Perception of the Causes and Effects of Flooding in Agrarian Communities of Southeastern Region of Nigeria

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ABSTRACT

The study assessed causes and effects of flooding in Southeastern Nigeria.A total of 400 respondents in 8 communities were sampled using multi-stage, stratified and random sampling methods, and the data were analysed using descriptive statistics. Eight factors were identified as factors influencing flooding, and heavy rainfall is the major cause of flooding as indicated by 99.2% of the respondents. Excess river discharge, building/farming on floodplains and climate change were ranked second, third and fourth as indicated by 85%, 59% and 52% respondents respectively.Moreover, heavy rainfall was foundto exacerbate the degree of influence of the other factors that caused flooding in the study area.Stream pollution, destruction of farmland, disruption of income sources, emotional trauma, disease outbreak, abandonment of property, seasonal displacement, loss of livestocks, loss of household property, traffic jam and loss of life were identified as the effects of flooding. Stream pollution and destruction of farmland were the main effects of flooding experienced as reported by 97.7% and 93.3% respondents respectively while only 8.5% indicated that flooding has caused loss of life in the study area. The findings show that some effects are associated with one another as destruction of farmland led to food insecurity and disruption of income earning sources led to emotional trauma that took the lives of some. Four, recommendations including the construction of standard drainage facilities, provision of food safety nets and early flood warning were made to minimize the effects of flooding in these communities in Southeastern Nigeria, thereby promotingthe Sustainable Development Goal 11.

Keywords: Flooding, Agrarian communities, Nigeria, Heavy rainfall, Stream pollution

1. INTRODUCTION

Flooding is generally a condition of complete or partial inundation of normally dry areas due to overflow of tidal or inland or waters or from abnormal and rapid accumulation of runoff (Jeb and Aggarwal, 2008; Djimesah, Okine and Mireku, 2018). It is a common environmental hazards (Adewuyi and Olofin, 2014; Akukwe and Ogbodo, 2015; Lumbroso, 2020). Although floods are a natural occurrence, they are becoming more damaging and costly due to human activities and factors like unchecked urbanisation, impermeable surfaces, clogged drainage systems, inappropriate use of flood plains, deforestation, and increased population (Jeb and Aggarwal, 2008; Ogba and Utang, 2008; Balabanova and Vassilev, 2010; Ojigi et al., 2013; Akukwe and Ogbodo

2015).According to statistics, floods in the USA and Europe inflict significant economic damage but often claim a fairly small number of lives, while floods in third-world nations typically result in numerous deaths and little damage (Klijn, 2009).

Flooding has been described globally as one of nature's most damaging phenomena (Adeoye et al., 2009; Aderogba, 2012; Lumbroso, 2020). in the same vein, rising sea levels, particularly in coastal cities, and variations in seasonal and annual rainfall resulting from climate change have increased the frequency of flooding worldwide (IPCC, 2007; Syaukat, 2011). This has resulted in a rise in pest outbreaks, a decrease in crop yields, widespread soil erosion, and water logging (FAO, 2008; Emaziye et al., 2013).

In Asia for instance, heavy rainfall, melting snow, glacial outbursts, and dam break flows have been identified as the main causes of inland flooding while the effects of flooding include; agricultural deficiency, starvation,disease outbreaks, unemployment, and the displacement of people with associated povertyin West Bengal(Ismail and Mustaquim, 2013). According to Ninno et al. (2003), floods affected food security of millions of families in Bangladesh, and Muriadi and Wljaya (2013) noted that flooding has causedfood insecurity in Indonesia.

In Africa, severe flooding is a major issue for many cities (Lumbroso, 2020). This problem is exacerbated by factors like increased storm intensity and frequency, increased runoff from impermeable surfaces, occupation of floodplains, blocked drainage systems,and inadequate waste management(Douglas et al., 2008; Eneji et al. 2016; Ojo and Adejugbagbe, 2017).

Nonetheless, flooding in Nigeria has been caused by topographic factors, artificial factors (such as burst dams, burst water pipes, levee failure, silted up drainage, uncontrolled urbanisation, and natural factors (such as rainstorms, torrential or heavy rains, tidal waves, and ocean storms typically along the coast) (Etuonovbe, 2011, Dan-Jumbo, Metzgerand Clark, 2018).

In various parts of Nigeria, flooding has killed people and forced thousands away from their homes; caused loss of life, animals and property; destroyed businesses, bridges, roads and other infrastructure. It has also caused disruption of services; polluted water resources and increased the risk of diseases (Jeb and Aggarwal, 2008; Ogba and Utang, 2008; Adeloye and Rustum, 2011; Etuonovbe, 2011; Olorunfemi, 2011; Olanrewaju, 2019), destroyed farm land and agricultural products resulting to poverty, hunger and starvation (Ejikeme et al., 2015) and affected households' food security status (Ajaero, 2017).

Two States namely Anambra and Imo selected for this study in South eastern Nigeria consist of communities known for their vulnerability to flooding due to their location; nearness to the River Niger, and are mostly agrarian. Since majority of the sampled households are agrarian and depend on agriculture as their major livelihoods source, it is pertinent to carry out study on the causes and effects of flooding in Southeastern Nigeria as there is dearth of in-depth research carried out on the topic in both Imo and Anambra States that have been selected for the study. Undoubtedly, flooding is caused by a variety of factors and cannot be attributed to a single factor, and it is associated with certain negative effects that are location-specific. In order to provide long-term solutions for flood disasters, this study investigated the causes and effects of flooding in agrarian communities that experience perennial flooding in Southeastern Nigeria.

2. MATERIAL AND METHODS

2.1 Study Area

2.1.1 Locationand Climate

The study area, Southeastern Nigeria is made up of Abia, Anambra, Ebonyi, Enugu and Imo States. It is located between latitudes 4° 20′ to 7° 10′ north of the equator and longitudes 6° 35′ to 8° 25′ east of the Greenwich Meridian with a land size of about 28,983km^2. The region is bounded to the north by Benue and Kogi States, to the south by Rivers State, to the east by Cross River State and to the west by Delta State (Figure 1). Imo and Anambra States have beenselected for this study.Imo and Anambra States were selected because they were the only two most affected Statesin the region by the 2012 floods termed the most devastating floods in Nigeria (UN-OCHA, 2012; Nigeria Hydrological Services Agency, 2020), and have flood vulnerable and agrarian communities. Imo State is located between latitude 5°10′N to 5°25′N and longitude 6°35′E to 7°23′E of the Greenwich meridian with a total land area is about 5,183sqkm. It is bounded on the east and west by Abia State and Rivers State respectively, and on the north by Anambra State and on the south by Abia and Rivers States.Anambra State has a spatial extent of about 4,816km^2, and lies between latitudes 5°40′ and 6°46′ north of the equator and longitudes 6°35′ and 7°21′ east of the Greenwich meridian. It is bounded by Enugu and Kogi States on the north, and to the south, by Imo State. Anambra State shares common boundaries with Abia and Enugu Stateson the east, and with River Niger and Delta State on the west (Fig. 1).

The climate of Southeastern Nigeriais tropical wet-and-dry climate or Aw climate according on Koppen's climate classification with an average of eight months of rainfall and four months of dry season. On average, the area receives an annual rainfall amount of about 1800mm (Anyadike, 2002). The two major seasons are namely; the rainy season (March to October) and the dry season (November to February).

Rainfall intensity is usually heavy between July and September while December is usually dry. Mean annual rainfall ranges from 1800mm to 2000mm. It experiences high temperatures all year round with an average value of 27°C while the average relative humidity ranges between 60-70% and 80-90% in January and July respectively (Anyadike, 2002). Changes in rainfall pattern have been noted to influence flood occurrence in the south eastern part of Nigeria and it usually occur between July and October.

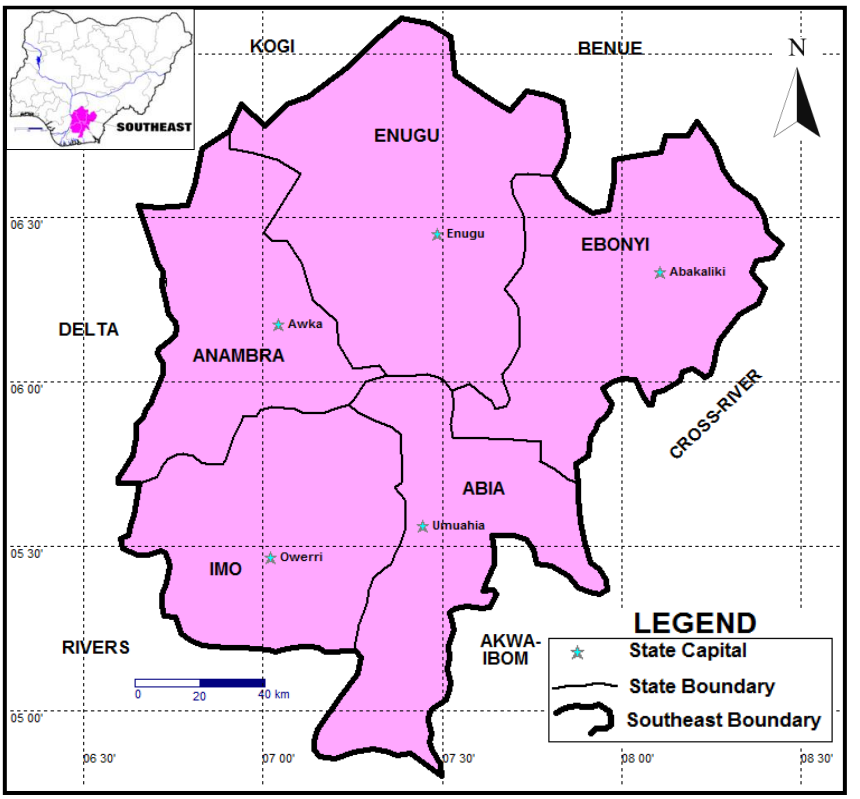

Figure 1: Southeastern Nigeria map
Source: GIS Lab., Department of Geography, University of Nigeria, Nsukka, 2015

2.2 Data source and Sample size

Structured questionnaire served as the major source of data for this study, and random sampling method was employed in the administration of the copies of questionnaire as shown in Table 1.Two States (Anambra and Imo) were selected due to their vulnerability and they being agrarian. In Imo State, only two Local Government Areas (LGAs) were affected by the devastating 2012 floods, so, for unbiased representation, two LGAs in Anambra State were selected for the study due to their vulnerability to flooding as well as being accessible.However, Anambra East and Ogbaru LGAs in Anambra State, and Oguta and Ohaji/Egbema LGAs in Imo State were selected for the study. A total of eight communities were selected (2 each from the 4 LGAs) using multi-stage sampling methods.Stratified sampling method was employed to select the actual number (copies) of questionnaire administered to respondentsin each community (Table 1) using the census figures.

The population of Anambra East, Ogbaru, Oguta andOhaji/Egbema LGAs were 152,149, 223,317, 142,340 and 182,891 persons respectively in the last official census conducted

in 2006 (National Population Commission, 2010) with a total of 700,697 persons. The population was updated in 2016 (first year of data collection) using equation 1 at the LGA level. The population of Anambra East, Ogbaru, Oguta andOhaji/Egbema LGAs used for the analysis became 205,401, 301,478, 192,159 and 246,903 persons respectively, making it a total of 945,941 persons. Census figures were published at least at the LGA levels, and not at community levels, hence, the use of LGA figures to justify the number of households sampled. The sampled communities, LGAs and States are shown in Figure 2.

$$P_2 = P_1 (1+r)^n \quad ...(1)$$

Where; P_2 is the projected population
P_1 is the known population (2006 in this case)
R is the rate of natural increase, 2.8% as noted by the United Nations, 2013.
n is the number of years between P_1 and P_2 (interval),that is, 11 years.

Notably, the respondents comprised household heads (mostly farmers) in agrarian communities whose households had experienced flooding and its associated effects between 2012 and 2017. Data were collected between 2016 and 2017.

Table 1: Sample size of the study

State	**Local Government Area (LGA)**	**Sampling size**	**Community Sampled**	**Household sampled**
Anambra	Anambra East	(205,401 / 945,941) x 400 = 87	Otuocha and Igboariam	2 communities (44 for one community and 43 for the other) = 44+ 43 households
	Ogbaru	(301,478 / 945,941) x 400 = 128	Ogbaru and Ossomala	2 communities (64 for each community) = 2 x 64 households
Imo	Oguta	(192,159 / 945,941) x 400 = 81	Oguta and Ezi-Orsu	2 communities (41 for one community and 40 for the other) = 41+ 40 households
	Ohaji/Egbema	(246,903 / 945,941) x 400 = 104	Mmahu and Opuoma	2 communities (52 for each community) = 2 x 52 households
Total		400	8	400

The sample size was determined using Yamane (1967) equation where the sampling size of any study is with a population between 100,000 and more persons, is 400 at +/-5% level of precision. It is given as;

$$n = N/[1+N(e^2)] \quad ...(2)$$

where;
n – is the sample size
N- is the population of Anambra East, Ogbaru, Oguta and Ohaji/Egbema LGAs
e – is the level of precision/sampling error i.e. 0.05.
N=205,401+301,478+192,159+246,903=945,941
$n = 945,941/(1+(945,941*0.05^2))$
n = 400 respondents

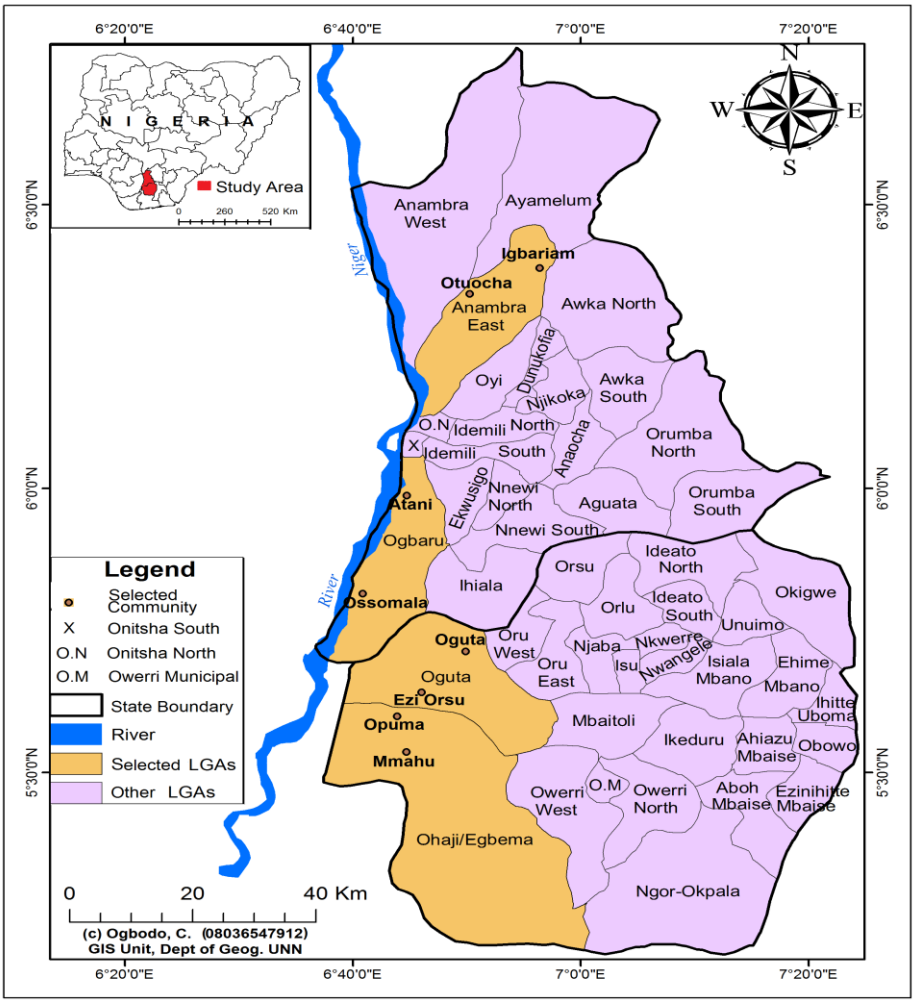

Figure 2: The study area showing the sampled Communities and LGAs
Source: GIS Lab., Department of Geography, University of Nigeria, Nsukka, 2016

2.3 Data Analysis

Descriptive statistics was used to illustrate the socioeconomic characteristics of respondents,
causes and effects of flooding

3. RESULTS AND DISCUSSION

3.1 Demographic and Socio-economic Characteristics of Respondents

The demographic and socioeconomic characteristics of the respondents are shown in Table 2. The study comprised 56.2% and 43.8%males and females as heads of households respectively. The analysis shows that majority (25.8%) of the respondents were between the ages of 40 years and above while 20.7% were between 30 and 39 years of age while a quarter were between 60 and 69 years. Only 1.2% were above 70 years and 6.3% were younger participants ranging from 20 to 29 years. The age distribution shows that majority (92.5%) of the participants were between 30 and 69 years with a resultant long years of stay in the communities. Majority (64.5%) were married with only 7.8% being single.Apart from farming which was predominant, other sources of livelihoods includes;hunting, fishing, trading, civil services, artisanship among others. In terms of number of years stayed in the community, majority (47.6%) had spent between 30 to 49 years in their communities while 11.2% had spent between 60 and 69 years. Only 2% indicated to have stayed <10 years in their communities and this is an indication that majority of the respondents had long years of farming experience since majority of them were farmers. Thus, they had adequate knowledge of the causes and effects of flooding over time. A quarter of the respondents were uneducated (25.8%) with only 21.1% having post secondary school education. Majority (53.5%) of the respondents had either Primary (First School Leaving Certificate (FSLC) or Secondary education (Senior Secondary Certificate Examination (SSCE), thus showing an average literacy rate. Moreover, majority of the households relied on agriculture (farming) as their main source of income/livelihoods making them highly vulnerable to flooding since their primary livelihood sources were climate-related.

Table 2:Social and economic characteristics of respondents

Characteristic	Component	Frequency	Percent (%)
Sex	Male	225	56.2
	Female	175	43.8
	Total	400	100
Primary sources of livelihoods	Farming	368	92.0
	Fishing	3	0.8
	Trading/Business	3	0.8
	Civil servant	26	6.5
	Total	400	100
Age	20-29Years	25	6.3
	30-39Years	83	20.7
	40-49Years	103	25.8
	50-59Years	84	21
	60-69Years	100	25
	70 Years & above	5	1.2
	Total	400	100
Marital status	Single	31	7.8
	Married	258	64.5
	Divorced	5	1.3

	Separated	27	6.7
	Widowed	79	19.8
	Total	400	100
Years stayed in community	Less than 10 Years	8	2
	10- 19Years	38	9.5
	20-29Years	60	15
	30-39Years	99	24.8
	40-49Years	91	22.8
	50-59Years	59	14.7
	60-69Years	45	11.2
	Total	400	100
Educational qualification of heads of households	Non formal	103	25.8
	FSLC	115	28.7
	SSCE	98	24.5
	NCE/OND	64	16
	B.Sc or equivalent	17	4.3
	M.Sc or equivalent	3	0.7
	Total	400	100

Source: Researcher's computation, 2017

3.2 Perceived Causes of Flooding

Eight (8) factors were identified by the respondents as influencing flooding, and their analysis reveals that 99.2% of respondents agreed that heavy rainfall is the primary cause of flooding (Table 3). This is interesting given that the study area receives around 1800 mm of precipitation annually, and that other studies have suggested that increased rainfall cause flooding, as confirmed by Akinsanola and Ogunjobi (2014).Heavy rainfall is perceived to have an impact on flooding, which happens when the rate of precipitation surpasses infiltration and the capacity of rivers and existing drainage systems to evacuate surface water.

As indicated by 85% of respondents, excess river discharge is the second major cause of flooding experienced in the study area. The most common type of flooding in the study area was river flooding, which generally happened when rivers overflowed their banks as a result of increased volume of water reaching the rivers at a point in time, thereby exceeding the rivers capacities.A significant portion of respondents 59% and 52% indicated that building/farming in floodplains and climate change caused flooding respectively. Flooding usually results from altering natural water pathways by building houses or farming in floodplains. Climate change have been noted to cause extreme climate variability and weather-related events like flooding as agreed by Syaukat (2011); Adishi and Oluka (2018) and Mba, Ezehand Umerah(2020). Other causes of floods that respondents mentioned were: lack of gutters; flat terrain; impervious surfaces; and God's vengeance (44.5%, 36.8%, 22.3%, and 10.3%, respectively). Similarly, flooding is caused by impervious surfaces and inadequate drainage facilities (such as gutters), result from excessive surface runoff that builds up faster than it can be evacuated. These findings are in tandem with the findings of Douglas et al. (2008); Etuonovbe (2011); Oladokun and Proverbs (2016) and Dan-Jumbo at al. (2018).

The topography of the study area is generally low lying, and vulnerable to flooding, thus the reason that flat terrain (low topography) formed one of the major causes of flooding. Flat terrain is worsened by heavy rainfall and inadequate drainage facilities because the rate of evacuation of excess run-off is often slower in areas with flat terrain than when the slopes are pronounced. The study of Oladokun and Proverbs (2016) agrees with inadequate drainage as a cause of flooding that even affect flood risk management in Nigeria.

Ironically, a few respondents believe that flooding represents God's wrath because they feel that they are being punished by God for an unexplainable reason.

Table 3: Households' perceived causes of flooding (n =400)

Cause of flooding	Percent (%)	
	Yes	No
Heavy rainfall	99.2	0.8
Excess river discharge	85.0	15.0
Flat terrain (low topography)	36.8	63.2
Climate change	52.0	48.0
Building/farming on floodplains	59.0	41.0
Wrath of God	10.3	89.7
Impervious surfaces	22.3	77.7
Inadequate drainage facilities (lack) of gutters	44.5	55.5

Source: Researcher's computation, 2017

Values in brackets are the number of responses or frequency

3.3Perceived effects of flooding

Table 4 shows that the effects of flooding in the study area consist of economic, physical, to emotional effects. According to the findings, majority (97.7%) indicated stream pollution as a major effect of flooding. It has been noted that a significant number of householdsget their drinking water from streams, so, stream pollution is one of the unavoidable effects of flooding in the study area. The results also show that 93.3%households have experienced the destruction of their farmlands due to floodingwhich has a detrimental implication on food security.

Table 4: Effects of flooding (n = 400)

Effect of flooding	Percent (%)	
	Yes	No
Loss of life	8.5 (34)	91.5 (366)
Destruction of farmland	93.3 (373)	6.7 (27)
Abandonment of property	30.3 (121)	69.8 (279)
Traffic jams	11.0 (44)	89.0 (356)
Loss of household property	17.7 (71)	82.3 (329)
Seasonal displacement	24.3 (97)	75.7 (303)
Loss of livestock	20.0 (80)	80.0 (320)
Stream pollution	97.7 (391)	0.3 (9)
Disease Outbreak	36.7 (147)	63.3 (253)
Emotional trauma	88.3 (353)	11.7 (47)
Disruption of income earning opportunities	92.7 (371)	7.3 (29)

Source: Researcher's computation, 2017
Note: Values in brackets are the number of responses or frequency
However, the study also revealed that 92.7% of the households had their income earning opportunities disrupted by floods which consequently caused 88.3% to experience emotional trauma.Farmers who obtained loans from banks for farming activities and experienced total loss due to the floods, suffered heartbreaks because of their inability to repay the loan. The highest degree of this emotional trauma is suicide, as reported by some respondents, and it agrees with the report of Ujumadu (2012).Flooding has led to disease outbreak (e.g. cholera) and abandonment of property particularly farmlands as were indicated by 36.7% and 30.3% respondents respectively. Other effects are loss of life, household property and livestocks (including fish ponds) which were indicated by 8.5%, 17.7% and 20% respectively. Traffic jam as an effects of flooding was indicated by 11% of the respondents residing mostly in Atani, Oguta, Otuochaand Mmahu communities that are LGAs' headquarters. In addition, seasonal displacement due to flooding is reported by 24.3% respondents, since flooding forced some households to migrateto safer land. The findings of this study are in tandem with those of Jeb and Aggarwal (2008); Ogba and Utang (2008); Adeloye and Rustum (2011); Etuonovbe (2011); Olorunfemi (2011); Odufuwa et al. (2012); and Adewuyi and Olofin (2014); Olanrewaju et al. (2019).

Finally, the findings show that flooding is a kind of stressor that negatively impacts households, with the most common effects in the study area being stream pollution, destruction of farmlands, disruption of income earning sources and emotional trauma. Since the households in the study area are mostly agrarian, majority of homes in South eastern Nigeria are adversely affected by flooding.

4. CONCLUSION

The study investigated the causes and effects of flooding in agrarian communities of Southeastern Nigeria. Flooding in the study area is primarily caused by heavy rainfall, excess river discharge, building/farming on floodplains,climate change, low topography, inadequate drainage facilities, impervious surfaces and wrath of God in descending order.However, heavy rainfall was found to be the major cause of flooding as it exacerbated the degree of influence of the other factors that caused flooding in the study area.
Eleven effects of flooding were identified in the study area range made up of physical, economic, and emotional impacts. Stream pollution and destruction of farmland were reported as the major effects of flooding followed by disruption of income sources, emotional trauma, disease outbreak, abandonment of property, seasonal displacement, loss of livestocks, loss of household property, traffic jam and loss of life. Some of the effects are interlinked e.g. destruction of their farmland leads to food insecurity while disruption of their income earning sources leads to emotional trauma that caused some to take kill themselves. Notably, the study area is vulnerable to flooding and largely agrarian, thus, households record devastating damages as their sources of livelihoods are affected by perennial floods.

5. RECOMMENDATION

In the face of the identified causes and effects of flooding, the following recommendations that centres on mainly reversing or tackling the factors that cause flooding have been made.

a) Constructing standard drainage facilities that can accommodate large volumes of runoff and properly channel them to their discharge points.
b) Coordinated urban planning involving landuse zoning, so, people are penalized for building in flood pathways.
c) Providing food safety nets to improve resilience for flood victims in times of flood disasters since their communities are vulnerable to flooding.
d) Creating awareness of the importance of early flood warning and adhering to the instructions as this would prepare them for flood disasters, thereby minimizing the effects. Implementing the recommendations would foster an inclusive, safer, resilient and sustainable human settlements in the South-eastern region of Nigeria as enshrined in Sustainable Development Goal 11.

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