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Vulnerability Assessment and Household Preparedness Level to Flood in Ogunpa-Oni Sub River Basin

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Authors' contributions

This work was carried out in collaboration among all authors. Authors TAB and MOA designed the study. Author TAB performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MOA managed the thematic analyses of the study. Authors TA, JEA, SAA and SN managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Flood is a natural event that cause varying degree of losses despite initiatives to mitigate its impact. As the drive to retore normalcy in flood riddle areas increases, concerns about the vulnerability of areas in relation to households' responses to flood has emerged. This study therefore, identified areas vulnerable to flood; elicit households' sociodemographic attributes and examine their level of preparedness to flood in Ogunpa and Oni River Basin. A GIS-based approach was adopted along with 121 well-structured questionnaires administered to the respondents. A multi-criteria analysis (that considers slope, rainfall, soil type, DEM and NDVI was adopted), descriptive statistic and binary logistic model was used to achieve the objectives. The results from the vulnerability map revealed varying vulnerability status across Ogunpa and Oni River Basin. In addition, the

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sociodemographic statistics revealed important variables that influences household decision to prepare for flood. It was also known that factors that drive households to prepare for flood vary across households in Ogunpa and Oni River Basin. The study recommends enlightenment campaign on proper refuse disposal, strengthening of environmental regulatory agency, adoption of participatory approach in the buildup of environmental policy and increasing the level of awareness on the need for insurance policy that covers household against disaster such as flood**.**

Keywords: Flood vulnerability; preparedness level; binary logistic model; multi-criteria and weighted overlay.

1. INTRODUCTION

As more parts of the globe experience the devastating effect of flood [1], the progress of at least two forth of the Sustainable Development Goals (SDM) that aims to end poverty, protect the planet and ensure prosperity for all would be hampered. Moreover, and to substantiate the possibility of future deteriorating welfare conditions linked to flood, researchers [2-4] have indicated that climate change would increase the frequency and magnitude of flood occurrence [5-6] also reported that the intensity and magnitude of flood events are aggravated by the developmental decisions taken by people and the societies at large, they concluded that the impact are most times unevenly distributed. For instance, the first fifteen countries examined of their annual flood statistics shows that majority (80%) of the people affected are from low-income developing countries of Asia, Africa and Latin America [7]. Similarly, the after effect of flood according to [8-9] often leave the less privilege families poorer as they have limited financial resources.

Efforts to resolve the after effect of an extreme events requires an in-depth knowledge of risk, hazard and vulnerability to chart appropriate measure to mitigate the impact the undesirable occurrence [10]. Risk is a function of hazard, exposure and vulnerability [1], whereas, hazards are human induced or natural occurrence that distort the economic and social arrangement of a system [11]. Vulnerability is the outcome of an altered internal feature that change hazard to disaster [12-13]. The components of the element at risk according to [14], includes people, and or the social arrangement, the condition that influences their ability and readiness to adapt to unpleasant occurrence such as flood. Therefore, the knowledge of human capacity in times of flood enables the development of holistic flood risk management approach.

The integrated flood risk management approach has converging literature supporting its effectiveness in mitigating the impact of flood [15-17]. The approach combines the structural (that is, erecting barriers) and non-structural approach (which raises the level of awareness and warning in respect to risk) to reduce the negative impact of flood rather than adopting one of the two approaches [18]. Drawing from literature [16]; [19-21], flood risk management emphasizes reduction of flood impact by averting the impact of highest flow (simply by reinforcing the capacity of catchment to hold water), provision of mustering points and the use of non-structural methods [22-23].

The preventive, precautionary and preparative approaches on the other hand are major components of the non-structural method. Preventive measures regulate land utilization to mitigate flood destruction while the precautionary and preparatory measures promote early warning system, massive enlightenment training and education aimed at mitigating flood impacts [16]; [24-25]; [23]. The success of the precautionary and preparatory methods is tied to the level of preparedness and risk awareness of an impending flood [26]. The foregoing statement is instructive from Motivational hypothesis that individual that recognizes their level of exposure to high risk embark on flood mitigation actions [27]; [26].

Causalities and damages following flood event remains high despite the documented benefits linked with precautionary and preparatory measures in mitigating the impact of flood. Similarly, borrowing a leaf from motivational hypothesis, it is important to understand the pathway of how individual adopt flood mitigation measures and factors that influences their preparation. A knowledge of this relationship is important to provide holistic ways to mitigate the impending impact of flood. This study assesses the vulnerability status of areas within Ogunpa-Oni River basin. Ogunpa-Oni sub river basin of Ogun-Oshun River basin, as such, drains into Ogun-Oshun River basin. Similarly, it elicits some socio-economic variables and subsequently examine the level of preparedness of residents within the basin on the premise of motivational hypothesis. The other sections of this paper present information in line with the earlier stated objectives.

2. METHODOLOGY

This section has two parts. The first part presents the methodological approach employed in identifying the vulnerable areas using the Geographical Information System (GIS). Preparatory measures taken by residents in flood prone areas according to literature has proven effective in mitigating the effect of flood. More importantly, given the fact that motivational hypothesis stated that individuals are more motivated to prepare and take precautions against events that will make them lose their resource particularly if they perceived their flood risk level is high, hence, the rationale to administer questionnaire to the respondents to assess their level of preparedness.

2.1 Study Area

The study area lies between latitude $7^{0}14'$ N and $7^{0}28'$ N and longitude $3^{0}48'$ E and $3^{0}57'$ E. The whole of Ibadan South West Local Government Area (LGA) falls in the basin, and traverses Ibadan South East, Ibadan North East, Ibadan North, Ibadan North West, Ido and Oluyole Local Government Area Councils.

2.2. Data and Methods

This sub-section gives the detail of the data used for this research. It is made of three parts. The first part elucidates on the data required for the spatial analysis. The second part explains the data and method followed in collecting and processing some sociodemographic attributes of households in the study area. The third part explains the methodological steps taken to know how prepared households are to flood particularly in vulnerable areas.

2.2.1 Data requirement for spatial analysis

The spatial assessment of areas vulnerable to flood typically require the development of a GIS-based approach. The criteria required to carry out the spatial analysis in respect to the magnitude of flood are presented in Table 1.

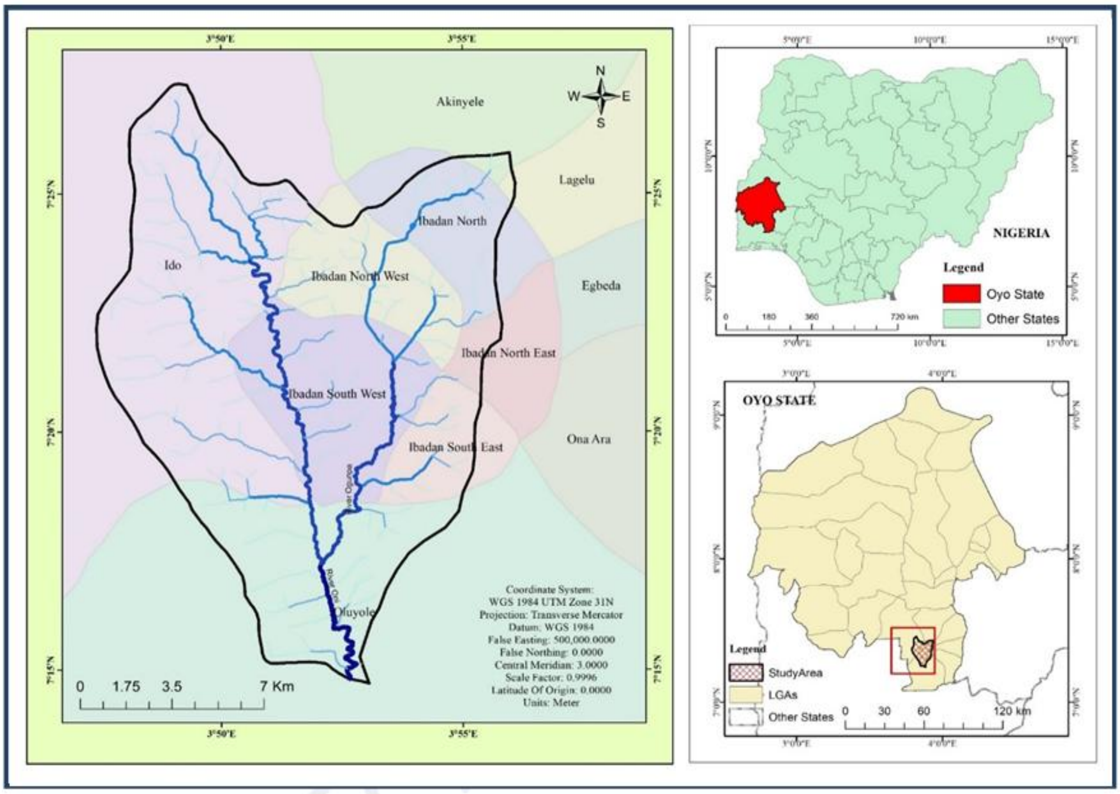

Fig. 1. Study area Map

Table 1. Characteristics of data used for the study

Data	Extracted Data	Attributes	Source	Data type
Shuttle Radar Topographic Mission (SRTM)	Digital Elevation Model/Slope	30 meters	USGS	Secondary
Rainfall	Mean Annual Rainfall	30 years mean predicted values	Global climatic Model	Secondary
LandSat	Normalized Difference vegetative Index (NDVI).	30 meters	USGS	Secondary
Topographic Sheet	Drainage Network	Scale: 1: 50,000	OSGOF	Secondary
Soil Map	Predominant Soil Type	1:1,300,000	Centre for World Food Studies	

Source: Author's compilation of data used.

Drainage density is the ratio of the entire length of stream channel to the area cover by watershed [28]. It underscores the hydrological, climatic and geomorphological equilibrium [29]. In addition, drainage density according [30] is measured in km/km^2, the author also explained drainage density explains the closeness of stream to each other for evaluation of the mean length of drainage channel.

Rising greenhouse gas retain more warm air in the atmosphere, hence, alters the climatic state. This process simultaneously increases evaporation, causing warm sea surface to increase the atmospheric vapour that falls as rain [31]. Heavy rainfall and rising sea level have a direct link with flood incidence in a catchment [31]. With projections of intense rain, an understanding of the rainfall pattern in the area under consideration is crucial.

The topography of an area determines the extent and the overall magnitude of inundation. For instance, elevation among other parameters has significant effect on flood inundation. Elevation is vital in flood assessment, therefore, data relating to elevation, and also description of field reality should be collected [32].

Vegetation is vital in conserving the ecosystem. It supports the energy exchange process, create atmospheric and hydrological equilibrium, and ensures unhindered carbon cycle [33]. Naturally growing vegetation create flow resistance in the event of flood, and the resistance offered depend on the nature (flexible against rigid) of the vegetation [34]. Remotely sensed image provides information (spectral indices) about the nature of the vegetation and thereafter, the level of resistivity. Technically, Normalized Difference Vegetation Index (NDVI) explores the spectral reflectance variance between red and near-infrared channel and correlate it with vegetation biophysical factors [35-36]. The NDVI value ranges between -1 and +1, such that, values close to zero signifies bare surface while values close to one signifies a dense vegetation.

A multi-criteria model was adopted to bring together the foregoing (such as elevation, slope, soil parameters, rainfall and NDVI) data in different layers to identify areas vulnerable to flood and otherwise. These inputted data and as used in this study is supported by research conducted by [37-40]. Global oil palm suitability assessment. The input raster for each criterion was used as decision variable for systematic GIS interaction between layers in multi-criteria analysis. Spatial-analysis tools of ArcGIS enabled the required data processing [41].

The weighted overlay analysis module in the ArcGIS was used to generate the output raster and subsequently enabled the combination of the input raster through the geo-spatial analysis. For each input raster of the cell, a new reclassified value was assigned on an evaluation scale ranging from 1 through to 5. The least vulnerable areas are represented with 1, 5 show the area with the highest vulnerability. The new values assigned to the reclassified criteria (Rainfall, drainage density, digital elevation, slope, NDVI and soil) was thereafter weighted. The AHP process applies pairwise comparison technique to develop the criteria's weight. This comparison matrix is displayed in Table 2 below.

The weight assigned to each criterion from the pairwise comparison matrix is as follow: Rainfall: 33%, drainage density: 26%, digital elevation: 16%, slope:12%, NDVI: 8% and soil: 6%. This system compares two criteria at a time in terms of their importance to flood and also assesses the consistency ratio. The consistency ratio shows the consistency or otherwise in pairwise comparison process [42-43], and is given as;

$$CR = \frac{CI}{RI} \dots\dots\dots\dots\dots\dots\dots \quad (1)$$

$$CI = \frac{x-n}{n-1} \dots\dots\dots\dots\dots\dots\dots\dots \quad (2)$$

Where;

Lamda (x) is defined as the maximum Eigen value;
CI is the Consistency index CI;
CR is the Consistency Ratio;
RI is the Random Index;
N define the number of criteria or sub-criteria in each compared pairwise matrix.

Where a consistency ratio (CR) value is greater than zero but less than or equals to 10 percent, the process is considered consistent. We got a consistency ratio (of 10%) which equals 10%. This result rationalized our judgement and gave the impetus to proceed with the result from the AHP [44]. Following the weight derived for each criterion, the weighted overlay analysis was used to generate the vulnerability map of the Oni and Ogunpa Basin.

A number of multi-criteria methods are useful to conduct a consistent land evaluation. Among others are simple additive scoring [45], Analytical Hierarchy Process (AHP) and Artificial Neural network [46]; [47] and Linear combination and developing fuzzy-logic. For example, [48] adopted fuzzy logic to cover the choice of common knowledge to decide a suitable vineyard. Furthermore, [49] employed Fuzzy logic and WLC technique to choose the most suitable Site for water Reservoirs in Malaysia between two suitable locations. Using a different approach, [50] adopted AHP to evaluate Thailand's land suitability for cash crop cultivation. The fuzzy logic and the AHP appears more in recent literature in terms of its use in land evaluation methods, however, AHP has more literature convergence in terms of its use [51]; [52]. The theoretical underpinning AHP ease the process of bringing together varying feature and stating another classification to show important feature in hierarchy at each level [53].

2.2.2 Data requirement for level of preparedness and sociodemographic assessment

A total of 250 questionnaires were printed and administered to the respondents. Only 121 questionnaires were used for this study. The others were either not returned or answered properly. The administration of the questionnaire was done with the landlord association. The chairman gave the date on which the members in the community meets. On this day, the questionnaire was administered to the respondents. Questions asked to the respondents include age, gender, Regular source of income, family size, years spent in school, marital status, house ownership.

2.3 Statistical Model to Evaluate Residents' Level of Preparedness

To assess the preparedness level of respondents in the study area, the analytical framework estimated by [54]; [9] were useful in this study. A logit regression model was estimated to establish the probability that a household embarked on preparedness action. Logit model estimates change in value of a variable resulting from a unit change in the value of another. It is a non-linear model that aid the estimation of dependent variable (Y) with value 0 or 1. In this study, it is the probability that resident in flood prone areas embark on measures to mitigate the impact of flood or otherwise. The logistic probability function is stated as;

$$P_i = \frac{1}{1+e^{-z_i}} = f(Z_i)\dots\dots\dots\dots\dots\dots \quad (3)$$

Where P_i is the probability that a household i (i=1, 2, ….., n) embarked on flood preparedness measures. The Z_i index is a random variable that predicts the probability of a household embarking on flood preparedness measures or otherwise. The probability (P_i) in equation 1 is transformed as;

$$P_i = \frac{e^{z_i}}{1+e^{z_i}}\dots\dots\dots\dots \quad (4)$$

Therefore, the i th observation of a household is stated as;

$$Z_i = \frac{ln\,P_i}{1-P_i} = \beta_0 + \sum \beta_0 X\dots\dots\dots\dots \quad (5)$$

Thus, $ln(P/1-P) = 1$, if the household embark on any flood preparedness measure while $ln(P/1-P) = 0$, if household did not embark on flood preparedness measures. Therefore, the empirical model is stated as;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{41} X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + +\varepsilon\dots\dots\dots \quad (6)$$

Where;

Y is the binary dependent variable;
X's are independent variables and defined as;
X_1…House ownership X_2 Household size
X_3 Adversely affected by previous flood
X_4 Knowledge of flood risk areas
X_5 Regular income source
X_6 Healthy household
X_7 Access to warning
ε_i is the error term;
$\beta_0$is the constant;
$\beta_i$are the coefficients of regression.

3. RESULTS AND DISCUSSION

This section discuss result from two separate analyses. The first part employs a spatial technique to examine biophysical features (slope, elevation, soil, drainage and rainfall) that are perceived and supported by literature to have significant contribution to the magnitude of flood. The second section explained the statistical analysis conducted on the data collected from resident in flood prone areas. It presents the sociodemographic attributes of respondents and results of logit model explained residents' level of preparedness to flood in places identified as flood prone areas.

3.1 Spatial Assessment of Ogunpa-Oni Sub River Basin

In this section, attention is given to each of the biophysical features considered in this study. Each feature (that is, the criterion) is processed, and they eventually facilitated the images for the final process of arriving at the vulnerability map. Explanation of their contribution to flood from literature appear in this subsection.

Table 2. Comparison matrix of the features

	Rainfall	Drainage Density	DEM	Slope	NDVI	Soil	Normalized principal Eigenvector %
Rainfall	1	3/5	3	3/5	3	1/6	33.00
Drainage Density	2/5	1	3	3 1/3	3 1/6	3 1/3	25.55
DEM	1/3	1/3	1	3	3/5	3/5	16.02
Slope	2/5	2/5	1/3	1	3 1/3	3 1/3	12.30
NDVI	1/3	1/3	1/3	1/3	1	2 3/5	7.65
Soil	1/3	1/3	2/5	1/3	2/5	1	5.49

Source: Author's Computation

Table 3. Response and sociodemographic data

Name of variables	Type of variable
Gender	Dichotomous
Age	Continuous
Regular source of income	Dichotomous
Family size	Continuous
Prepared for flood	Dichotomous
House insured	Dichotomous
Refuse disposal	Nominal
House drainage	Dichotomous
Cleared drainage	Dichotomous
Know flood risk areas	Dichotomous
Understand flood risk map	Dichotomous
Share knowledge with neighbor	Dichotomous
Healthy household members	Dichotomous
Access to early warning	Dichotomous
House ownership	Dichotomous
Adversely affected by past flood	Dichotomous

The legend in Fig. 2 shows varying colour graduation describing the drainage density of the basin under consideration. Areas with drainage density value less than 5km^2 have low drainage density. These areas are gentle sloping, receives low amount of rainfall and are predominantly with materials that give little or no resistance to flowing water. On the other hand, surfaces with poor permeability, poor infiltration, high rainfall and steep slopes have drainage density value greater than 5km [55].

The rainfall distribution of the area under consideration is presented in Fig. 3. According to Fig. 3, the amount of rainfall received in the catchment ranges between 1,264mm to 1378mm. Areas within the basin experiencing more rainfall have higher tendency to be more vulnerable to flood while those receiving less rainfall be less vulnerable to flood all things being equal.

The elevation of the study area is presented in Figure 4. According to the legend in Fig. 4, the elevation in Ogunpa and Oni River Basin vary from 118 degrees to 281 degrees. The image shows that the lowest point in the study area is 118 degrees while the highest elevation is 281 degrees. It goes to show that areas in the basin have varying elevation, and as such, will have varying vulnerability status. Areas in the lowest plane (118 degrees) would feel the negative impact flood more than those in the highest plane (281 degrees).

According to Fig. 6, NDVI of the area under consideration range between -0.07 and 0.41. The negative value indicated (with red colour) are areas with bare surfaces or areas which have undergone significant change from the natural course. These areas would aid flooding relative to areas with positive values. Positive NDVI values indicate the presence of vegetation, and vegetation create resistance to flowing water in times of flood.

3.2 Vulnerability Map

Workable policy depends on the quality of information available. Biophysical factors such as rainfall, elevation, slope, predominant soil type and its properties, vegetal cover are important when assessing the spatial flood vulnerability. For instance, researchers [56] and [57] opined that topography combined with other environmental elements defines the level of vulnerability of an area to flood. Going by the afore-mentioned, Ogunpa and Oni River Basin was assessed using the multi-criteria analysis and the result is presented in Fig. 8.

The multi-criteria overlay analysis shows that the entire land area covered by river Ogunpa and Oni after the basin was delineated amounts to about 218.495km^2. Of this expanse of land, the highly vulnerable areas (occupy 15.6129km^2 representing 7.1457%) and the vulnerable (occupy 133.3761km^2 representing 61.0431 %) amounts to 148.989km^2. This result shows a potential risk that could affect about 20,149 houses in the areas identified as highly vulnerable and about 105,930 houses in areas identified as vulnerable in the event of flood.

The less vulnerable area (occupy 67.7830 km^2, accounting for 31 % of the land) and the least vulnerable (which occupies 1.7230 km^2 and amounting to 0.79 %) area account for 69.506km^2. In total, 19,836 and 4 houses are at risk in the event of flood in areas that have been identified as less and least vulnerable, respectively.

The vulnerability variation within the basin could be linked to differences in the slope, elevation, vegetal cover and predominant soil type. For instance, areas highly vulnerable to flood have lower elevation (varying between 118-139 degrees) above the sea level; has lower slope (varying between 0-5.8 and 5.9-14 degree); received more rainfall ranging between 1328-1378mm. Also, more anthropogenic activities (i.e., more built up which makes the NDVI value range between -0.07-0.11 through to 0.17) was discovered and has third and fourth order stream flowing through it.

On the other hand, areas that are less to least vulnerable to flood have the highest elevation (varying between 198-281m above sea level); area with higher slope ranging between 27-51 degrees for areas that are less vulnerable, while those with 52-110 degree are the least vulnerable areas. Finding also show that the amount of rainfall received in less and least vulnerable areas ranged between 1,264 - 1327mm. The value from the NDVI analysis show that areas that are less to least vulnerable to flood have less anthropogenic activity (less built up with NDVI value ranging 0.18-0.41). Whereas, the drainage density shows that most of the areas that are less to least vulnerable have first and second order stream flowing through it.

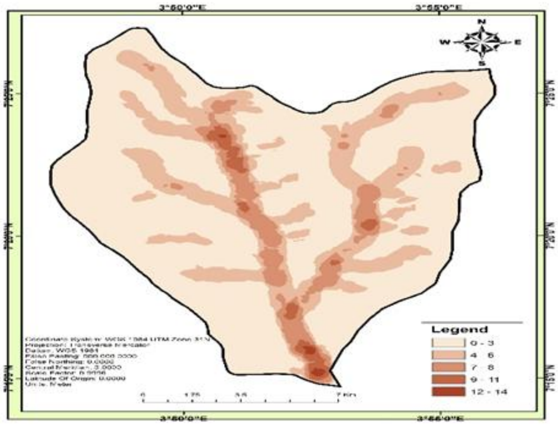

Fig. 2. Drainage density

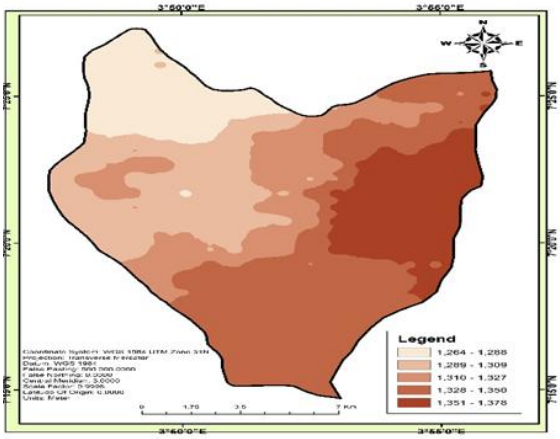

Fig. 3. Rainfall distribution

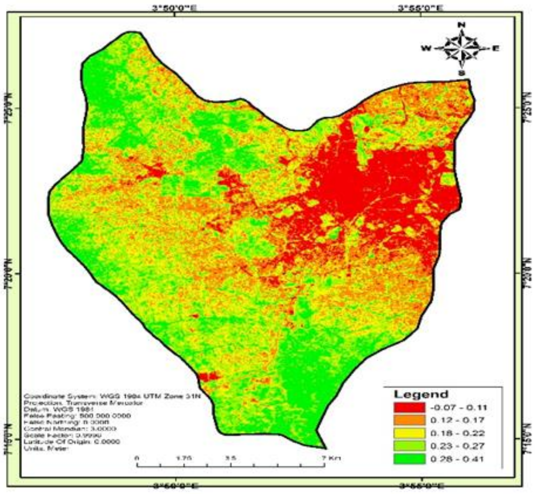

Fig. 4. Normalized Difference Vegetative Index (NDVI)

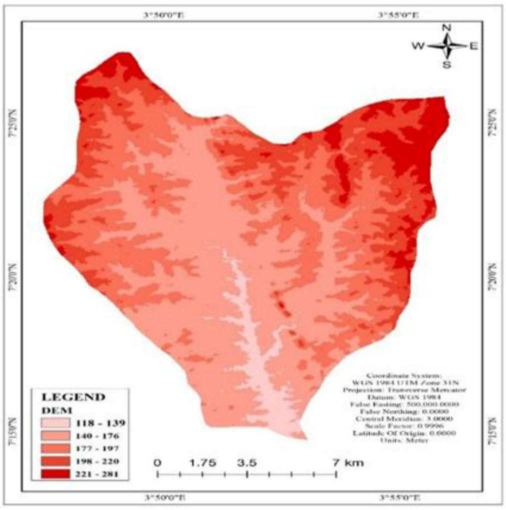

Fig. 5. Digital Elevation Model (DEM)

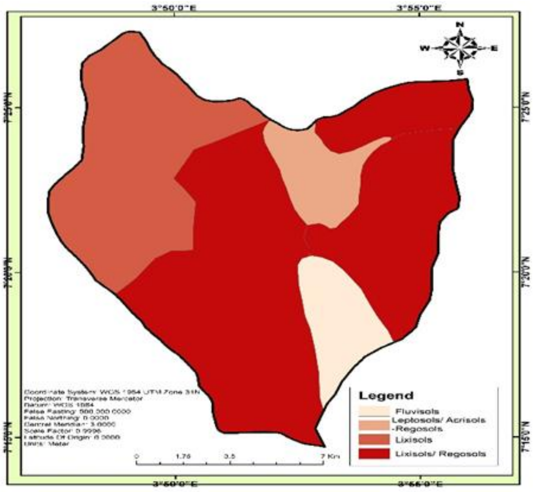

Fig. 6. Digital Elevation Model (DEM)

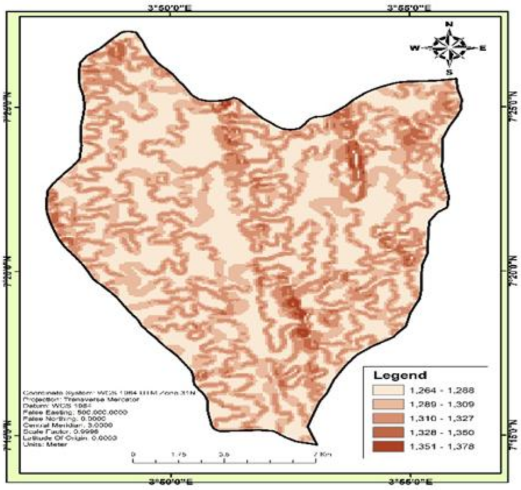

Fig. 7. Digital Elevation Model (DEM)

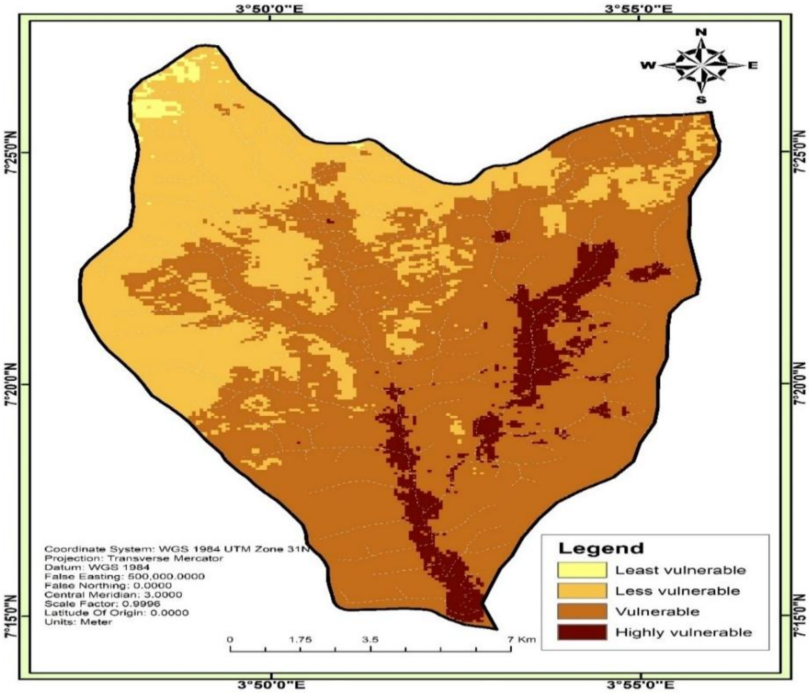

Fig. 8. Vulnerability map of Ogunpa and Oni River Basin

3.3 Sociodemographic Assessment

This sub-section presents in detail, the sociodemographic attribute of respondents. The summary statistics of the sociodemographic attributes of the respondents are presented in Table 3.

Of the 121 enumerated respondents, 61.16 percent of them are male respondents while 38.84 percent are female. Respondents who owned houses in the study area amounts to 52.07 percent. The result also shows that majority of those that owned houses in the study area were male while 47.93 percent were female. 74.38 percent of the respondents are married while the remaining 25.62 percent were either not married, divorced or separated. It was discovered that 48.76 percent spent between 7-12 years acquiring formal education; 34.71 percent spent 1 to 6 years; 14.88 spent 13-18 years while 1.65 percent spent over 18 years in school.

The statistic of household prepared for flood show that majority (75.21 percent) of the respondents are prepared for flood while others (24.79 percent) are not prepared. It could be inferred that attitude of respondents to insurance policy is poor as majority (94.21 percent) of the respondents did not have any insurance policy against disaster such as flood. Only 5.79 percent of the respondent insured their houses, and it mostly against burglary and not to flood.

Proper refuse disposal reduces blockage in canal and water ways and thereafter reduce the negative impact of flood. statistic from the field show that 54.55 percent of the respondent disposed their refuse through refuse collectors; 36.36 percent burnt their refuse while 9.09 percent dispose their refuse in drains when rain falls. Field verification affirmed significant heaps of refuse in the canal which illuminates poor refuse handling.

Gutters aid free flow of water especially when it is free of obstructions and cleared of dirt. Field findings revealed that 80.17 percent of the households have gutters around their houses while 19.83 percent do not have. In addition, 61.16 percent of the household regularly clear their gutter of dirty aid free flow of water and 38.84 percent did not clear the gutter around their house.

According to Table 4, 32.23 percent of the respondents was adversely affected by previous flood while 67.77 percent in the study area were not adversely affected by previous flood event.

Table 4. Demographic attributes and response variable from enumerated respondents

Variables	Frequency (Percentages)	Variables	Frequency (Percentages)
Socio-demographic attributes			
Gender		Regular source of income	
Male	74 (61.16)	YES	112 (92.56)
Female	47 (38.84)	No	9 (7.44)
Age		Family Size	
30-39	7 (5.79)	1-4	66 (54.55)
40-49	20 (16.53)	5-8	50 (41.32)
50-59	36 (29.75)	9-12	5 (4.13)
60 and above	58 (47.93)		
Response variable			
Prepared for flood		Understand flood risk map	
Yes	91 (75.21)	YES	7 (5.79)
No	30 (24.79)	No	114 (94.21)
House insured		Share knowledge with neighbor	
Yes	7 (5.79)	YES	114 (94.21)
No	114 (94.21)	No	7 (5.79)
Refuse disposal		Healthy household members	
Burning	44 (36.36)	YES	108 (89.26)
Refuse collector	66 (54.55)	No	13 (10.74)
Pouring in drainage	11 (9.09)	Access to early warning	
House drainage		YES	34 (28.10)
Yes	97 (80.17)	No	87 (71.90)
No	24 (19.83)	House Ownership	
Cleared drainage		YES	63 (52.07)
Yes	74 (61.16)	No	58 (47.93)
No	47 (38.84)	Adversely affected by past flood	
Know flood risk areas		YES	39 (32.23)
Yes	75 (61.98)	No	82 (67.77)
No	46 (38.02)		

Source: Field Survey, 2018

Inferring from the statistic in Table 4, majority (61.98 percent) responded to know what flood risk map is but, 38.02 percent do not know what flood risk map is. Furthermore, 61.98 percent know flood risk areas while only 38.02 percent of the sampled population do not know the flood risk areas.

3.4 Binary Logistic Model Estimated to Elicit Household Level of Preparedness for Flood

A number of factors determine measures respondents adopt to mitigate the impact of flood. Factors that drive respondent's adoption of flood mitigating measures was identified by estimating a binary logistic model. In this study, the dependent variable is the preparedness measure that respondents adopt to mitigate the effect of flood. The measure includes drainage clearing, fence reinforcement, structural upgrade, piling of sand bags and tires, fixing broken drainage, proposal waste disposal, de-paving paved area in their compound.

Some socio-economic variables (house ownership, household size, regular source of income and health status of household) was also included in the model. Their inclusion is premised on their perceived influence on household decision to prepare for flood. For instance, the owner of a house vulnerable to flood may motivate the owner adopt measures to protect the building against the negative impact of flood. Similarly, action taken in preparation for flood is a function of available funds. There is a low likelihood that a household without regular income would embark on flood mitigation measure, and so are respondents who do not own the houses in which they live.

Subsequently, the marginal effects of the explanatory variable on the dependent variables was estimated and the outcome is presented in Table 5.

The likelihood ratio value of 53.56 indicates that some of the coefficients of the explanatory variables are statistically different from zero. The chi-square (0.0002) value also shows that the model performed well.

According to the estimate, household size, adversely affected by previous flood events, knowing flood risk areas and access to early warning have significant influence on the likelihood of household preparedness to flood. That is, household size, adversely affected by previous flood event, knowing flood risk areas and access to early warning increases the likelihood of preparedness to flood among the sampled respondents.

The probability of embarking on measures that prepares household against the damaging impact of flood on the average increases for households with large family size according to Table 5. Although the coefficient appears low, it is however, significant. This hints that household with large family will embark on measures that prepares that them ahead of flood event but not with the needed enthusiasm when compared with the damages that comes with flood events. This is instructive because as family size increases, the financial obligation of the household increases, especially when many of the household are dependent.

Also inferring from Table 5, household that has experienced flood in the past are likely to embark on measure that prepares them ahead of flood events. This result is significant, and it suggest that, household that previously experienced the devastating effect of flood are more inclined to raise their level of preparedness because of their past experience. This outcome corroborates the findings of [19] and [26].

The likelihood of embarking on measure that shows a household is prepared for flood according to Table 5 increases for household that know the flood risk maps of their area. This finding is in tandem with the report of [19] and [9] which opined that household with adequate knowledge of flood are better informed and as such well-prepared for flood.

In responding to flood, access to early warning play a crucial role in alerting households and the entire neighborhood. From the result in Table 5, the likelihood of a household preparing for flood events increases for households with access to early warning. Access to early warning had significant relationship with household level of preparedness. This finding is consistent with the report published by [9].

Surprisingly, house ownership, having regular source of income and health status of the household were not statistically significant with the preparedness level of household to flood in the study area. As for house ownership, it is assumed that measures will be taken by owners of the buildings to mitigate the impact of flood. Tenants may not be proactive to embark on mitigating measure that prepare them ahead of flood because they have to inform the landlord before taking any step.

Also, having a regular source of income was expected to have a significant relationship with the level of preparedness as the capacity to prepare for flood depends on the available resource, hence, household without regular inflow of resources may not be prepared for flood and vice-versa. Similarly, the health status of household is ought to have significant effect on household preparedness level to flood because funds to prepare ahead will not be channeled to health challenges.

Table 5. Marginal effect after logistic

Preparation for flood	dy/dx	Std. Err.	Z	P>|z|
House Ownership	.1750766	.09526	1.84	0.066
Household size	.0380785	.01984	1.92	0.055*
Adversely affect by previous flood	.1557872	.08053	1.93	0.053*
Know flood risk areas	.4636964	.12362	3.75	0.000*
Regular income source	.1063127	.19221	0.55	0.580
Healthy household	.3103064	.21296	1.46	0.145
Access to early warning	.2263627	.06599	3.43	0.001*

Source: Field survey, 2018. (*) dy/dx is for discrete change of dummy variable from 0 to 1

The goodness of fit and reliability was conducted on the Logistic model used to estimate the level of preparedness of flood in Ogunpa-Oni River Basin. It was conducted on 121 observations and on 10 groups. The Hosmer-Lemeshow chi2(8) and Prob > chi2 revealed a statistic of 6.74 and 0.5650, respectively. This result affirms the goodness of fit of the model.

4. SUMMARY, CONCLUSION AND RECOMMENDATION

The vulnerability assessment revealed that significant part of the delineated land (Ogunpa-Oni river basin) was vulnerable to flood and that any prolonged/heavy rainfall will flood the area and subject the residents to vary degree of hardship. Areas not vulnerable was found less in proportion to the vulnerable. More worrisome is the fact that significant households in Ogunpa-Oni River basin are not prepared for flood. Although the study revealed that measures adopted by households in preparation for flood vary across households in Ogunpa-Oni River basin, a positive waste disposal was observed among respondents. The same study also shows that many of the respondents still dump refuse in canal, river channels. This requires attention to allow free flow of water particularly in the raining season. Residents in the study area had poor attitude to insurance policies as observed from the result.

Consequent on these, findings, this study recommends that:

- residents with previous devasting flood experience along with those with good knowledge of where the flood is most intense in the area should lead team that liaises with appropriate authority responsible for managing natural event such as flood. Doing this will make action participatory and most effective in mitigating the negative effect of flood.
- residents earlier identified as knowledgeable about the pattern of flooding in the area should also sort to establish cooperation among residents and encourage them to join information sharing system to spur meaningful deliberation and agreeing on erecting appropriate signage in places considered as hot spots particularly during the raining season.
- a radical and continuous enlightenment campaign to sensitize people in the study area on the impending danger of dumping refuse in the river. Laws that prohibit dumping of refuse inappropriately should be allowed to have its full weight on those that violates such laws.
- since only few residents had insurance policy and particularly covering burglary, residents should be encouraged to subscribes to insurance policy that can cover them against natural occurrence like flood
- residents should be encouraged to prioritize at least a media instrument of their choice that will keep them in tune with early warnings regarding flood.

Enlightenment campaign on the need to make people living in flood prone areas understand the areas at risk to flood to mitigate the effect of flood.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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