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Assessment of flood occurrence and vulnerability in Kabba/Bunu local government area, Kogi State, Nigeria

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Abstract

Flood is one of the malevolent effects on the environment that affects man adversely hence needs to be monitored and managed to avoid loss of lives and property. This study assesses flood occurrence and its vulnerability in Kabba/Bunu Local Government area of Kogi State Nigeria. The achieved objectives were mapping out the extent of flood in the area, identifying factors responsible for flooding in the area, and assessing the socio-economic impact of flood in the area. Both primary and secondary data were explored for this study. The primary data used are questionnaire administration and the geographical locations of the area. The secondary data includes; the Sentinel data, Landsat 8 imagery 2021, Aster DEM, and soil data of the study area. However, 50 questionnaire sample size was purposely selected and distributed randomly. Descriptive statistical analysis was performed on the data using frequency and percentage to check the impact of the flood on the environment. Filtering analysis was performed on the Sentinel data to check the flood extent in the study area. Band combination was performed on the Landsat bands (5, 4, 3) and the unsupervised classification method was embraced using the Iso-cluster algorithm to achieve the Landuse and cover of the study area. The drainage of the study area was generated by inputting Aster DEM into the hydrological model of HEC_RAS software and the drainage density was computed using line density calculation. The elevation of the area was generated using the surface analyst tool in the GIS environment on the ASTER DEM. The identified factors such as Landuse, drainage, elevation, and soil were reclassified according to the flood rating scale to identify the vulnerability areas. The result of the flood extent shows 25.6% (67187 Ha) of the study area was flooded. The factors responsible for flood in the study include; soil which is categorized into sandy clay loam covers 17% of the land coverage while sandy loam covers 28.5% and loamy sand covers 54.5%. The elevation ranges from 75m to 649m, and the land use and cover were classified into vegetation (89224Ha), built-up (69874Ha), water body (269 Ha), and rock (269 Ha). The study shows that there is an impact of flood on the environment when all the impact factors were strongly agreed and agreed to by the respondents.

Keywords: Flood; Vulnerability; Environment; Drainage; and Elevation; AsterDEM

1. Introduction

An extension of the social impacts of floods is well exposited in the submission of [1] that the negative effects of floods are significant on the well-being of the affected population leading to the destruction of their overall happiness. A flood is an overflow of an expanse of water that submerges the land [2]. Floods, as one of the most common natural hydrological hazards, have been occurring in floodplains for millennia. They are caused by river overflows, heavy rainfall, tidal surges, snow melts, and groundwater seepage. Floods are of many types including flash flooding, flooding due to the rising of groundwater, coastal flooding, and flooding due to the opening of a dam or reservoir [3], [4].

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Flood hazards are the most common and destructive of all-natural disasters and are floods threat to life and property and each year, flood disasters result in tremendous losses and social disruption worldwide [2]. From history, floods as affected millions of human populations and caused fiscal losses amounting to billions of US dollars [5]. Floods not only affect the victims, but also have a great gross effect on the national economy of the country where the poverty level rises due to the incidence [6].

However, flood risk in metropolises is increased by urban development and other combinations of physical exposure which has altered its hydrological conditions [7]. Flood risk is linked to the exposure of social systems to flood hazards (in the form of flood water depth, extent, duration, and velocity of flow) and their vulnerabilities (the propensity to be adversely affected by flooding caused mainly by lack of coping capacity) [8].

Consequently, there is a great need to better manage floods and therefore, scientists and various organizations have developed structural and non-structural measures to achieve this goal. Structural measures such as dikes, embankments, and levees seem not to be effective in the long run, because these measures can only reduce the flooding problem to a certain extent [9]. Furthermore, because the current structures are designed and constructed based on the flood events from the past, they have a larger risk of functional failure in case of a larger flood in the future. Therefore, non-structural measures complement structural measures such as flood risk zoning based on flood modeling and this is achieved through geospatial technology, which offers additional insights and support for flood management. Geospatial technology has helped flood management by predicting flood occurrences, determination of flood risk zones, and flood hazard zones, and mapping flood plans [10]. The produced maps are vital components for appropriate land use allocation in flooded areas, it also creates easy visualization and rapid accessibility to information which facilitates the identification of risk areas and prioritizes their mitigation effects [11].

Moreover, the provision of real-time notification of flooding alerting systems and other approaches such as; hydraulic engineering and low-impact development (LID) are beneficial for decreasing the impact of flood disasters on the lives of people [12], [13], [14], [15].

This study assesses the flood occurrence and its vulnerability in kabba/bunu local government area of Kogi State Nigeria with the objectives of mapping the flood extent in the area, identifying factors responsible for flood in the area, and assessing the socio-economic impact of flood within the area.

1.1. Study Area

Kabba/Bunu is a Local Government Area in Kogi State, located on Longitude 6º 0'0' to 6º 30'0' 'and Latitude 7º 45'0'' to 8º 15'0'' in the North Central part of Nigeria (Figure 1). The local government is also located in the Western Senatorial district of Kogi state. Its headquarters is located in Kabba town. It has an area of 2,706 km². Kabba/Bunu L.G.A shares boundary with Okene, Ijumu, Lokoja local government of Kogi state and Omuo-Ekiti in (Ekiti state). Some of the notable communities in Kabba/Bunu local government area include: Kabba, Oke-bukun, Iwaa, Apaa-Bunu, Aiyegule-Bunu, Igun-Bunu, Odo-Ape, Iluke-Bunu, Aiyede-Bunu, Ofere-Osomle-Bunu and Illah-Bunu [16].

The local government is an agrarian community with a humid tropical climate. Rainfall spans from April to November with the peak in July to September. It has high temperature and high humidity [17]. The dry season extends from December to March. The mean annual rainfall is 59%. The main vegetation cover type of the area is the Southern Guinea Savannah zone of secondary forest with the dominant type being savannah woodland consisting of trees of varying species and scanty tall grasses, shrubs, wild oil palm, while some parts of the area however been put to cultivation of arable crops like maize, vegetables (Okro, pepper), sorghum and tubers such as yam and cassava [16]. These vegetation types are green in the rainy season with fresh leaves and tall, but the land is open during the dry season, showing charred trees and remains of burnt grasses. The trees which grow in clusters are up to six meters tall, interspersed with grasses that grow up to about three meters. These trees include locust bean, Shear butter, oil bean, and *isoberlinia* trees [18]. The study area has two main rock types, namely, the basement complex rocks of the Precambrian age in the western half extending slightly eastwards beyond the lower Niger Valley and the sedimentary rocks in the eastern half. The various sedimentary rock groups extend along the banks of River Niger and Benue and Southeast wards through Enugu and Anambra States, to join the Udi Plateau [18].

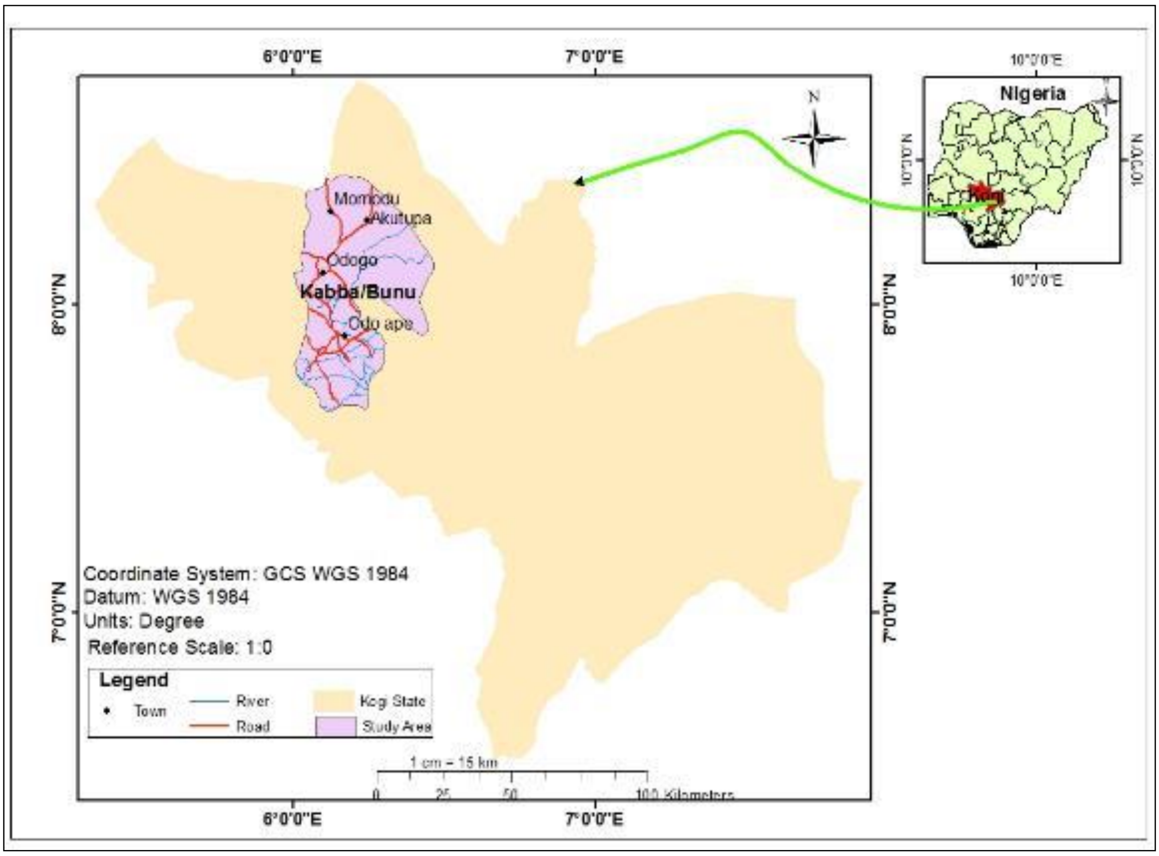

Figure 1 Study Area

2. Materials and method

This section shows the data and methods used in achieving all the set objectives of this study (Figure 3.1). The study includes; the data type and use, data sources and other geospatial and statistical analyses.

2.1. Data Type and Sources

Both primary data and secondary data were used in this study. The primary data includes; the geographical coordinates of locations in the study area and the questionnaire to assess the impact of flood on the environment. The secondary data includes; Landsat image used to quantify the Land use and cover of the study area; the soil map shows the soil types in the area and the ASTERDEM was used to determine the elevation of the study area.

2.2. Primary data

A well-structured questionnaire was administered using a multistage sampling technique. The sampling techniques include purposive sampling used to determine the general sample size and the sample size per community and Simple random sampling was used to select households for the study. Purposive sampling is entirely based on the judgment of the researcher, in that a sample is composed of elements that contain the most characteristics, representative or typical attributes of the population

2.3. Secondary Data

LandSat8 imagery of 14th of April 2020 with the path 189 row 055 and path189 row054 were acquired for this study from the United States Geological Service (USGS) archive. It has the spatial resolution of 15 meters for panchromatic, 30 meters for multispectral bands and 100 meters for thermal. Landsat 8 is a multispectral image in which the same scene is recorded simultaneously in several bands of the electromagnetic spectrum. The accuracy of its Operational Land Imager (OLI) has 12 meters circular error at 90% confidence while its Thermal Infrared Sensor (TIRS) has 41 meter circular error at 90% confidence. The Landsat image is used for the classification and mapping of land use and cover of the study area.

The ASTER DEM with 30m resolution was also acquired from the USGs website, the soil map of the area was acquired from Nigeria geological survey, and the administrative boundary of the study area was acquired from state ministry of land Kogi state. Sentinel1B data of 2018-09-22 was acquired from the NASRDA archive which was used to determine the flood extent of the study area.

2.4. Data Analysis

2.4.1. To Map Out the Extent of Flood in The Study Area

To achieve this objective, the acquired sentinel 2018 data of the study area was filtered using a filtering algorithm to enhance the image for the recognition of the flooded area, and the features were categorized.

2.4.2. Identify factors responsible for flood in the study area

The factors responsible were identified from the literature and factors that may be responsible for flood in the study includes; land use/cover of the area, digital elevation model (DEM), soil, stream network (drainage).

2.4.3. Land use/Land cover of the study area

Landsat 8 image of year 2020 was acquired and band combination of band 543 was created showing the false colour composite of the scene. The image was overlaid on the study area shape file and sub-mapped. The unsupervised classification iso-cluster algorithm was used for classification and USGS scheme was used for the arrangement of identified features in the area of study

2.4.4. Digital Elevation Model

Digital elevation model was generated from ASTERDEM using surface analysis algorithm in the GIS environment.

2.4.5. Soil type

The soil map was acquired from Nigeria Geological survey, scanned, digitized and the study area part was extracted. The various soil types were identified and interpreted via soil textural triangle. The percentage of the various soil compositions was computed and used for the final identification of soil types in the study.

2.4.6. Drainage network

The drainage, were generated from ASTERDEM using hydrological model in HEC_RAS software after passing the process of filling, flow accumulation, direction, steam definition stream sink and order.

2.4.7. Assessing the socio-economic impact on the people in the environment

The sample size was selected using a purposive sampling method and a questionnaire was administered. Data entry was done using Epi-Data and exported into SPSS for analysis, descriptive statistic was used such as frequency and percentage to know the impact, and the results were displayed in tables and graphs.

Table 1 Data, Type, Sources and Year

S/N	Data	Data Type	Source	Year
1	Landsat 8 image	Secondary	https://www.usgs.gov/	2020
2	ASTER DEM	Secondary	https://www.usgs.gov/	2020
3	Sentinel 1B	Secondary	NASRDA	2018
4	Questionnaire	Primary	Fieldwork	2021

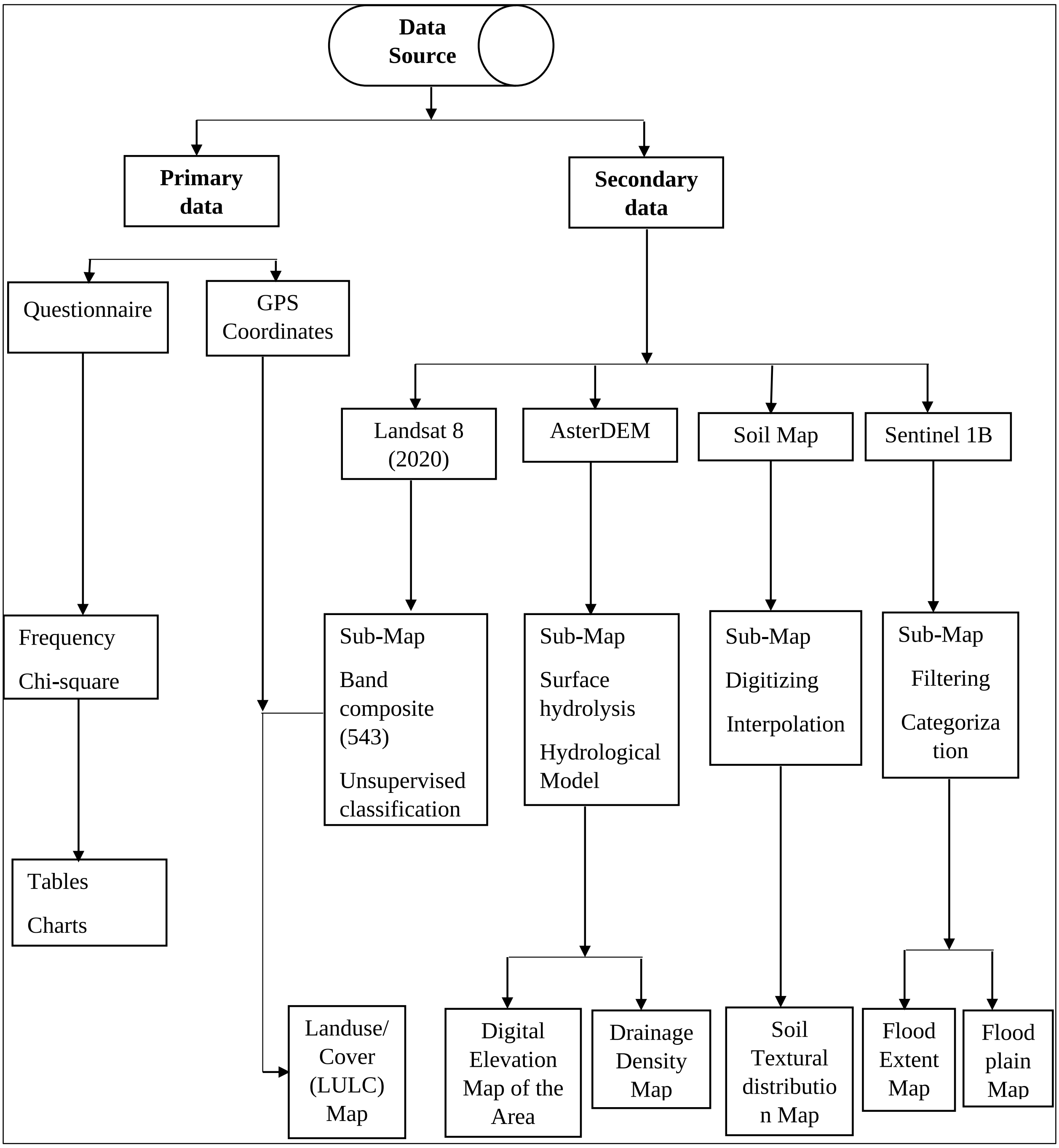

Figure 2 Methodology Workflow

3. Results and analyses

3.1. Flood extent

The flood 2018 occurrence of the study area was achieved using the sentinel radar data and SNAP software was used to carry out the enhancement process to bring out the flooded area. 25.6% (67187 Ha) of the study area was flooded while the other parts were not flooded with 74.4% (201562 Ha) (See Figure 3). The flooded area around the water channels is affirmed by [19], [20], [21], [22]. All the locations experienced flood occurrences in 2018. This has led to the destruction of properties and disruption of activities in this environment in 2018.

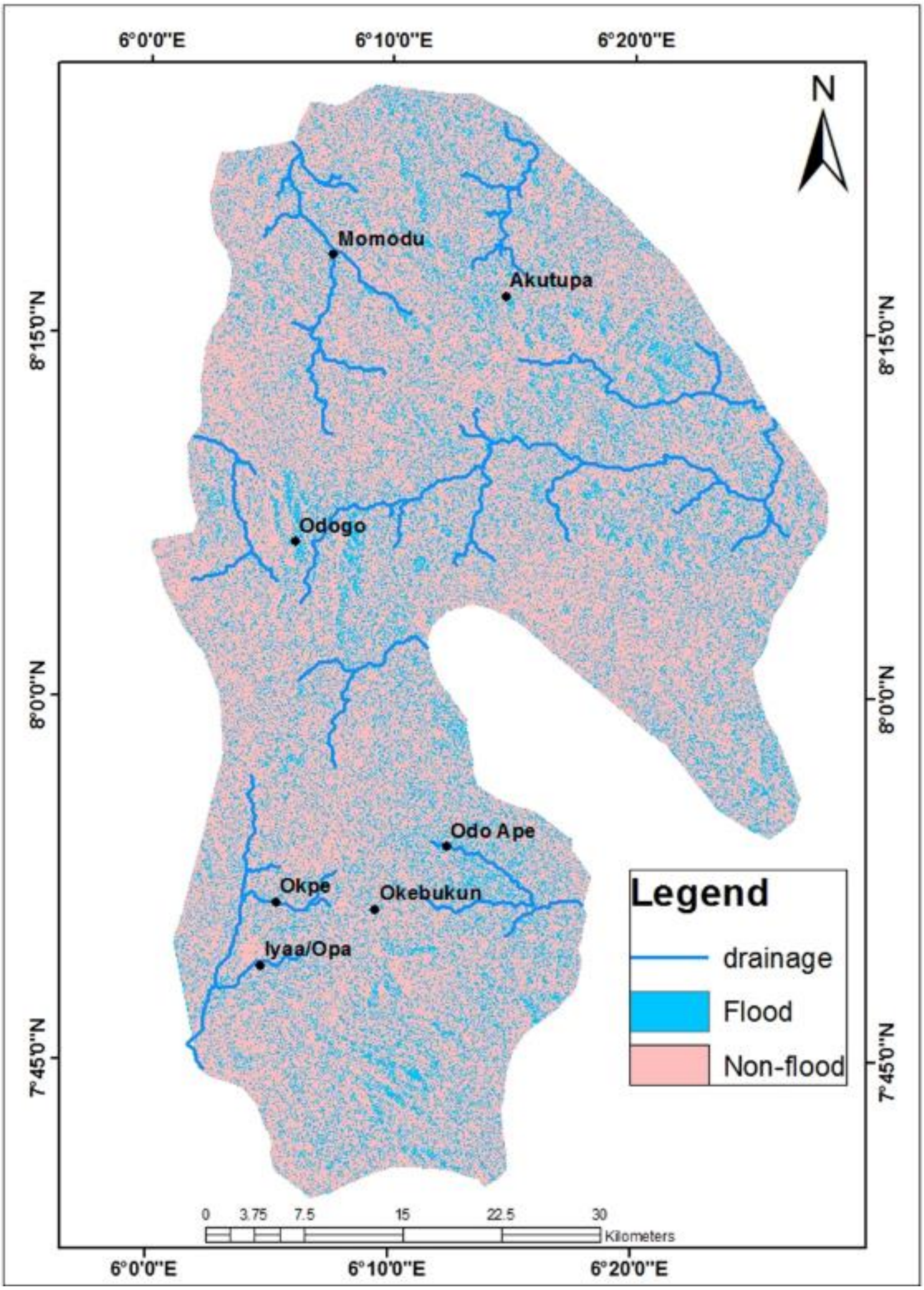

Figure 3 Flood Extent

3.2. Identify various factors responsible for flooding in the study area

The Identified factors include; soil texture, the digital elevation of the area, flood plain and the land use and cover.

3.2.1. Soil as a factor

Flood occurs when the soil cannot hold any more water or the rate of rainfall is higher than the rate at which water is infiltrated by the soil. The excess water accumulates on the surface and generates force causes damage to humans and extends to properties. Soil serves as a natural sponge that can absorb flood water and store it within its profile and soil has the potential of mitigating the impact of floods by accepting large quantities of water into it. Where the soil water intake capacity is limited due to the concrete layer which is an inherent property, infiltration is impaired. The soils that have limited capacity in holding water, could naturally be prone to flooding. The soil of the area is classified into three according to its types namely; Sandy clay loam; sandy loam and loamy sand (See Figure 4). Soil textural triangle was used for textural interpretation of the soil such as; the sandy clay loam has a proportion of (50% sand, 50% clay, and 10% silt) while sandy loam (has 70% sandy, 30% clay, and 20% silt); and loamy sand has (80% sand, 10% clay and 9% silt). Relating each of the soil types to the flood vulnerability rating scale; loamy sand is more vulnerable followed by sandy loam which is moderately vulnerable and sandy clay loam is non-vulnerable in the study area. This was confirmed by [23] if drainage is impeded in the drained soils, this leads to greater slumping and surface sealing which exacerbates overland water flow. In the study, the sandy clay loam covers 17% of the land coverage while sandy loam covers 28.5% and loamy sand covers 54.5% land coverage (See Figure 5 and Table 2). The ease or difficulty in the movement of water into the soil determines to a large extent whether land flow will occur. When the rate at which water is supplied to the soil has exceeded the rate of absorption by the soil, there would be enough water accumulation on the surface to cause floods on flat and valley areas and runoffs will occur following the slope gradient in the landscape. Knowledge of soil water intake is required as an indicator in determining the vulnerability of an area to flood. Infiltration in soils is also governed by other primary soil properties such as bulk density, porosity, soil permeability, and hydrologic conductivity [24].

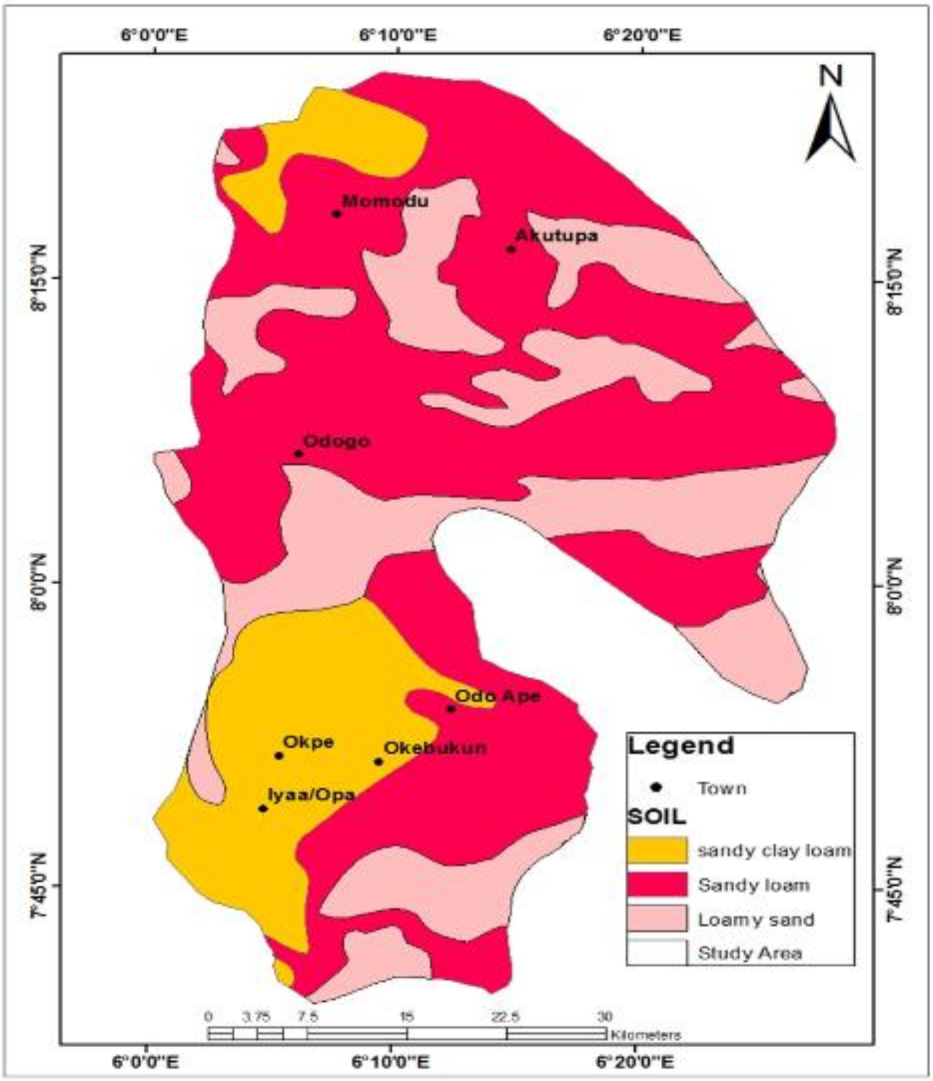

Figure 4 Soil texture of the study area

Table 2 Soil type and ranking

S/N	Soil type	Percentage (%)	Area (Ha)	Ranked
1	Sandy clay loam	17	45687	1 very low
2	sandy loam	28	75249	3 moderately
3	loamy sand covers	54.5	146468	5 very high

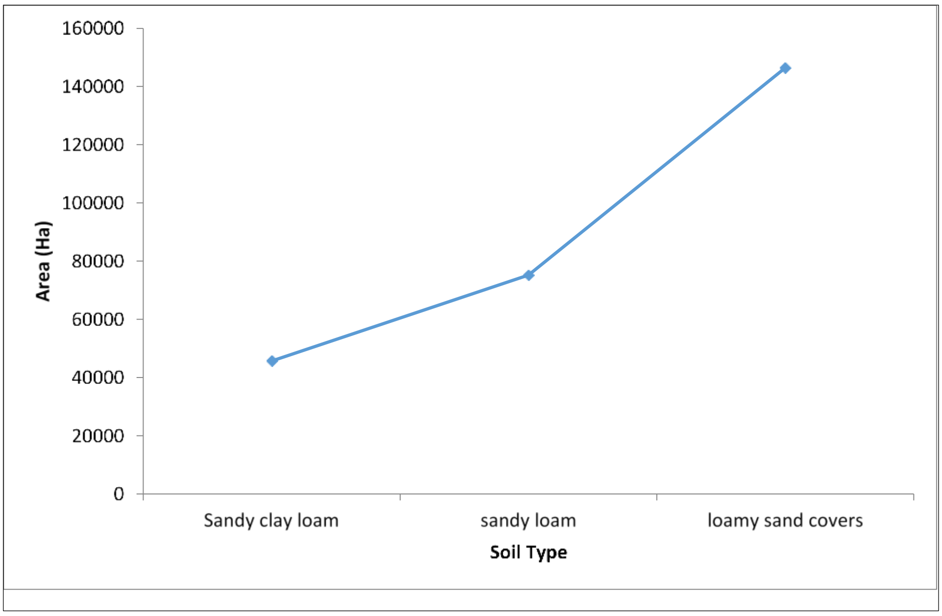

Figure 5 Soil Coverage in Hectares

3.2.2. The Elevation

A digital elevation model (DEM) is a predominant source of elevation data due to its simplicity and easy-to-use data. A DEM provides gridded elevation data in a raster structure that represents the terrain's surface. A DEM is commonly generated by extracting surface features from a digital surface model (DSM). Elevation is an important element that contributes to flood occurrence in an area [25]. A very steep slope allows free movement of water along the path while an area with a flat slope will allow the gathering of water thus causing the flood. Figure 6 shows the digital elevation model of the study area and it categorised into three classes according to the range of values attached such as; 75 - 278 (m) with 32.7% of land coverage while 278 – 399 (m) covers 33.9% of the land and 399 – 649 (m) with 33.4% of land cover (See Figure 7 and Table 3). The class range of 75 – 278 (m) is plain with the lowest elevation in the study area and the areas with that portion are highly vulnerable to flood such as in Mododu. The highest elevation in the study area ranges from 399 – 649 (m) and the areas that are located here that are not vulnerable to flood and the area are; Okpe; Okebukun and Odogo. DEMs have a great influence on producing accurate and reliable maps in the field of flood simulations. Using these maps helps in disaster risk reduction and management, especially in identifying specific areas that need to be prioritized for providing appropriate flood risk management measures to be taken to combat flood disaster.

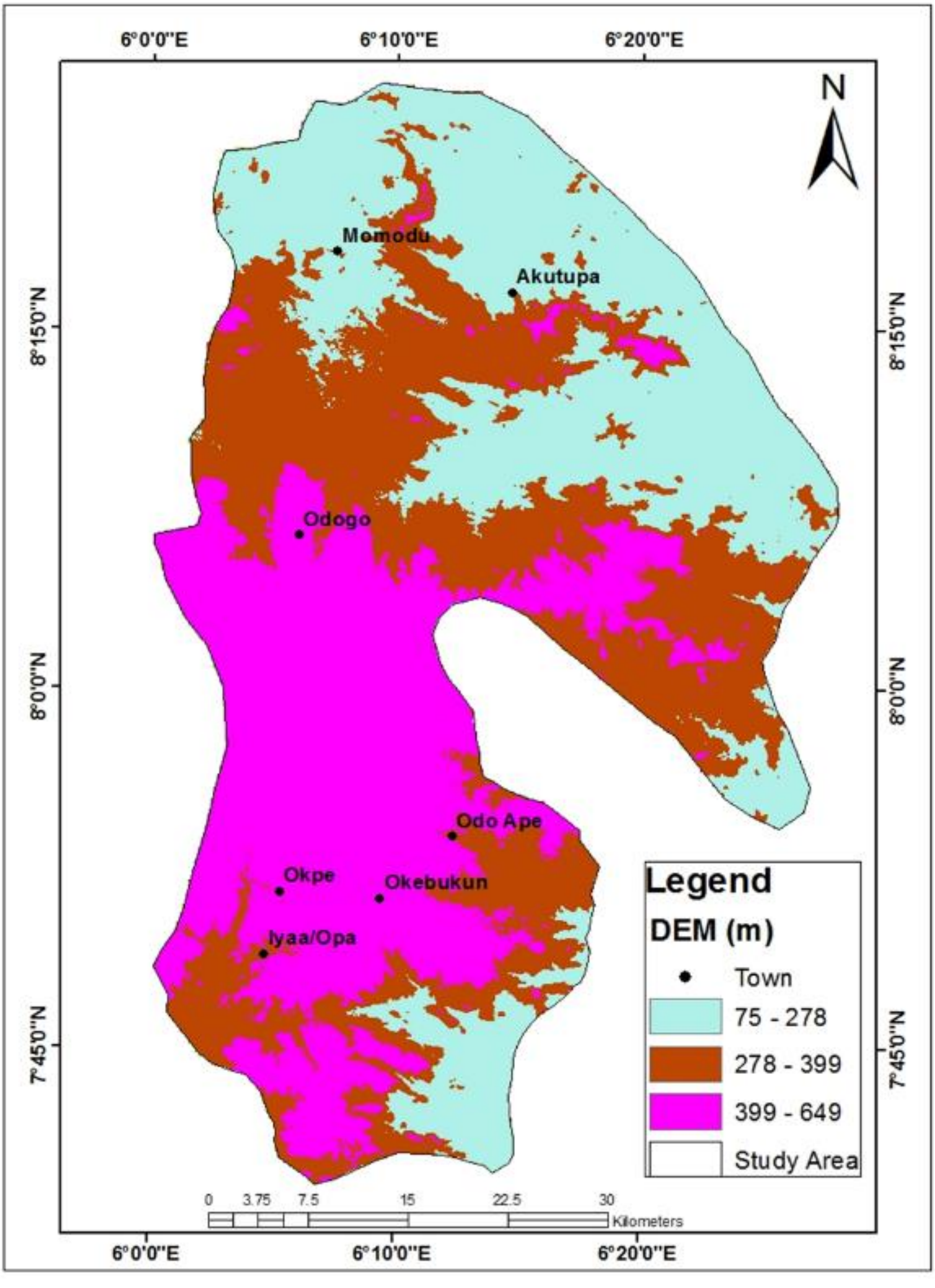

Figure 6 Digital elevation of the study area

Table 3 Elevation Type and Ranking

S/N	Elevation	Percentage (%)	Area (Ha)	Ranked
1	75 – 278 (m)	32.7	87880	5 very high
2	278 – 399 (m)	33.9	91105	3 moderately
3	399 – 649 (m)	33.4	89762	1 very low

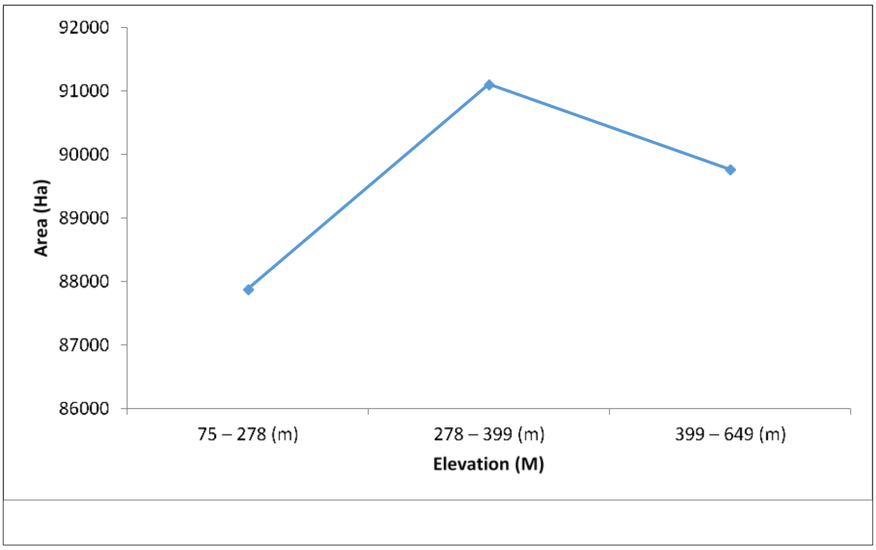

Figure 7 Elevation Hectares

3.2.3. Landuse and Landcover

Land cover describes features such as forests and water bodies that cover the earth while land use refers to the various ways by which land is used [26]. This could be for settlement and agriculture amongst others. Land use contributes to flooding especially where adequate planning for effective land use management is not considered. In such situations, houses are built haphazardly, vegetation indiscriminately removed and farmlands are cultivated without consideration for waterways and so on. These human activities amongst others create an imbalance in the natural environment hence, causing floods in the area affected.

However, land use and cover of the study area were classified using the unsupervised classification algorithm known as Iso-cluster, and the land use and cover classified features in the study area are; vegetation, built-up, rock, and water bodies with 33.2%, 26%, 0.1% and 0.1% land coverage respectively (See Figure 8, 9). The vegetation took the larger portion in the study area with the (89224Ha) followed by the built-up (69874Ha) and water body (269 Ha) and rock (269 Ha) took the same portion in the study area (See Figure 8, 9 and Table 4). According to the influence of the flood rating scale, the waterbody is rated higher> Built_up> vegetation> rock in that other. The water body was ranked high because most time floods occurred around the river boundary due to the intensity and high velocity of water flow. The built-up ranked second highest contributor to flood because building on the river channel obstructs the water flow which leads to flood. This ranking of land use and its contribution to flood is confirmed by [26].

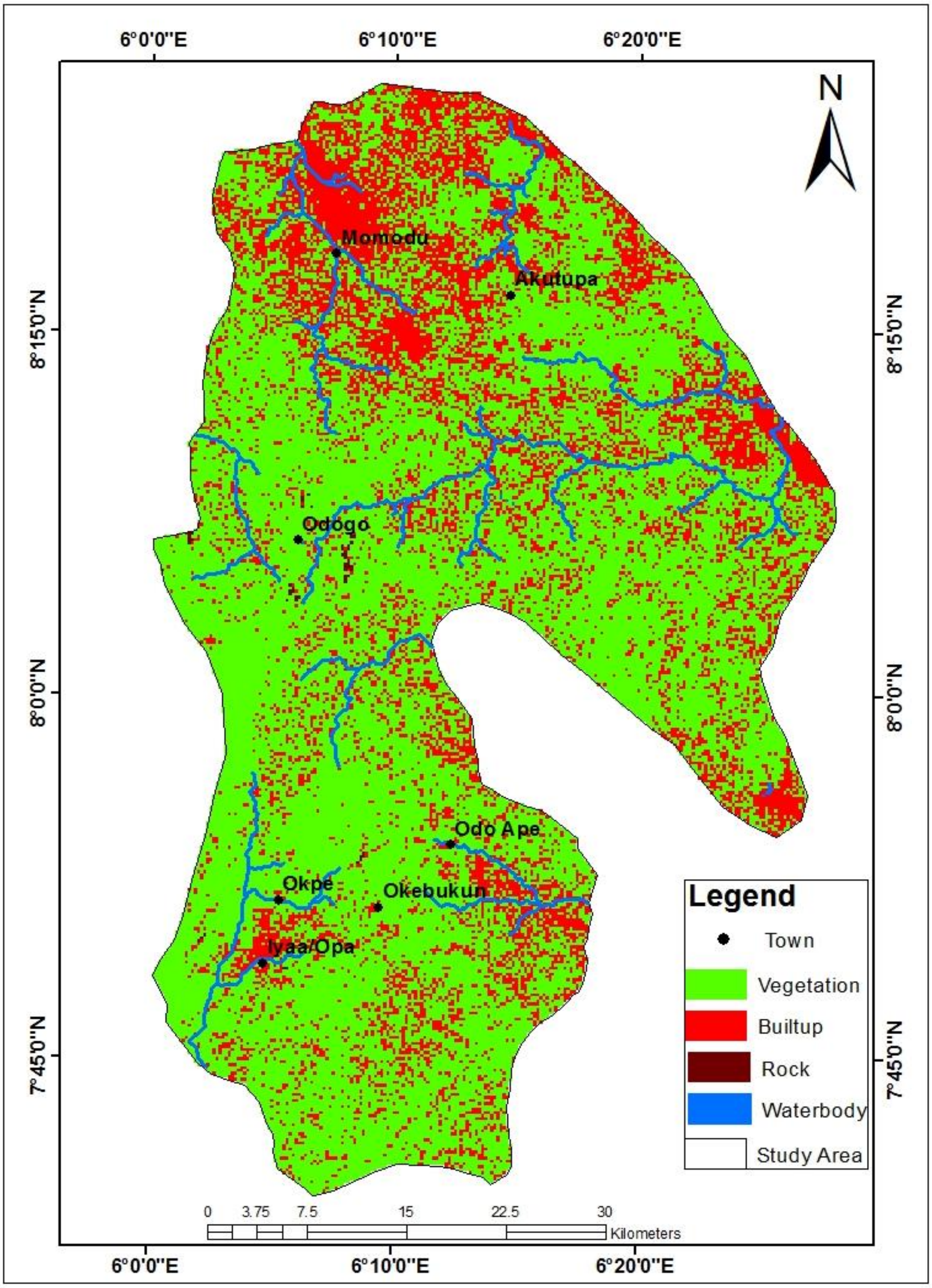

Figure 8 Land Use and Cover of the Study Area

Table 4 Land Use and Ranking

Feature	Percentage (%)	Area (Ha)	(Ranked)
Waterbody	0.1	269	5 (very High)
Built-up	26.0	69874	4 (High)
Vegetation	33.2	89224	2 (Low)
Rock	0.1	269	1 (Very low)

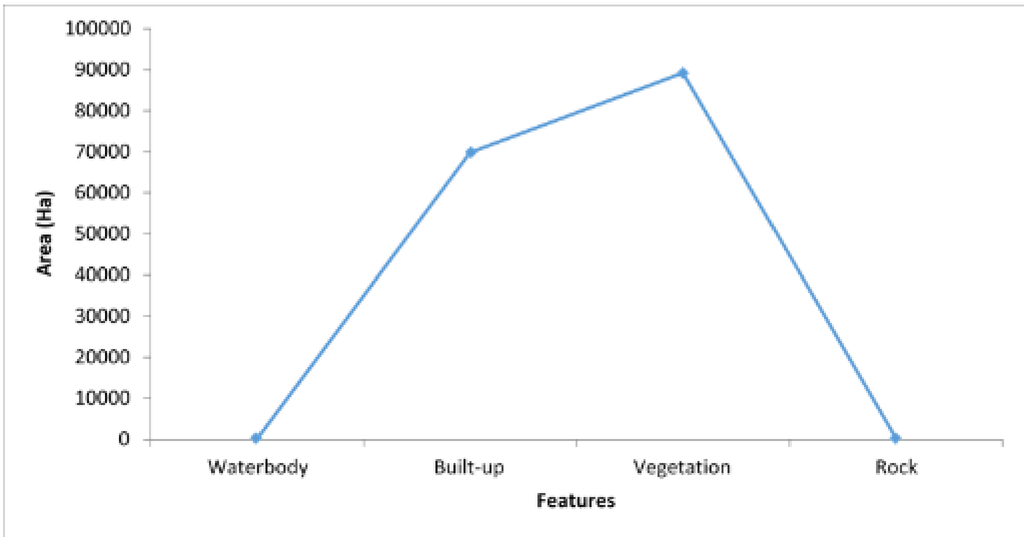

Figure 9 Land Use and Cover Area in Hectares

3.2.4. Drainage and Drainage Density

Figures 10, 11, and 12 show the generated drainage, flood plain, and the drainage density of the study area. The drainage was generated using hydrological model in hectras software and the drainage was buffered 100m which formed the flood plain. The area that is within the flood plain is highly vulnerable to floods such as; Odogbo, Okpe, Odo-ape, Iyaa/opa, and Momodu (See Figure 11). The drainage density of the study area shows the total length of all the streams and rivers in a drainage basin divided by the total area of the drainage basin (See Figure 12). The line density module was used to achieve this which calculates a magnitude per unit area from polyline features that fall within a radius around each cell. The drainage density layer was classified into five classes such as; 0 -11.79; 11.79 - 33.84, 33.84 – 53.84, 53.84 – 74.85, and 74.85 – 130.75 (See Figure 12). In the classification process, an area with a higher drainage density is very highly affected by flood and then ranked as class 5, which is 10212 Ha. Following the very high hazard class (16124 Ha) ranked as class 4, moderate (35475 Ha) ranked as class 3, low (24187Ha) ranked as class 2, and very low ranked as class 1 (180868Ha) (See Table 5). Mododu is highly vulnerable according to (See Figure 6) and the other vulnerable areas include; Okpe, Iyaa/opa, Odaope, and Odogo. While the very low or vulnerable areas are Okebukukun and Akutupe.

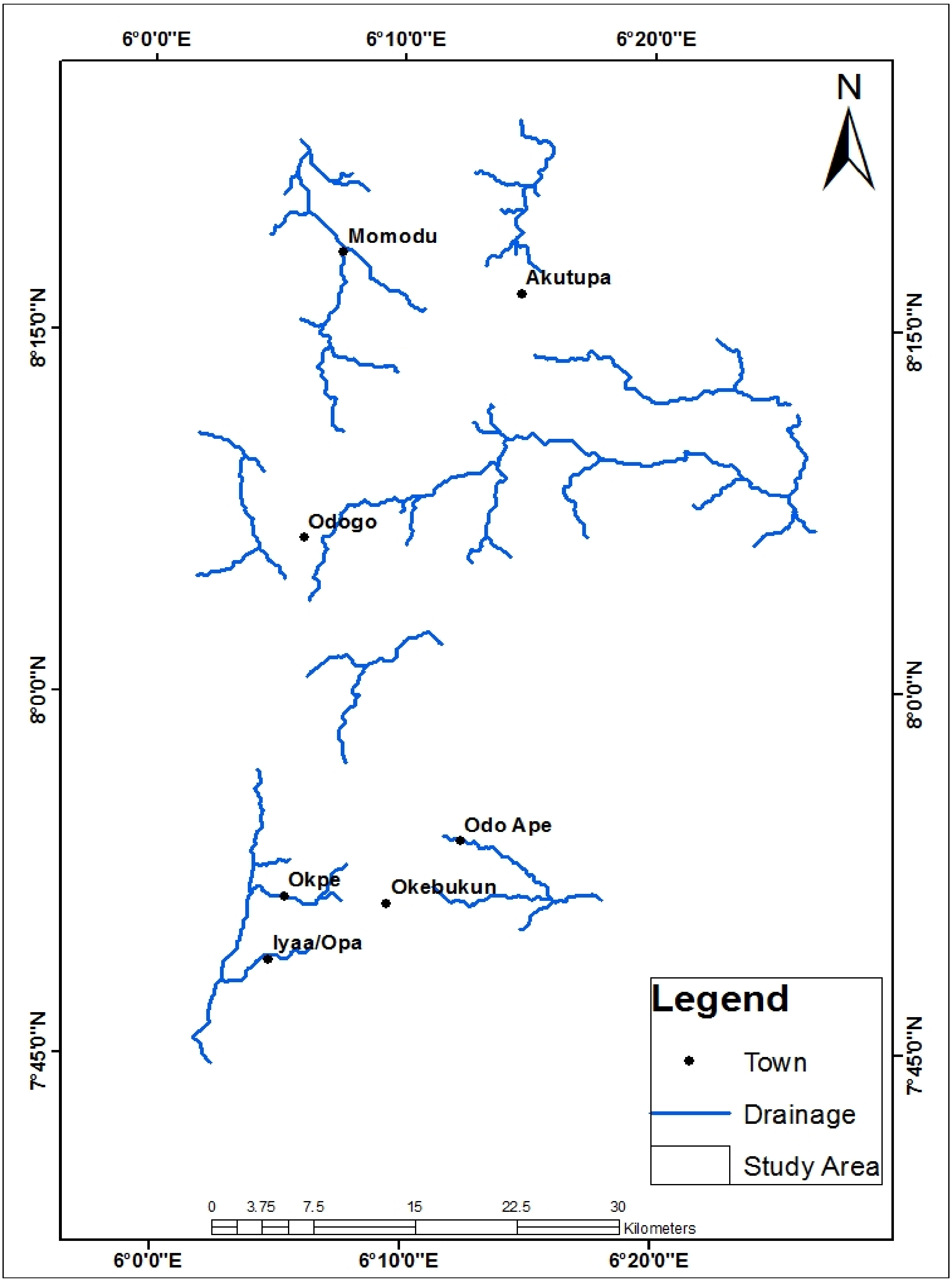

Figure 10 Drainage of the Study Area

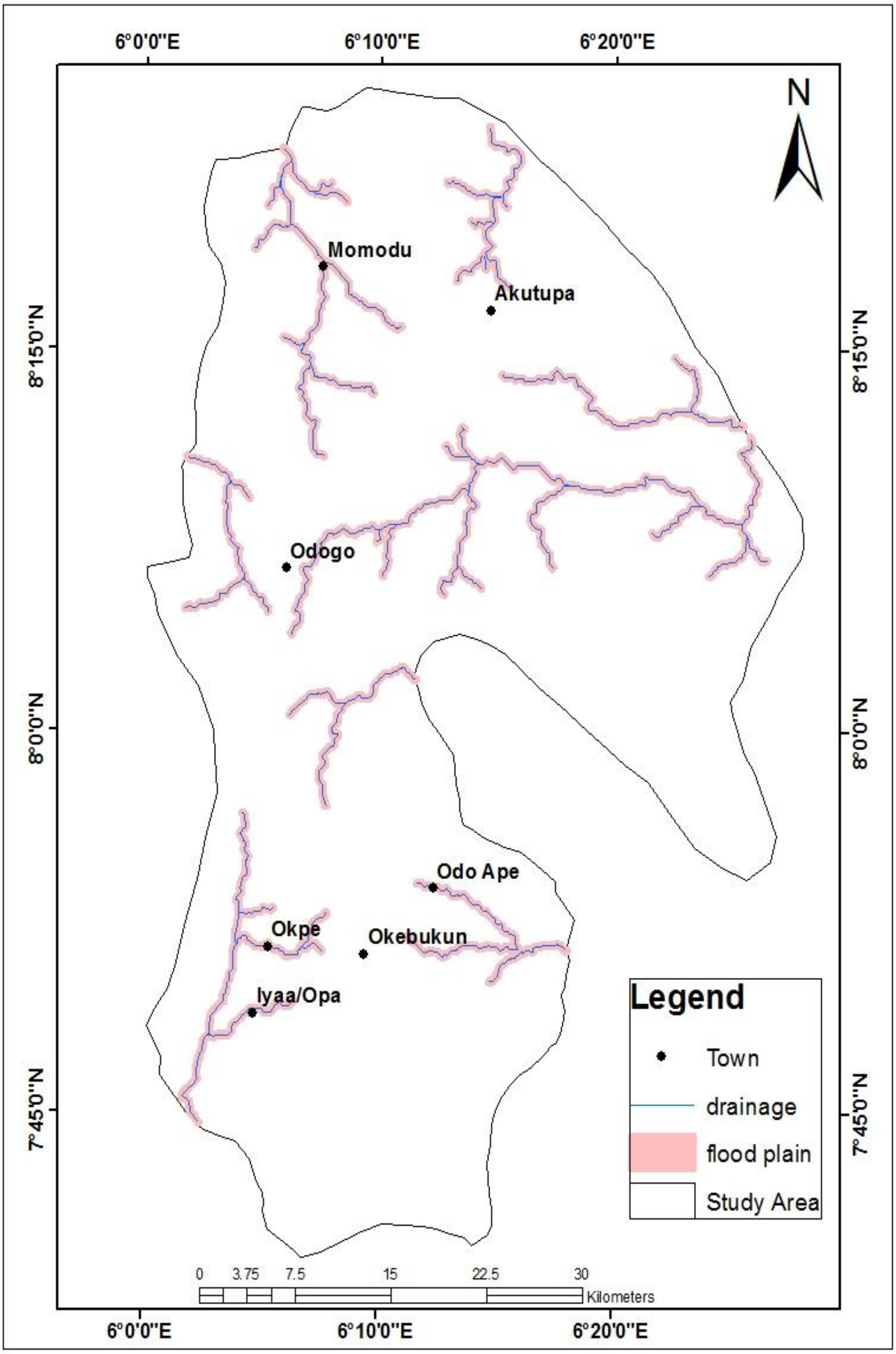

Figure 11 Flood Plain of the Study Area

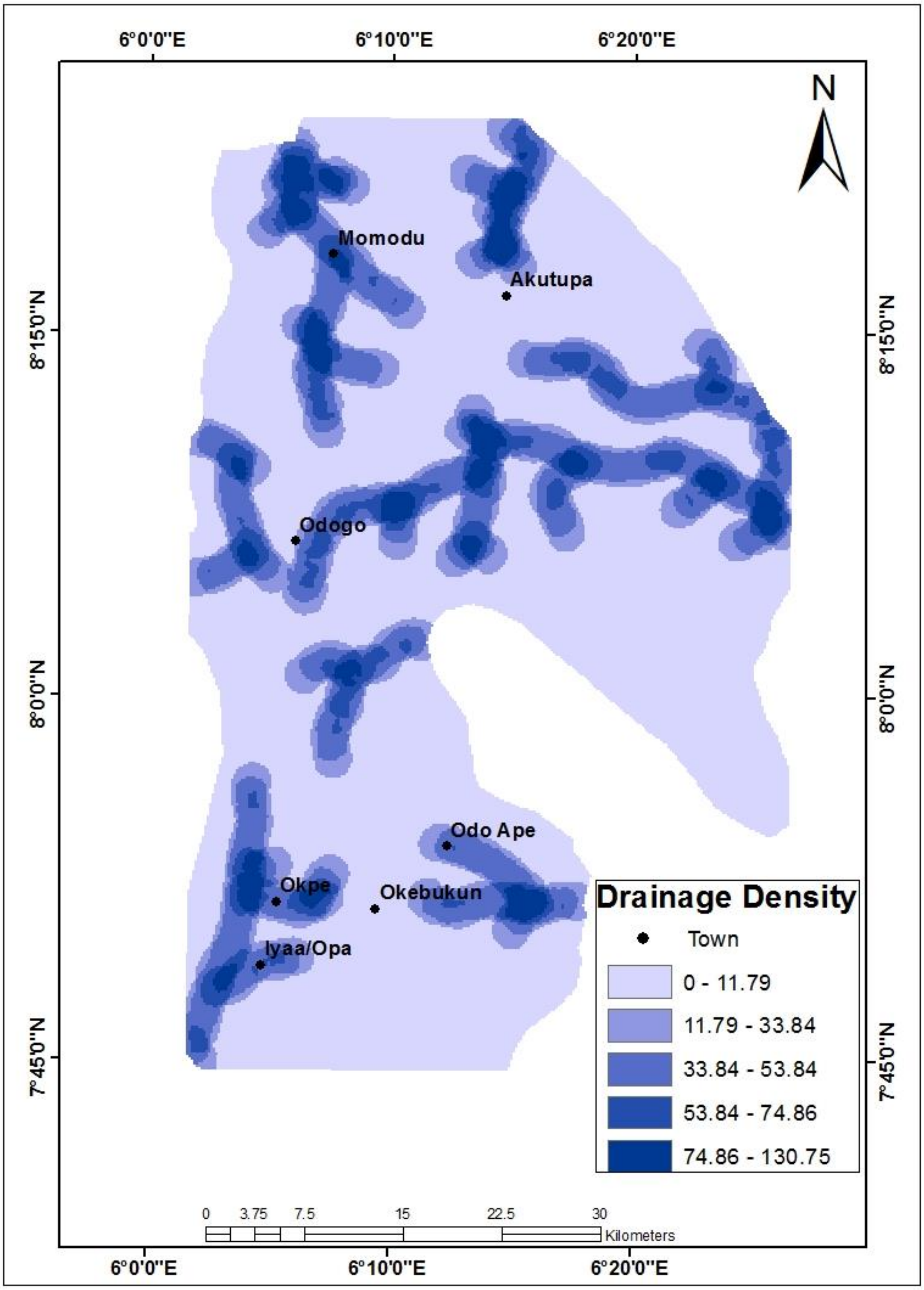

Figure 12 Drainage Density

Table 5 Drainage Density and Ranking

Density Range	Percentage (%)	Area (Ha)	(Ranked)
0 – 11.79	67.3	180868	1 (very low)
11.79 – 33.84	9.7	24187	2 (low)
33.84 – 53.84	13.2	35475	3 (Moderate)
53.84 – 74.85	6.0	16124	4 (High)
74.85 – 130.75	3.8	10212	5 (very High)

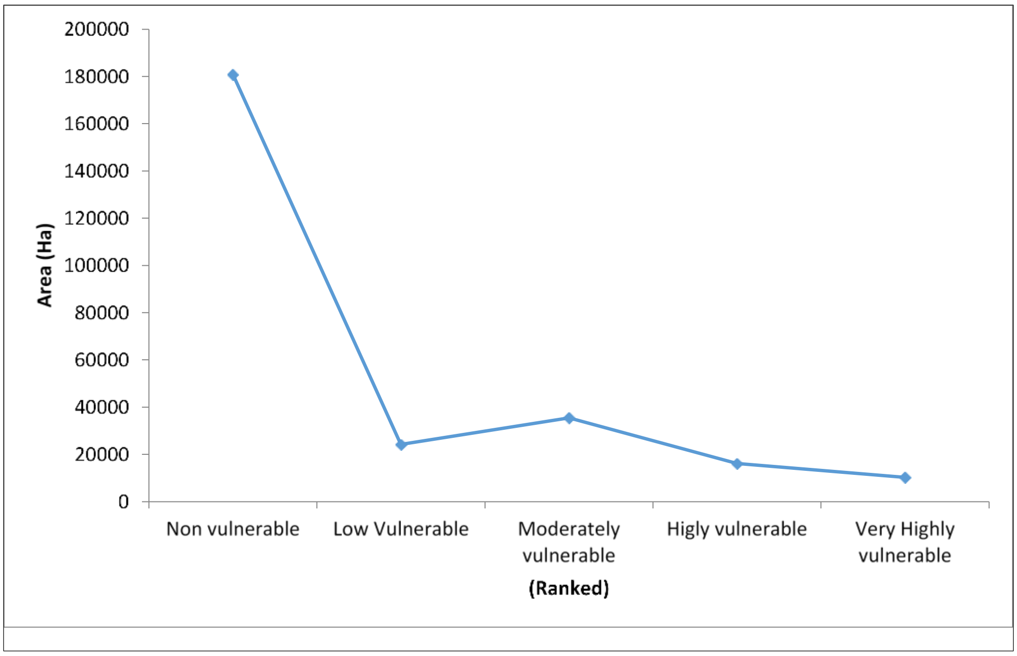

Figure 13 Drainage Density Area in Hectares

3.3. Socioeconomic Impact of Flood People

This objective was achieved with the use of questionnaire administration, 55 questionnaires were distributed and 53 were retrieved. The questionnaire was structured into three major parts namely; socio-demographic, the causes of the flood in the area, and the impact of the flood on the study area. The area that was purposely selected includes kabba town, Odo Ape, Oke bukun, Iyaa/Opa, Okpe Aiyegunle, Momodu, and Akutupa. Table 6 shows the socio-demographics of the respondents surveyed for this study. 55% of males and 45% of females were randomly selected for the survey. 66% of the sampled are married which is the larger percentage of the sampled followed by single with 22.6% and age of these respondents where the larger percentage of age go to the elderly from 46 and above 36% followed by the 36-45 age bracket with 32.1% and the younger age has the lowest with the percentage of 11.3%. Age is an advantage because the elderly has a wealth of knowledge about the flood occurrences in the study area. The tertiary level of education takes the larger percentage of the study area with 75.5% and the primary level of education has the least during the survey. The level of occupation of the respondents shows that business people took the highest with 43.3% followed by civil servants at 24.5% and farmers took the least with 5.7%. The religion of the respondents was also surveyed and the majority practiced Christianity 69.8% followed by Islam at 24.5% and the least was traditionalist with 5.7%.

Furthermore, Table 7 shows different indicators that cause floods in the study area and the level of respondent agreement. There are indicators considered such as; prolonged rainfall, heavy rainfall coupled with human activities, indiscriminate dumping of refuse on drainage channels, water flowing direction towards flat or low lying, nature of water infiltration of the soil, human removal of vegetation, land usage habits, opening of a nearby dam, improper water channels and government policies on construction of the building and all these were responded to with higher percentage of " Yes" as a scale of agreement with 86%, 94%,86%, 77.4%, 71.7%, 83.0%, 84.9%, 75.5%, 96.2%, 94.3% respectively. This result revealed that the man-induced factors which of course is experienced in the study area are mainly indiscriminate dumping, poor channelization, and floodplain encroachment combined with excessive rainfall responsible for the incessant occurrence of floods in Kabba local government. No doubt, the rate at which rural migrants flock into the cities encourages illegal buildings which results in the virtual breakdown of physical planning laws which must have been a major cause of floods in the study area. This work is confirmed by [27] with its level of agreement with the above-mentioned causes of flood.

Moreover, the study examined the impact of the flood on the people in the environment where various parameters were confirmed with the level of agreement of the respondents towards destruction, disruption of properties, and activities (See Table 8). The respondents show their agreement to the destruction of properties and 28% and 66% agreed and strongly agreed respectively while the cracks on land were also 58.5% and 39.6% agreed and strongly agreed respectively. The percentages of all other parameters assessed showed high at the agreed and strongly agreed respondents level of agreement in assessing flood impacts in the study area such as; washing away soil nutrient (58.5%, 39.6%), collapsing of buildings (47.2%, 50.9%), cracks on the house wall (45.3, 52.8), loss of investments (62.3%,37.7%), destruction of farm land (28.3%, 49.1%), claims lives (34.0%, 54.7%), release of dangerous animals (28.3%, 54.7%), Spread of water-borne diseases (60.4%, 37.7%), destruction of social amenities (52.8%, 41.5%) Destruction of social activities (54.7%, 34.0%), municipal pollution (58.5%, 34.0%), inflow to sewage (60.4%, 30.2%), traffic obstruction (64.2%, 34.0%) and aesthetic discoloring (56.6%, 26.4%).

Table 6 Socio-demographics Characteristics of the Respondents

Location	Frequency	Percent
Kabba	21	39.6
Odo Ape	11	20.8
oke bukun	5	9.4
Iyaa/Opa	3	5.7
Okpe	2	3.8
Aiyegunle	1	1.9
Momodu	8	15.1
Akutupa	2	3.8
Sex		
Male	29	54.7
Female	24	45.3
Marital Status		
Single	12	22.6
Married	35	66.0
Divorced	6	11.3
Age		
18-25	6	11.3
26-35	12	22.6
36-45	17	32.1
46 and above	18	34.0
Education Level		
not educated	5	9.4
Primary	1	1.9

Secondary	7	13.2
Tertiary	40	75.5
Occupation		
civil servant	13	24.5
Farming	3	5.7
Business	23	43.4
Student	6	11.3
others specify	8	15.1
Religion		
Christianity	37	69.8
Islam	13	24.5
Tradition	3	5.7

Table 7 The Level of Respondents in the Causes of Flood in the Study Area

Prolonged rainfall contributes to flooding	**Frequency**	**Percent**
No	7	13.2
Yes	46	86.8
Heavy rainfall couple with human activities.	Frequency	Percent
No	3	5.7
Yes	50	94.3
Indiscriminate dumping of refuse on drainage channel	Frequency	Percent
No	7	13.2
Yes	46	86.8
Water flow direction towards flat or low lying.	Frequency	Percent
No	12	22.6
Yes	41	77.4
The nature of water infiltration of the soil.	Frequency	Percent (%)
No	15	28.3
Yes	38	71.7
Human removal of vegetation leads to flooding	Frequency	Percent
No	9	17.0
Yes	44	83.0
Land usage habits contribute to flood	Frequency	Percent
No	8	15.1
Yes	45	84.9
Opening of nearby dam increases the volume of river	Frequency	Percent
No	13	24.5

Yes	40	75.5
Improper water channels promote flood	Frequency	Percent
No	2	3.8
Yes	51	96.2
Government policies on construction of building	Frequency	Percent
No	3	5.7
Yes	50	94.3

Table 8 Assess the Impact of Flood on the Socioeconomic

Destruction of properties	Frequency	Percent
Disagree	2	3.8
Strongly disagree	1	1.9
Agree	15	28.3
Strongly agree	35	66.0
Cracks on the land		
Disagree	2	3.8
Agree	30	56.6
Strongly agree	21	39.6
Washing away soil nutrient		
Strongly disagree	1	1.9
Agree	21	39.6
strongly agree	31	58.5
Collapsing of building		
Strongly disagree	1	1.9
Agree	25	47.2
Strongly agree	27	50.9
Cracks on the house wall		
Disagree	1	1.9
Agree	24	45.3
Strongly agree	28	52.8
Loss of investments		
Agree	20	37.7
strongly agree	33	62.3
Destruction of farm land		
Disagree	8	15.1
Strongly disagree	4	7.5
Agree	26	49.1

Strongly agree	15	28.3
Claims lives		
Disagree	3	5.7
Strongly disagree	2	3.8
Agree	18	34.0
Strongly agree	29	54.7
Release of dangerous animals		
Disagree	1	1.9
Strongly agree	8	15.1
Agree	29	54.7
Strongly agree	15	28.3
Tradition	3	5.7
Spread of water borne diseases		
Strongly agree	1	1.9
Agree	32	60.4
Strongly agree	20	37.7
Destruction of social amenities		
Disagree	3	5.7
Agree	28	52.8
Strongly agree	22	41.5
Destruction of social activities		
Disagree	5	9.4
Strongly disagree	1	1.9
Agree	29	54.7
Strongly agree	18	34.0
Municipal population		
Disagree	1	1.9
Strongly agree	2	3.8
Agree	31	58.5
Strongly agree	18	34.0
Inflow to sewage		
Disagree	2	3.8
Strongly disagree	3	5.7
Agree	32	60.4
Strongly agree	16	30.2
Traffic obstruction		
Strongly disagree	1	1.9

Agree	34	64.2
Strongly agree	18	34.0
Aesthetic discoloring		
Disagree	6	11.3
Strongly disagree	3	5.7
Agree	30	56.6
Strongly agree	14	26.4

4. Discussion

The study assessed flood occurrence and various objectives were examined such as: extent of flood in the study area, the factors that are responsible for this occurrence of flood and its impact of flood on the socio-economy of the study area. The results revealed that 25.6% of the study area was affected by flood in the 2018 raining season and factors that were considered include; land use and cover, the soil of the area, the elevation of the area and the drainage. The drainage density and the flood plain were generated from the drainage. The factors were scaled according to the flood vulnerability rating scale. The causes of flood were also examining using questionnaire administration according to the knowledge of the respondents, the result in Table 6 shows that human factors really caused flood such as; indiscriminate dumping of refuse, poor channelization and flood plain encroachment have combined with excessive rainfall. The impact of the flood on the socioeconomic was disastrous where a lot of properties and lives were claimed. This has caused the environment to be prone to diseases pipe bore diseases and dangerous animals coming out of the water body.

5. Conclusion

The study has revealed that Geospatial technology has the capability of assessing floods and the output will be shown visually via the presentation of maps. The extent of flood occurrence According to the factors considered Mododu is very highly vulnerable than other areas like Okpe, Iyaa/opa, Odaope, and Odogo which are moderately vulnerable throughout the considered factors.

percentages of all parameters assessed showed high at agreed and strongly agreed respondents level of agreement in assessing flood impacts in the study area which are; destruction of properties (28% and 66%), cracks on land (58.5% and 39.6%), washing away of soil nutrient (58.5%, 39.6%), collapsing of the building (47.2%, 50.9%), cracks on the house wall (45.3, 52.8), loss of investments (62.3%,37.7%), destruction of farm land (28.3%, 49.1%), claims lives (34.0%, 54.7%), the release of dangerous animals (28.3%, 54.7%), the spread of water borne diseases (60.4%, 37.7%), destruction of social amenities (52.8%, 41.5%), disruption of social activities (54.7%, 34.0%), municipal pollution (58.5%, 34.0%), inflow to sewage (60.4%, 30.2%), traffic obstruction (64.2%, 34.0%) and aesthetic discoloring (56.6%, 26.4%).

Recommendations

The adverse effects of flooding could be reduced with proper urban planning, starting with the identification of flood-prone areas through flood hazard mapping and assessment of Landuse and cover changes causing flooding in those areas

- There is an urgent need for a collaborative effort of both government and stakeholders to support town planning, engineering, and other professional agencies to combat flooding in the area to avoid its long-range consequences.
- Urban and Regional Planning Board and the ministry of Environment should enforce strict development orders, especially along the river courses. There should also be no further construction or removal of sand within a specified setback to the river. Development control regulations need to be strictly enforced.
- There is a need for a clear definition of functions to identify the authority in charge to ensure proper management of refuse along the river courses.
- There is a need for wide publicity not only to restrain further settlement of population around the course of the river, but also to educate the existing population in the areas of the need to protect their environment.

- There is a need for the local government to ensure good management of these roads and to ensure that there is adequate provision of drainages

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest is to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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