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Knowledge of Flood Causes as a Pre-requisite for Effective Early Warning Systems in a Rural Community of Kogi State, Nigeria

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ABSTRACT

Flood is one of the most devastating, frequently occurring and costliest natural hazard in the world. The establishment of early warning systems which could be a step in the right direction towards reducing this menace could be limited by the level of knowledge of the causes. This study was conducted to assess the social factors that could affect the efficiency of early warning systems using their respective relationships with the knowledge on flood causative factors in a rural community of Kogi State, Nigeria. A cross sectional study was conducted among 325 households in Oforachi community using quantitative method of data collection. Pearson's Chi Square Measure of Association and student t-test were used to assess the respective associations of the social factors with the level of knowledge using STATA/SE statistical software version 13.1 at 95% confidence level. The results showed that 8.00 % of the respondents had fair knowledge, 80.92% had good knowledge while, 11.08% had excellent knowledge of the causes of flood. The factors that influenced the knowledge level of the respondents in decreasing order of associations are Age, Education, Occupation, Flood experience, Marital Status and Ward. The knowledge of these associating factors will be very instrumental for the development of effective early warning signals and non-structural flood control measures.

Keywords: Association**,** Flood causes, Knowledge level, Oforachi, Rural community.

INTRODUCTION

Flood has been generally defined as the flow of water above the carrying capacity of a channel (Nwafor, 2006; Olajuyigbe et al. 2012; Zheng et al. 2017).There is a consensus of opinion that flood is one of the most devastating, frequently occurring and costliest natural hazard in the world responsible for over 30 % of all geophysical related hazards, accounts for about 31 % of economic losses globally and is responsible for about half of all deaths from natural disasters (Ohl and Tapsell, 2000; Ajin et al. 2013; Obeta, 2014; Komolafe et al. 2015). Among the various types of flood, the river or fluvial flood is directly connected to the ability of the stream channel to carry flood water (Ologunorisa and Adeyemo, 2005; Guo-hua et al. 2008).

In as much as there is a consistent occurrence of fluvial flood in various communities, the occurrence often takes the people by surprise. This may not be unconnected to the level of knowledge of the people on the occurrence of flood and its causative factors (Adelekan and Asiyanbi, 2016) which often times frustrates the establishment of preventive measures such as early warning systems. Various researches have been carried either by government agencies or independent researchers to assess the hazard and inundation (Daffi et al. 2014), social vulnerability (Adelekan, 2010; Adelekan, 2011) as well as elements and population at varying degrees of risk of flooding (Chen et al. 2011) at varying spatial scale. Little has been done to assess the level of knowledge of the people affected by this flood on the causative factors and the factors that may be responsible for possible variation in their knowledge level. It is however important to note that Flood Early Warning System is communication dependent (Greco and Pagano, 2017), thus the assessment of this knowledge becomes increasingly important as the shift from structural to non-structural measures of flood prevention and control is receiving increased attention among policy makers (Kundzewicz, 2002; Andjelkovic, 2001; Kreibich et al. 2017). More so, the absence of this information could increase their vulnerability to flood disaster. This study was carried out to assess the level of knowledge on flood causative factors and the factors that influence this knowledge as a pre-requisite for effective early warning systems in a Rural Community of Kogi State, Nigeria.

Materials and Methods

Study Area

This study was carried out at Oforachi Community covering Oforachi Ward I and II in Igalamela/Odolu Local Government Area of Kogi State, Nigeria (Fig. 1) between longitude 6^{o} 49' E and 6^{o} 57' E and latitude 7^{o} 06' N and 7^{o} 09' N (Alfa et al. 2018).The main river within the sub-basin (Ofu) is perennial and parallel in pattern to Imabolo and Okura rivers which are close to the study area. The area is nearly level to undulating with dominant slopes between 0 to 2% clay plains which are largely subject to seasonal water logging owing to impeded drainage (Alfa et al. 2018). The land within the study area is predominantly used for agriculture. The community is divided into nine (9) human settlements.

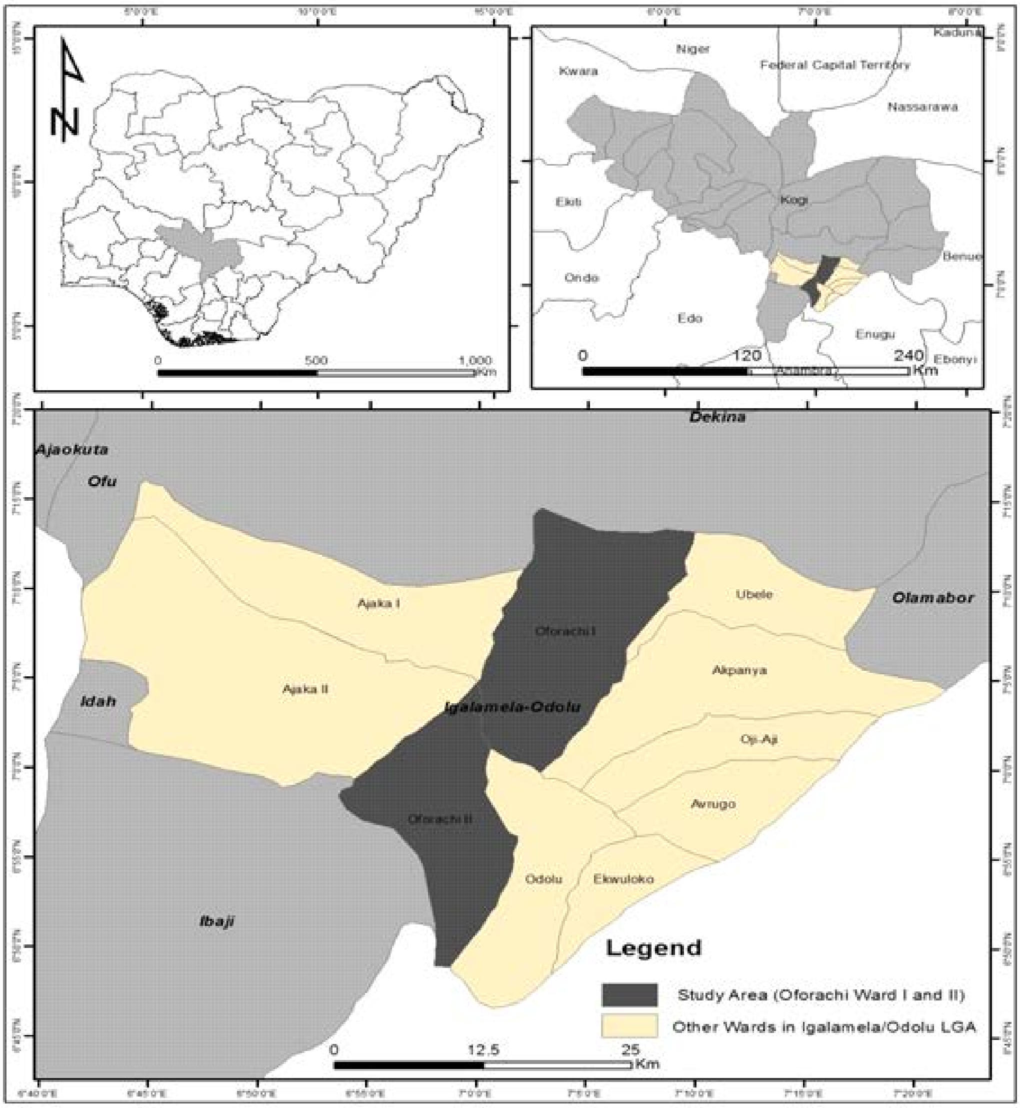

Fig. 1: Map of Nigeria showing Kogi State, Igalamela/Odolu LGA and Oforachi

Study Population

The study population comprised of all heads of households or representatives resident in Oforachi Community of Igalamela/Odolu Local Government Area (LGA) of Kogi State for a minimum of ten years.

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Study Design

A cross-sectional study was conducted among 325 household heads in Oforachi Community between September and October, 2016 using quantitative methods of data collection.

Inclusion and Exclusion Criteria

The study population included all household heads or the representatives who have been resident within the community for a minimum of ten years and consented to participate in the study, a household being a group of people living under the same roof and eat from the same pot. All household heads or representative who declined consent and scattered houses within the suburbs such as 'Fulani settlements' were excluded from the study.

Sample Size Determination

The sample size was estimated using sample size estimator developed by The Research Advisors (2006) for different Population sizes and different levels of confidence based on the method of Krejcie and Morgan (1970) expressed by eq. 1.

$$n = \frac{X^2NP(1 - P)}{d^2(N - 1) + X^2P(1 - P)} \quad (1)$$

Where, n = Sample Size

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level.

N = the population size.

P = the population proportion.

d = the degree of accuracy expressed as a proportion.

The total number of Households in Oforachi Community according to the records available at the Primary Health Care (PHC) centre is 616. A sample size of 320 was estimated at 99% level of confidence and 5% degree of accuracy. Thus, a minimum sample size of 325 was used.

Sampling Technique

A multi-stage sampling technique was used in this study. The first stage was the purposive selection of the Igalamela/Odolu LGA from the 21 LGAs in Kogi state being the LGA with the longest history of Ofu River flooding, followed by the selection of Oforachi Wards I and II (out of 10 political wards in the LGA) being the two wards that make up Oforachi Community. The selection of Oforachi Community was based principally on its history of being consistently flooded for over 20 years and secondly, on the basis of its accessibility and organisation relative to a few other communities which are quite dispersed, scattered and difficult to access.The final stage was the selection of the households proportionately from the selected ward. Household listing and enumeration was done to a total of 222, 62, 12, 99, 148, 12, 12 and 12 respectively for Oforachi, Okobu, Caterpillar, Atanegoma, Agwoko, Ojokuta, Ojoyibo, Ojuwo and Camp out of which 116, 32, 7, 20, 52, 77, 7, 7 and 7 were respectively selected. A consented household head was sampled and in the event that he or she declined, the next contiguous household was sampled. Computer generated list of random numbers from Minitab 14.2 statistical software was used to select the respondents for each of the settlements in this study.

Data Collection

A four part semi structured interviewer administered questionnaire was used for data collection in this study. The sections are; socio-demographic characteristics of respondents, geographic characteristics of households, historical flood characteristics and opinions of the causes of floods. The elevation and proximity of households to the river were the physical characteristics used. The elevation and coordinates of the households were obtained directly using a Garmin hand-held Global

Positioning System receiver model GPSmap 78sc. The coordinates were used to estimate the distance of the households from the river using ArcGIS 10.2.2 software. Reconnaissance visits were paid to the District Head and the Village Head of the Community to intimate them on the research and solicit for their support. Two Community Health Extension Workers (CHEW) and two teachers with a minimum qualification of National Certificate in Education (NCE) and one National Youth Service Corps (NYSC) member were trained as research assistants for field enumeration. The data collection instruments were pretested in Idah LGA prior to the commencement of the study. Ethical clearance was sought and obtained from the Postgraduate committee of the Department of Water Resources and Environmental Engineering, Ahmadu Bello University, Zaria. Verbal informed consent was obtained from all the respondents with confidentiality and anonymity of their responses assured.

Data Management and Analysis

In order to determine the level of knowledge of respondents on the causes of flood, seven questions designed on the five point likert scale was used. The seven causative factors were stated in the positive with the lowest score of 1 for 'strongly disagree' and the highest score of 5 for 'strongly agree'. The seven causative factors used are highway construction without adequate drainage, prolong rainfall, heavy rainfall upstream, embankment breach, loss in river carrying capacity due to sedimentation, terrain elevation and proximity of households from the river which are similar to those adopted by Guo-hua et al. (2008) and FitzGerald et al. (2010) although their study did not assess the knowledge of the people. A total score less than or equal to 21 (60%) was regarded as no knowledge, scores greater than 21 (60%) but less than or equal to 26.25 (75%) as fair knowledge, scores greater than 26.25 (75%) but less than or equal to 31.5 (90%) as good knowledge while scores greater than 31.5 (90%) was regarded as excellent knowledge. Respondents who have experienced flood had a score of 1 while those that have not experienced flood had a score of 0. Pearson's Chis Square test of independence was used to examine the relationship between the level of knowledge of the respondents respectively with Flood Experience, Ward, Gender, Age, Marital Status, Education and Occupation. The statistical analysis was carried out using STATA/SE statistical software version 13.1. $P < 0.05$ was considered statistically significant.

RESULTS

The socio-demographic characteristics of the respondents are presented in Table 1. Majority of respondents in this study 175 (53.85%) were from Oforachi Ward I while the remaining 150 (46.15%) were from Oforachi Ward II. A majority 234 (72%) were males while 91 (28%) were females. The age distribution shows that 6 respondents (1.85%) were between 26-30 years, 19 (5.85%) between 31-35 years, 54 (16.62%) between 36-40 years while a majority 246 (75.69%) were above 40 years. Furthermore, 279 (85.85%) respondents were married while 7 (2.15%) and 39 (12%) respondents were divorced and widowed respectively. An equal number of respondents of 90 (27.7%) had primary and Adult education respectively closely followed by secondary education held by 86 (26.5%) respondents while only 59 (18.2%) respondents proceeded to a tertiary institution. With respect to the occupation of respondents, a majority 206 (63.4%) were farmers, 58 (17.9%) were civil servants, 40 (12.3%) were traders, 14 (4.3%) were craftsmen while a minority 7 (2.2%) were involved in other occupations not listed in the options. Furhermore, a majority 125 (38.5%) respondents had spent between 31-40 years in the community, 106 (32.6%) for more than 40 years, 60 (18.5%) between 21-30 years while 34 (10.5%) had spent 11-20 years. Finally, the minimum household size was one while the maximum and mean sizes were 30 and 13±8.

Table 1: Socio-demographic characteristics of respondents

Character	Frequency	Percentage
Ward		
Oforachi I	175	53.85
Oforachi II	150	46.15
Total	325	100.00
Gender		
Male	234	72.00
Female	91	28.00
Total	325	100.00
Age (Years)		
26-30	6	1.85
31-35	19	5.85
36-40	54	16.62
Above 40	246	75.69
Total	325	100.00
Marital Status		
Married	279	85.85
Divorced	7	2.15
Widowed	39	12.00
Total	325	100.00
Highest Education		
Primary	90	27.69
Secondary	86	26.46
Tertiary	59	18.15
Adult Education	90	27.69
Total	325	100.00
Occupation		
Farming	206	63.38
Trading	40	12.31
Civil Servant	58	17.85
Craftsman	14	4.31
Others	7	2.15
Total	325	100.00
Length of Stay in Community (Years)		
11-20	34	10.46
21-30	60	18.46
31-40	125	38.46
Above 40	106	32.62
Total	325	100.00

	Minimum	**Maximum**	**Mean±SD**
Household Size (Persons)	1	30	13±8

SD = Standard Deviation

Furthermore, the historical characteristics of flood occurrence for the community surveyed are presented in Table 2.The results show that 197 (60.62%) respondents have ever experienced flood in their households while 128 (39.38%) have never experienced flood in their households.

Out of the 197 (60.62%) respondents

that have experienced flood, 104 (52.79%) had their first experience in 1991, 69 (35.03%) in 1995, 5 (2.54%) in 1997, 4 (2.03%) in 1999 while 15 (7.06%) had theirs in 2000. This implies that the households have been flooded for a minimum of 16 years to a maximum of 22 years with an average of 20.08±2.58 years.

The results in Table 2 also show that the maximum depth of flood water at the households ranged from 0.2 m to 3.0 m with an average of 1.158±0.72 m. Furthermore, Table 2 reveals that the flood water lasted for a minimum of 1 day to a maximum of 7days with an average of 4.00±1.67 days.

Table 2: Historical Characteristics of Flood Occurrence in Oforachi Community

Characteristics	Frequency	Percentage
Have you ever experienced flood		
Yes	197	60.62
No	128	39.38
Total	325	100.00
Year of first experience		
1991	104	52.79
1995	69	35.03
1997	5	2.54
1999	4	2.03
2000	15	7.61
Total	197	100.00
How many times have you been flooded? (Years)		
16	55	27.92
21	49	24.87
22	93	47.21
Total	197	100.00
Mean±Standard deviation	20.076±2.58	
Maximum Depth of flood water (m)		
0.2	13	6.60
0.5	47	23.86
1.0	70	35.53
1.5	34	17.26
2.0	18	9.14
3.0	15	7.61
Total	197	100.00
Mean±Standard deviation	1.158±0.72	
Duration of flood (days)		
1	6	3.05
2	35	17.77
3	60	30.46
4	7	3.55
5	44	22.34
6	31	15.74
7	14	7.11
Total	197	100.00
Mean±Standard deviation	4.00±1.67	

The results of the level of respondents' knowledge of flood causes are presented in Fig. 2.

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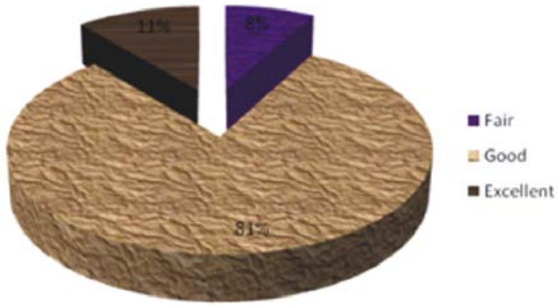

Fig. 2: Level of Respondents' knowledge of Flood Causes

The results show that 26 (8.00%) had fair knowledge, 263 (80.92%) had good knowledge while, 36 (11.08%) had excellent knowledge of the causes of flood.

The results of the Pearson's chi square test of the measures of association between the knowledge level and flood experience, ward, education, gender, age, marital status and occupation of respondents respectively are presented in Table 3.

The results showed that there was no association between the knowledge level and gender (Pearson's chi^2 = 3.15; P = 0.207). Meanwhile the factors that influenced the knowledge level of the respondents in decreasing order of associations are Age (Pearson's chi^2 = 44.46; P = 0.000), Education (Pearson's chi^2 = 44.39; P = 0.000), Occupation (Pearson's chi^2 = 18.52; P = 0.013), Flood experience (Pearson's chi^2 = 17.87; P = 0.000), Marital Status (Pearson's chi^2 = 9.81; P = 0.044) and Ward (Pearson's chi^2 = 9.68; P = 0.008).

Table 3: Respective Measures of Association of Various Factors with Knowledge of flood causes in the community

Parameter	Knowledge Level			Total	Pearson's chi^2	P-Value
	Fair	Good	Excellent			
Experienced Flood?						
No	20	92	16	128		
Yes	6	171	20	197	17.87	0.000
Total	26	263	36	325		
Ward						
Oforachi I	20	131	24	175		
Oforachi II	6	132	12	150	9.676	0.008
Total	26	263	36	325		
Education						
Primary	0	68	22	90		
Secondary	14	64	8	86		
Tertiary	6	47	6	59	42.3862	0.000
Adult Education	6	84	0	90		
Total	26	263	36	325		
Gender						
Male	20	184	30	234		
Female	6	79	6	81	3.1481	0.207
Total	26	263	36	325		
Age						
26-30	0	6	0	6		
31-35	0	19	0	19		
36-40	13	27	14	54	44.457	0.000
Above 40	13	211	22	246		
Total	26	263	36	325		
Marital Statu						
Married	20	223	36	279		
Divorced	0	7	0	7		
Widowed	6	33	0	39	9.8097	0.044
Total	26	263	36	325		
Occupation						
Farming	20	156	30	206		
Trading	0	40	0	40		
Civil Servant	6	46	6	58		
Craftsman	0	14	0	14	18.5246	0.013
Others	0	7	0	7		
Total	26	263	36	325		

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DISCUSSION

In this study, about 60% of the respondents have experienced flood over varying periods from as far back as 1991 till date for a majority 52.79 %. This assertion was confirmed by the Village Head and the District Head in separate interviews both agreeing that flood has been an annual occurrence in Oforachi Community from the early 1990s. This notwithstanding, only 11% of the respondents had an excellent knowledge of the causes of flood while about 8% had fair knowledge. The fact that a majority 81% had good knowledge provides a ray of hope that a well-designed early warning system has a good potential of being effective in the community subject to an understanding of the factors associated with the discrepancies in the level of knowledge. The results of the Pearson's Chi Square test of association reveal that the respondents' level of knowledge of flood causes within the community is influenced by age, education, occupation, previous flood experience, marital status and Ward in decreasing order of association. This trend confirms the assertions of previous flood-related studies (Messner and Meyer, 2006; Ruin et al. 2008; Daffi et al. 2014). Since the level of knowledge is communication dependent and the flood early warning system is also communication dependent, it follows that a system designed with specific consideration of the aforementioned factors has a high likelihood of being effective (Greco and Pagano, 2017; Kreibich et al. 2017. The knowledge of these associating factors will be very instrumental for the development of effective early warning signals and non-structural flood control measures as strongly opined by Gladfelter (2018). Meanwhile, the closeness of the P-value of the marital status to 0.05 showed that the association between the knowledge level and marital status is actually very weak. The difference in knowledge level between the two wards may not be unconnected to the fact that majority of those with previous flood experience (69.04%) were from Oforachi ward II, while only 30.96 % were from Oforachi ward I.

Although other studies on the knowledge of flood causes seem to be non-existent, the closest similar studies on the general knowledge of flood and flood hazard showed a similar trend to this study (Ali, 2007; Thieken et al. 2007; FitzGerald et al. 2010).

CONCLUSION

This study has shown that the respondents' level of knowledge of flood causes within Oforachi, a rural community in Kogi State, Nigeria is influenced by age, education, occupation, previous flood experience, marital status and Ward in decreasing order of association. These factors should therefore be considered in the development of early warning systems or signals within the community for a high efficiency to be guaranteed.

Conflict of Interest: No conflict of interest declared.

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