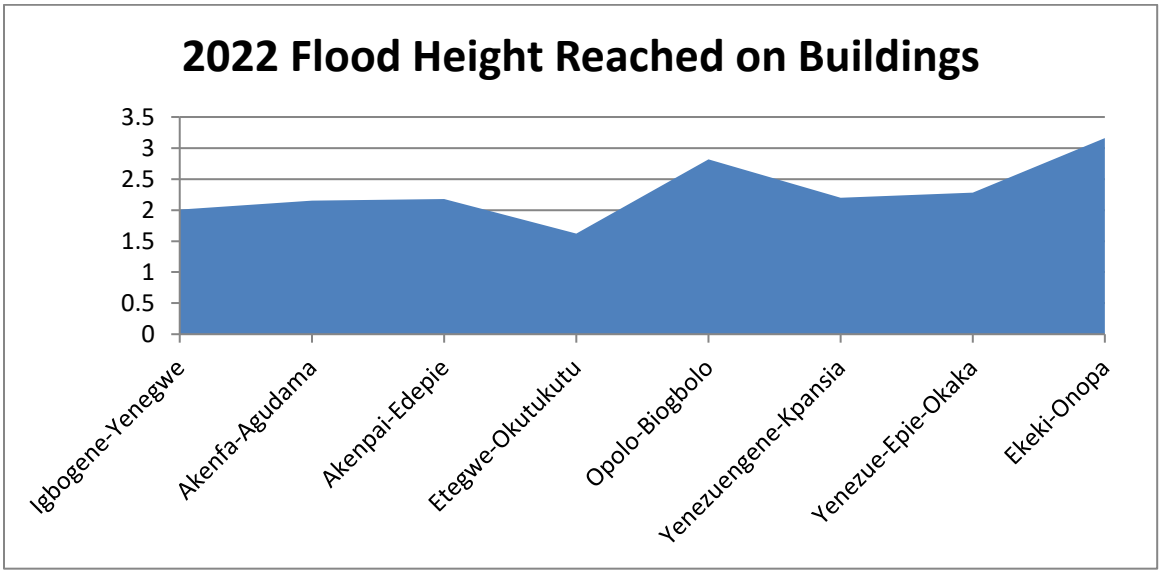


Fig. 2. Flood Height Reached on Buildings in Communities along Epie Creek During 2022 Flood (Author's Fieldwork).

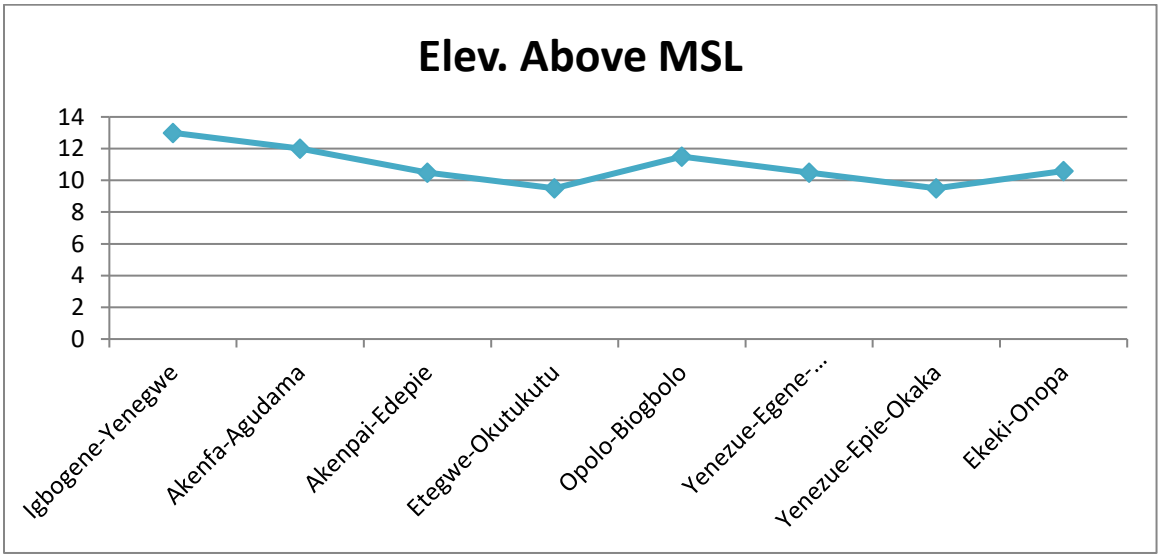


Fig.3: Elevation above mean sea level of Communities located along Epie Creek. (Source: Author's Fieldwork, 2024).

ii) Dimension of Flood waters Around Buildings Located at Distance to Epie Creek.

The vulnerability to flooding of communities along Epie Creek was also measured in terms of the dimension of flood waters usually found around dwellings of inhabitants of the area. Thus, the frequency of occurrence, the extent of spread and the duration (resident period) of flood waters around dwellings of inhabitants were assessed. Hence, peoples' opinion were sampled using well structured questionnaire to assess the vulnerability of four (4) categories of inhabitants with reference to the proximity to the river channel namely, those whose dwellings are located *very close,close,far*, and *very far* from the channel. Table 2 shows the number of respondents (857) used for the analyses and their location with reference to the river channel.

Table 2. Location of Respondents at Distance to the Epie Creek.

Proximity	Very Close	Close	Far	Very Far	Total
No. of Respondents	243	351	143	120	857
% Response	28.3	41.0	16.7	14.0	100

Results from table 3 has shown that about 69% of the respondents lives close to the channel while only about 31% were located far from the channel. This shows that greater percentage of the inhabitants of the area choose to live closer to the river channel owing to numerous benefits that may be derived from the source of water as suggested in Umeuduji (2017). Haven gotten the location of inhabitants of the area, the study then sampled their opinion on the dimension of floods in

terms of frequency of flood occurrence, spatial extent of flood water, and the duration of flood within and around their vicinity.

a) Flood Frequency within and around Buildings

Peoples' opinions on the degree of occurrence of flood in the area were sampled and results shown in table 4A. From the responses; about 75% of inhabitants of the area who lives close to the river channel reported to experiencing flooding '*very often'*while only about 25% of inhabitants who lives far from the river channel reported of that flooding in their area occurs *'very often'.* Again, those who reported to experience flooding 'often"; about 64% lives close while 35%lives far from the channel.

Meanwhile, for those who reported to be experiencing flooding 'not too often'; 63% of them lives close and very close while about 37% of those who lives far reported that they experience flood not too often. Lastly, of the 13% of those who cannot explain the flood situation in the area, 51% lives close and very close while about 49% lives far and very far from the channel.

Therefore, it is expedient to note that, proximity to the channel is a major factor that exposes the inhabitants of Epie Creek to flooding where, people whose building are located closer to the channel are expected to be more at risk of flooding than those living far. See table 3A.

Table 3A. Proximity and Flood Frequency Around Buildings Along Epie Creek.

Proximity to Channel	No. of Respondents (%)	Very often (%)	Often (%)	Not too Often (%)	Cannot Explain (%)
Very Close	243 (28.30%)	69 (33.17%)	102 (27.13%)	41 (25.32%)	31 (27.93%)
Close	351 (41.00%)	87 (41.83%)	177 (47.07%)	61 (37.65%)	26 (23.42%)
Far	143 (16.70%)	34 (16.35%)	54 (14.36%)	28 (17.28%)	27 (24.32%)
Very Far	120 (14.00%)	18 (8.7%)	43 (11.44%)	132 (19.28%)	27 (24.32%)
Total	857	208	376	162	111

%	100	24.28%	42.87%	18.90%	12.95%

Source: Authors' Fieldwork (2024).

b) Proximity and Flood Extent around Buildings.

This was measured in terms of coverage of flood waters around premises. The table 4B showed that out of the 34.19% of those who reported that flood waters surrounds the whole premises (buildings); about 65% lives very close and close to the river channel, while only 35% lives far and very far from the channel. For those who reported that flood waters covers two-third of their premises; 60% of them live close and very close to the channel while the remaining 35% lives far and very far from the channel. Again, for those who reported that flood water covers half of their premises, more than 75% of them live very close and close to the channel while only less than 25% of them live far and very far from the channel. Also, for those who reported that flood water covers only a small portion of their surroundings; more than 60% lives very close and close to the channel while less that 30% lives very far and far from the channel.

Following the above, it has been revealed that although, there is variations in the spread of flood waters even amongst those who live close to the river channel; the results have shown that proximity to the channel is a major determinant that exposes the inhabitants of the area to flooding. Thus, those whose surroundings are located close to the channel are expected to be more at risk of flooding with regards to the spread of flood waters within their surroundings than those whose buildings are located far from the river channel.

Table 3B. Proximity and Flood Extent around Buildings along Epie Creek

Proximity to Channel	No. of Respondents (%)	Surrounds whole Building (%)	Surrounds 2/3 Building (%)	Surrounds 1/2 Building (%)	Surrounds only small portion (%)

Very Close	243 (28.30%)	83 (28.33%)	74 (25.0%)	48 (30.97%)	38 (33.63%)
Close	351 (41.00%)	109 (37.20%)	135 (45.61%)	70 (45.16%)	37 (32.74%)
Far	143 (16.70%)	53 (18.09%)	50 (16.89%)	21 (13.55%)	19 (16.81%)
Very Far	120 (14.00%)	48 (16.38%)	37 (12.50%)	16 (10.32%)	19 (16.81%)
Total	857	293	296	155	113
%	***100***	***34.19%***	***34.54%***	***18.09%***	***13.18%***

Source: Authors' Fieldwork (2024).

c) Proximity and Flood Duration around Buildings

The duration of flood waters in terms of the resident period of water within the premises of inhabitants of Epie Creek has been assessed from opinions of residents with reference to their location with distance from the channel. Thus, out of the 38.86% of those who reported that flood water lasts for a period between one to two months; more than 80% of the respondents live very close and close to the channel while, less than 20% live far and very far from the channel. For those who reported that flood water resides within a space of one month; again, more than 70% live very close and close to the channel while, less that 30% live far and very far from the channel.

Also, for those who reported that flood water resides for a period of less than one month; about 52% of them live close and very close to the channel while, about 40% lives far and very far from the channel. Also, out ofabout 8.4% of those who reported that the water resident period is not well known; about 59% live very close and close o the channel while, about 40% live far and very far from the channel. With the results presented in table 3C, it is imperative to state that proximity to Epie Creek is another factor that contributes to the vulnerability of the people living in the area.

Table 3c. Proximity and Flood Duration around Buildings along Epie Creek

Proximity to Channel	**No. of Respondents (%)**	**1-2 Month (%)**	**Within 1-Month (%)**	**Less than 1-Month (%)**	**Unknown (%)**
Very Close	243 (28.30%)	105 (31.53%)	84 (33.20%)	40 (20.10%)	14 (19.44%)
Close	351 (41.00%)	166 (49.85%)	94 (37.15%)	63 (31.66%)	28 (38.89%)
Far	143 (16.70%)	32 (9.61%)	47 (18.58%)	45 (22.61%)	19 (26.39%)
Very Far	120 (14.00%)	30 (9.01%)	28 (11.07%)	51 (25.63%)	11 (15.28%)
Total	857	333	253	199	72
%	***100***	***38.86%***	***29.52%***	***23.22%***	***8.40%***

Source: Authors' Fieldwork (2024).

Conclusion and Reccommendations.

The results of the study on the vulnerability to flooding of communities along Epie Creek has shown that though, the area is generally prone to flooding, but the elevation above MSL has been found to contribute less to the inhabitants exposure to flooding. Instead, the peoples' *proximity* to the channel has been found expose the people to flooding. Thus, since vulnerability is contextual, the results of the study have shown that people whose buildings are located close to the Epie channel are more exposed to flooding than those whose dwellings are located far from the channel. It is expedient to also not that since, those whose buildings are located close to the channel experience floods more often and of greater coverage and resident period in terms of the duration of stay of the flood water in the area. Owing to the results, the study recommends the relocation of inhabitants living very close to the channel. This will not only reduce level of casualties during flood events but would enable the proper planning of the environment such as the canalization of the Epie Creek.

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