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Urban Flood Risk Impact on Road Accessibility and Socioeconomic Life in Egor Geographical Area of Edo State, Nigeria

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Abstract. Road accessibility as well as the height of socioeconomic activities can be predicated by many factors. However, in many urban areas of developing countries, road flooding has become a concern to both movement and socioeconomic activities. Hence, this study was conducted to examine the impact of flooding on road accessibility and socioeconomic life in Egor Geographical Area of Edo State, Nigeria. The study adopted the case study survey, with nine zones of intense flooding purposely selected for the investigation. Thereafter, forty-two copies of a semi-structured questionnaire were administered in seven streets in each zone. In addition, field observation was conducted to supplement data from the questionnaire. The data were analysed using descriptive statistics, while analysis of variance (ANOVA) test was used to compare the level of flooding among the identified zones. The result showed that major cause of flooding in the area was lack of adequate channelization of flood waters in many roads, especially among the local feeder roads. It was also found that, the few drainage facilities of the major arterial and collector roads were silted with flood debris and mud sands washed off from the untarred local roads. With respect to severity of flooding, while field observation showed that flood menace was a familiar thing around streets in the study area, the level of severity however, was found to be statistically different among the zones. Damage to road infrastructure, restriction of movement, high cost of transportation, displacement of people, insecurity and loss of property were among the socioeconomic consequences of flooding in the study area. The study recommended that government intervention measure to road flooding in the area should be holistic rather than the disjointed incrementalist approach often adopted.

Keywords*:* Accessibility; Egor; Flooding; Life, Road; Socioeconomic

1. Introduction

Flooding is one of the major contemporary environmental problems of man in this twenty first century. According to WDR (2010) study of natural hazards in the United States for the period between 2000 and 2008 indicated that, among the various natural hazards, floods have affected the largest number of people all over the world, with an estimate of 99 million people affected by flood incidence each year. This is especially the case in most wetlands of the world (Bariweni *et al* 2012). Recently, floods and its consequences are becoming too frequent and threat to sustainable development in human settlements (Aderogba, 2012). According to Merriam-Webster (2012 reported in Magami, Yahaya, and Mohammed, (2014), flood is a rising and over flowing of a body of water especially onto normally a dry land. While Etuonovbe (2011) noted that flood happens when a land that is usually dry is covered with water of river overflowing or heavy rain.

Flooding can be attributed to a number of factors including natural and anthropogenic factors (see Bruijnzeel, 2004; Ziegler, *et. al.* 2009; Atabay, *et. al.* 2013; Nwigwe and Emberga, 2014, and Lokonon, 2016). However, urbanization has become one major agent of urban flooding due to land use intensity in urban area (Zhang, *et* al, 2019; Mukherjee, 2016; Oyeleye, 2013; Ezemonye and Emeribe, 2011 and Odjugo *et al*., 2006). While urban flooding in this regard, is the inundation of land or property in a built environment particularly in more densely populated areas (Mukherjee, 2016), urbanization on the other hand is the process of population shift from rural setting to urban life style. It is the outcome of socio-economic and political developments that result in urban concentration and growth of large cities, changes in land use and transformation from rural to metropolitan pattern of organization and governance (Godly, 2008). Urbanization can also be seen as a development process that involves the intensive use of land which results in high rate of land consumption in urban centres thereby leading to the expansion with respect to areal extent of urban land use Oyeleye (2013)

In the last two decades now or so, the rates of rate of urban expansion have been extremely alarming, both in land use and population pressure. For instance, in 2008, for the first time in history, half of the world's population reportedly lived in urban areas and it was reported that urban areas were further expected to experience most of the future global population growth (United Nations, 2010). Intensity of urban land use does not only lead to flooding in urban areas (Mukherjee, 2016; Oyeleye, 2013; Ezemonye and Emeribe, 2011 and Odjugo *et al*., 2006), but can also have the potency to increase the scale and frequency of floods and can expose communities to increasing flood threats (Parker, 2000; USGS, 2003). In Nigeria for example, the 2012 flood according to the National Emergency Management Agency (NEMA) distorted 30 states, with 7 million people affected. From the report, 587,476 houses were destroyed, 2.3 million people displaced and 363 deaths were reported. Also, several farms were submerged, animals and many biodiversity were killed and loss of over 500, 000 barrels of oil each day.

Although urban expansion is a global observation which has occurred significantly all over the world; but in the developing countries however, it has been observed in recent time to have taken a different dimension. In these countries, contemporary urbanization is not only rapid in nature but also problematic in character (Aina, 1992). In particular, the negative impact of flooding on road network has not been given adequate attention in the past (Pyatkova, Chen, Butler and Vojinovic, 2019). Yet, the road is an essential element for social security, socioeconomic growth, friendly environment and spatial interaction. Roads are critical element of urban environment due to the repercussions of their disruptions (Tacnet and Mermet 2012). In Egor local government, the current study area, where land use intensity in the face of expanding population and inadequate urban plan policy has manifested to increasing rate of flood menace and problem of road accessibility on movements and socioeconomic life. Against this backdrop, this study examined the nature of flooding in the study area, with emphasis on the impact on roads accessibility and socioeconomic life in Egor, Edo State, Nigeria. In the process, the study attempted to explore the views of the ordinary people affected by flood menace and the varied impacts on their interaction in order to concretize basis for policy framework to manage the issues and challenges raised.

The Study Area

The study focused on Egor Geographical Area of Edo State (Figure 1). Egor is one of the five LGAs that made up the present Benin Metropolis and the third largest LGA in population both within the metropolis and the whole of Edo State. Its headquarters are in the town of Uselu. It has an area of 93 km2 and a population estimate of 339,899 as at 2006 which was projected to be 560,816 as at December 2023. In terms of climate, Egor geographical area has a tropical climate like the entire Benin City, with two distinctive seasons (rainy season and dry season), with an average temperature of 28 degrees Celsius, and average humidity level of 68%.

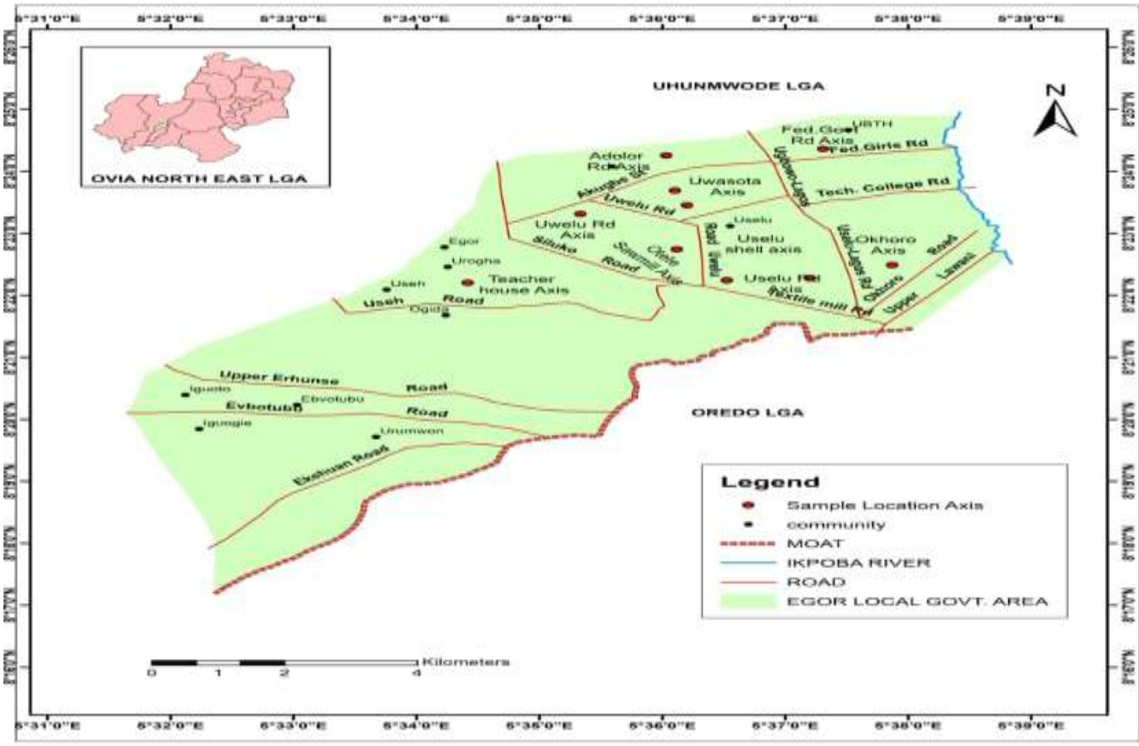

Figure 1: Egor Local Government Area (Inset, Edo State).
Source:

2. Materials and Methods

This investigation adopted a mixed method of sampling in arriving at data for the study. The study made use of mainly primary data sources, collected through a semi-structured questionnaire and field observation. Initially, the purposive sampling was used to select nine zones of intense flooding across the study area. These include Adolor College axis, Federal Girls College axis, Uwasota-Ojo axis and Okhoro-Medical axis. Others are Uselu Shell axis, Uwelu, Teachers' House-Egor, Otote-Osakpanmwan and Edaiken axes. Thereafter, systematic sampling technique was used to select the final streets and individuals for questionnaire administration within each sample zone. In each zone, 42 copies of the instrument were administered in seven streets, with six copies per street to persons between the ages of 18 years and above who could adequately address the questions raised on the contextual issue. Field observations were conducted at regular interval at both raining and non-raining days. The justification for on-rain observation was to have detailed knowledge of the degree and frequency of flood incidence immediately after rains and its multiplier effects on both accessibility of roads and socioeconomic activities in the area. The questionnaire responses were analyzed using mainly descriptive statistics, while analysis of Variance (ANOVA) test was used to determine the differences in the rate of flooding among the selected zones.

3. Results and Discussion

3.1 Background Information of the Respondents

Unlike many related studies, this present work relied more on the views of the local people affected by flooding to establish valid arguments for policy formulation and action direction. This projected the study not only unique, but also particularly distinctive from the more abstract and mechanical approach of much of existing studies, which appeared to downplay the opinion of the ordinary people affected by flood incidence in establishing valid arguments and theories for policy formation and action direction. Therefore, in order to ensure the credibility of information used in the study, a semi-structured questionnaire was administered to a defined sample of the population with specific attributes that included people of age eighteen and above, and who have adequate knowledge of their locality and thus must have lived in the area for a cumulative number of years not less than five years (see Table 1). The survey which started in November, 2022 lasted till August 2023, in order to adequately monitor flooding characteristics in the study area and its implication on roads and socioeconomic activities of the people.

Table 1: Background Information of Respondents

Sampled Location (Axis)	Sample Size	Gender		Age in Years			Years of Stay in the Area		
		Male	Female	Under 25	25- 44	Above 44	≥5 -10	11 - 20	> 20
Adolor College Road Axis	42	20	22	14	19	9	20	19	3
Federal Girls College Axis	42	15	27	15	17	10	18	18	6
Uwasota-Ojo Axis	42	19	23	12	21	9	16	22	4
Okhoro-Medical Axis	42	24	18	16	19	7	17	15	10
Uselu Shell Axis	42	16	26	14	20	8	14	17	11
Uwele Axis	42	21	21	17	18	7	18	16	8
Teacher’s House-Egor Axis	42	23	19	13	21	8	20	8	14
Otote-Osakpanmwan Axis	42	14	28	12	19	11	19	14	9
Edaiken Axis	42	22	20	15	17	10	17	13	12
Total	378	174	204	128	171	79	159	142	77

***Source*:** Authors’ Field Survey, 2023.

3.2 Flood Characteristics and Impact on Road Accessibility in The Study Area

3.2.1 Causes, Nature, Rate and Severity of Flooding in the Study Area

Even up to the current moment, most segments of the study area still lack government presence of any sort. Field observation showed that, most of the area is characterised by flood pondages, underdeveloped, clogged, seasonality and inaccessibility of roads as well as threat from flooding. Participant interview revealed that major cause of flooding in the study area was the lack of channelization of most of the roads. And in many pockets of places where there was drainage facility, many of them were however not through to the river or other emptying outlets where flood waters could run into. Instead, flood waters were saturated in few shallow drains which were clogged and did not have clear channelization due to lack of maintenance. According to Singh, *et al*, 2018) and Yang, *et al* (2019), if the road drainage facility is inadequate or poorly maintained to address the runoff caused by high-intensity rainwater, the road system would be the first to be directly affected. This seemed to be the prevailing problem in the study area. In the midst of the majority of roads that were not tarred in the area, it was gathered that local government presence in terms of grading was almost non-existence. Flood problems in the study area was observed to be triggered by the non-construction of most of the roads, where comprehensive drainage system could be built for a stormwater control. Other causes of flooding in the area were poor urban development such as building on water ways, blocking of water channels and government projects. Government projects particularly roads projects have been discovered to trigger flooding in some areas while also trying to address flooding in other areas. A case in point was found around Tome-Line-Uselu Shell axis where government dualization of section of the arterial road (Uselu-Lagos Roads) was seen to aggravate flooding in many locations of the axis. This often occurs where government intervention measures are met to serve as palliative rather than holistically addressing the root cause of flood problem.

In terms of flood severity, the opinion report in Table 2, indicated that most of the selected locations experienced very severe flooding after a downpour. Specifically, areas with the most severe flooding of the local feeder road after a downpour was Adolor College Road Axis with the proportion of very very severe (VVS) responses by residents of 64.3% out of the 42 sampled respondents. Apart from being a low-lying terrain, the longstanding decay of the section of the arterial road as well as the deplorable state of many feeder roads linking the arterial road with no obvious channels to move stormwater within the axis to the main drainage system was observed as the major trigger of flood in the area. It is a matter of time whether the rehabilitation work of government carried out in section of the road (Adolor College Road Junction) while conducting the research would ameliorate flooding problem in the entire neighbourhood. Other area of very severe flooding was Okhoro axis with the proportion of very very severe (VVS) responses by residents of 61.9% out of the 42 sampled respondents. Contrary, the area with the least severe flooding after a downpour was the Teachers’ House-Egor axis, with the proportion of very very severe (VVS) responses by residents of 11.9% out of the 42 sampled respondents. Field observation showed that, this axis which hitherto was one of the hottest spots of flooding in the city in the last twelve years or so have now been somewhat relieved through a section of the uncompleted stormwater drainage system started by Comrade Adams Oshiomhole’s administration. This stormwater drainage was initially met to move stormwaters in Egor-Useh-Ohonmwon axis and connect them with stormwater drainage system evacuating stormwater in the whole of Benin City to the river.

On the average, many locations of the study area were observed to be facing one level of flooding or the other. Intriguing, the catchment area affected by flooding in the study area has continued to expand as areas not hitherto flooded are now gradually being threatened by flood. This is observed to be facilitated by lack of maintenance of the roads especially, the local feeder roads where almost all of them have no drain system that move flood waters in local areas to the main drainage facility. This is the reason why flood waters in many areas were left flowing on lands. In many areas, the local feeder roads are the most flooded urban environment as property owners in effort to control flooding from their property, channel flood waters into the roads.

Table 2: Severity of Flooding by Zones/Axis (Where: VVS = Very Very severe, VS= Very Severe, S= Severe, NVS= Not Very Severe and NS= Not Severe).

Severity of Flooding	VVS 5 f/(%)	VS 4 f/(%)	S 3 f/(%)	NVS 2 f/(%)	NS 1 f/(%)	Total f/(%)
Adolor College Axis	27 (64.3)	10 (23.8)	5 (11.9)	0 (0.0)	0 (0.0)	42 (11.1)
Federal Girls College Axis	17 (40.3)	5 (11.9)	5 (11.9)	10 (23.8)	5 (11.9)	42 (11.1)
Uwasota-Ojo Axis	19 (45.2)	5 (11.9)	9 (21.4)	5 (11.9)	4 (9.5)	42 (11.1)
Okhoro-Medical Axis	26 (61.9)	11 (26.2)	4 (9.5)	1 (2.4)	0 (0.0)	42 (11.1)
Edaiken Axis	7 (16.7)	18 (42.9)	14 (33.3)	2 (4.8)	1 (2.4)	42 (11.1)
Uselu Shell Axis	19 (45.2)	7 (16.7)	2 (4.8)	11 (26.2)	3 (7.1)	42 (11.1)
Teachers' House-Egor Axis	5 (11.9)	16 (38.1)	13 (34.0)	4 (9.5)	4 (9.5)	42 (11.1)
Otote-Osakpanmwan Axis	22 (52.4)	8 (19.0)	4 (9.5)	5 (11.9)	3 (7.1)	42 (11.1)
Uwelu Axis	19 (45.2)	15 (35.7)	3 (7.1)	3 (7.1)	2 (4.8)	42 (11.1)
Total	161 (42.6)	95 (25.1)	59 (15.6)	41 (10.8)	22 (5.8)	378 (100.0)

Source: *Author's Field Survey, 2023*

3.3 Duration of Flood Waters by Location Before Drying Off

The investigation revealed that the zones/axes with the most severe flooding were also found to coincide with locations having the longest period of stagnant flood waters before total percolation into the ground. Specifically, Adolor College, Okhoro, Federal Girls College and Uwasota-Ojo axes were ranked in the respective order as the first, second, third and fourth locations with highest duration of stagnant flood waters after a downpour before total percolation (Figure 1). This was observed to be possible as most of these locations had similar capacity of drainage system that ensured that the time taken for flood waters to disappear after rains were not likely to be significantly different from place to place in the study area. Again, while this study did not attempt to assess the features and characteristics of soil in the different location, however, the percolation power of soil in the different locations were not also expected to be significantly different from location to location, because the entire Benin City should have the same soil type. In terms of the time taken for the rain waters to run off after a downpour, similar to the Table 2, it was discovered that zones like Adolor and Okhoro axes with a proportion of 64.3% and 61.9% respectively took more time (4hours and above). It was further revealed, that different length of time was required for the flood waters to dry up almost completely in the different sample locations, with the recorded total length tended to be longer than two hours in most of the locations (Figure 1). However, from the bar chart analysis (Figure 1), it could be argued that places which experienced severe flood after a downpour similarly experienced longer time for the rain waters to run off, and this was a major observation during regular field observation.

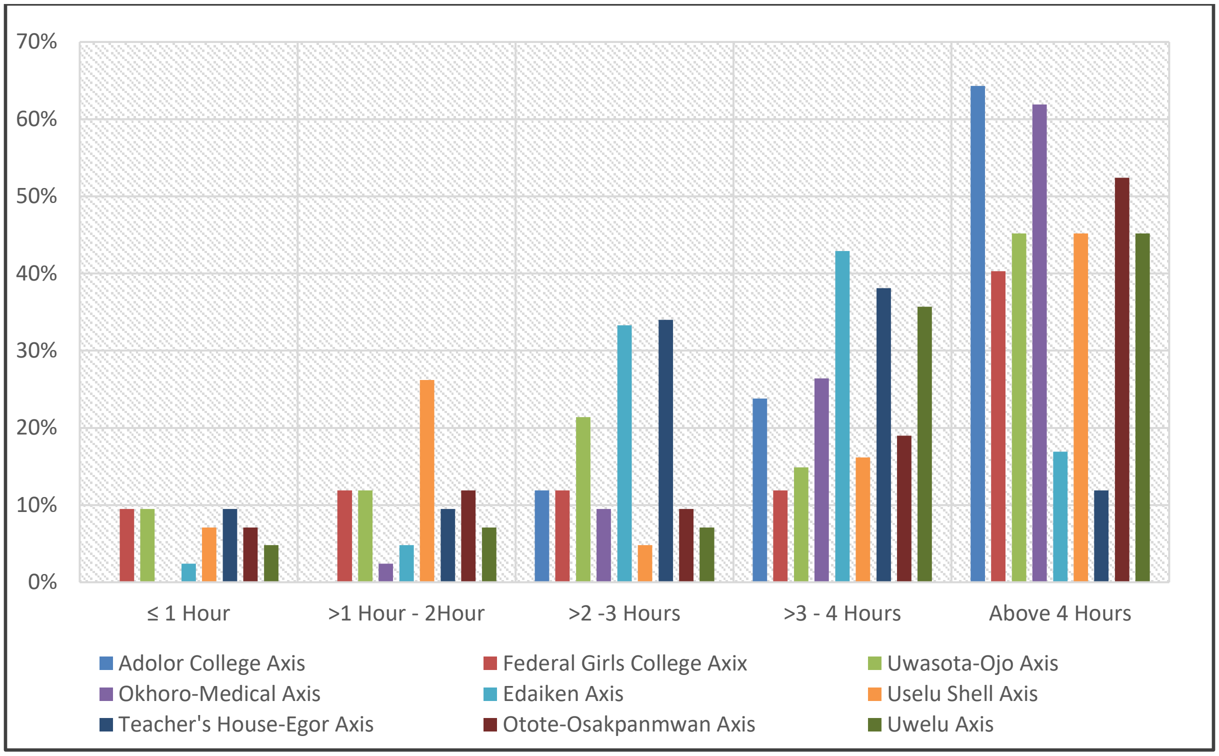

Figure 1: Duration of Flood Waters by Zones/Axes Before Drying Off
Source: Authors' Field Survey, 2023.

3.4 Frequency of Flooding After Rainfall

The frequency of flooding per number of rains was found to be very high among the selected zones except for Uselu Shell and Teacher's House-Egor axes. It was also discovered that, areas such as Adolor College, Okhoro-Medical and Otote-Osakpanmwan axes were the most frequent places of flooding in the study area. This indicates that, flooding occurs almost anytime of rains of some units of intensity. On the other hand, zones such as the Teachers' House-Egor and Edaiken axes recorded the lowest frequency per rains. A clear examination of the information conveyed in Table 2, showed that flooding across the entire study area was as frequent as the frequency of the total number of moderate to heavy rainfall which pointed to the fact that most of the areas experienced flooding very very often (VVO) or very often (VO) according to the participant response opinion of the respondents. Therefore, it can be argued that the vast localities of the study area (67.7%) battled with flood-related challenges and threats (Table 2). And with characteristics of a relatively low-lying terrain and the absence of comprehensive channelization and adequate drainage system for stormwater evacuation in sight, it was clear that, the study area was not likely to get out of flood menace soon, unless active measure were taken to address the current flood challenges in the study area.

Table 2: Frequency of Flooding by Zones/Axes (Where: VVO = Very Very Often, VO= Very Often, O= Often, NVO= Not Very Often)

Frequency of Flooding	**VVO 4 f/(%)**	**VO 3 f/(%)**	**O 2 f/(%)**	**NVO 1 f/(%)**	**Total f/(%)**
Adolor College Axis	27 (64.3)	10 (23.8)	5 (11.9)	0 (0.0)	42 (11.1)
Federal Girls College Axis	17 (40.3)	5 (11.9)	5 (11.9)	15 (35.7)	42 (11.1)
Uwasota-Ojo Axis	19 (45.2)	5 (11.9)	9 (21.4)	9 (21.4)	42 (11.1)
Okhoro-Medical Axis	26 (61.9)	11 (26.2)	4 (9.5)	1 (2.4)	42 (11.1)
Edaiken Axis	7 (16.7)	18 (42.9)	14 (33.3)	3 (7.2)	42 (11.1)

Uselu Shell Axis	19 (45.2)	7 (16.7)	2 (4.8)	14 (33.3)	42 (11.1)
Teachers' House-Egor Axis	5 (11.9)	16 (38.1)	13 (34.0)	8 (19.0)	42 (11.1)
Otote-Osakpanmwan Axis	22 (52.4)	8 (19.0)	4 (9.5)	8 (19.0)	42 (11.1)
Uwelu Axis	19 (45.2)	15 (35.7)	3 (7.1)	5 (11.9)	42 (11.1)
Total	161 (42.6)	95 (25.1)	59 (15.6)	63 (16.6)	378 (100.0)

Source: *Authors' Field Survey, 2023*

3.5 Accessibility of Roads After Downpour

According to Mao, Zhu and Duan (2012) and Rentschler *et al*., (2019) in Okechi (2023), flooding reduces transportation network capacity, either directly through physical destruction rendering roads unusable or through floodwater accumulation on the road surface thereby rendering them impassable. Both cases have been observed to trigger severe localized accessibility problem that can later become large scale concern in the study area (see Plates 1 and 2). Many roads in the study area are characterised with absence of drainage facility, pot holes, flood pondages, plant and soil recovery, which poses accessibility challenges even among trekking pedestrians.

Plate 1: Clogged Earth Road with Flood Pondages and Plants Recovery at Edaiken Avenue by Uselu Traditional Grounds
Source: Authors' Field Survey, 2023.

Plate 2: Submerged Portion of Uselu-Lagos Road, by Tomeline Engineers.
***Source*:** Authors' Field Survey, 2023

The position of road networks was loud because in the study because, the roads were observed to represent the key channels of flooding and flood related damages. As property owners scramble for the safety of their property in many flood-ravaged districts of the study area, the roads have become targeted points of flood water channelization and control. The implication of this new dimension of flood water control by the local people is that, most of the community roads, especially the untarred ones are left in shape where they can hardly support accessibility all-year round. While it is obvious that government presence was lacking in many zones of the study area (Plate 3), however, intriguing was the negative attitudes of the people towards flood management and maintenance.

Plate 3: Flooded Portion of the Popular Uwasota Road by Ojo Junction in Benin City.
Source: Authors' Field Survey, 2023.

Consequently, many roads in the area were either seasonal or nearly inaccessible in rainy season. The opinion report in Table 3 indicated that many roads in the study area were not accessible after a downpour. This cumulated to a huge setback to movements and all forms of socio-economic activities which are facilitated by spatial interaction. Movements during rainy season were noticeably not an easy engagement, as time, effort and finances are wasted to overcome spatial distance between locations. In many cases, movements were practically not straightforward, for what Atewe and Chokor (2019) described as winding and circuitous pattern of movement as residents explore escape and exit options around pot holes and other failed portions that characterised most of the roads in an attempt to locate places. While, the level of road inaccessibility after rains was seemingly different between the study zones, it was clear from the opinion result that roads in all the sampled locations had similar shape with little margin of differences in quality (Table 3). Hence, accessibility was worse of in places around Edailen, Uwelu and Otote-Osakpanmwan axes, but better off in places around Okhoro, Uselu Shell and Federal Girls College Axes (See Table 3).

Table 3: Accessibility of the Roads After Downpour

	Accessibility Status		
Locations	Not Accessible f/(%)	Accessible f/(%)	Total f/(%)
Adolor Axis	18 (42.9)	24 (57.1)	42 (11.1)
Federal Girls College Axis	17 (40.5)	25 (59.5)	42 (11.1)
Uwasota-Ojo Axis	19 (45.2)	23 (54.8)	42 (11.1)
Okhoro Axis	15 (35.7)	27 (64.3)	42 (11.1)
Edaiken Axis	20 (47.6)	22 (52.2)	42 (11.1)
Uselu Shell Axis	16 (38.1)	26 (61.9)	42 (11.1)
Teachers' House-Egor Axis	21 (50.0)	21 (50.0)	42 (11.1)
Otote-Osakpanmwan Axis	19 (45.2)	23 (57.8)	42 (11.1)
Uwelu Axis	20 (47.6)	22 (52.2)	42 (11.1)
Total	165 (71.4)	213 (28.6)	378 (100.0)

Source: *Authors' Field Survey, 2023*

3.6 Road Accessibility Options After Downpour in the Study Area

Figure 2 explains the options residents whose roads were easily not accessible immediately after downpour take in reaching their desired places of activities in the study area. From the opinion report of participant respondents, it was evident that residents go through tough times in trying to access their different places of socioeconomic activities during raining season, as they would have to access their destinations either by using alternative routes which were not significantly in better shape than the flooded roads or use the roads in flooded condition. The option of waiting for the flood to recede have been reported with its own consequences on the commuters as this alternative often lead to increase in transportation fare assuming the night catches on with the person if he uses public transportation. On the other hand, using personal car can even be more dangerous, especially in localities where security issue was a concern. Thus, in the event of a break down, the personal driver was reported not only just scrambling for his safety and how to reach his destination, but also how to ensure that the breakdown vehicle was secured. These were the reported reasons why waiting for flood to dry before continuing journey was not usually the option of most people in the area (Figure 2).

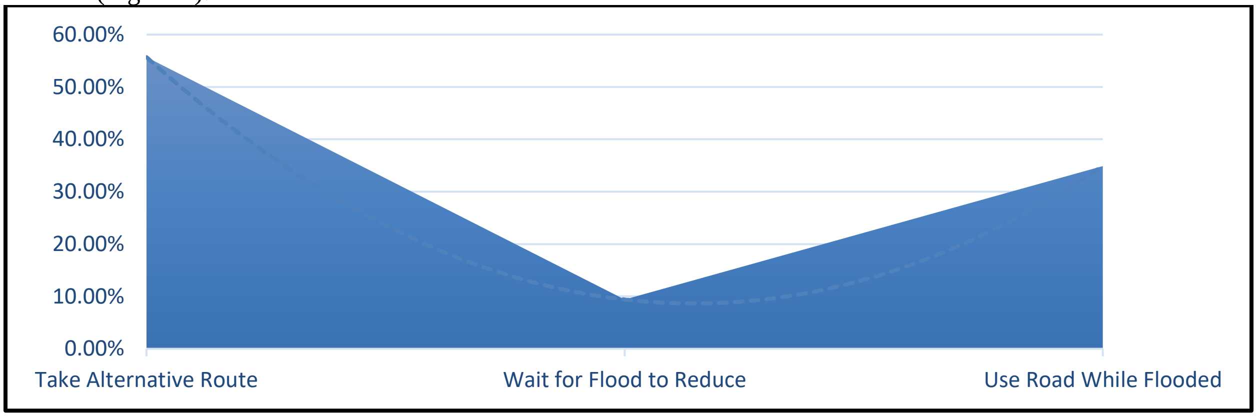

Figure 2: Road Accessibility Options After a Downpour
Source: Authors' Field Survey, 2023.

In that regard, trekking was observed to be the dominant means of movement each time there was a heavy rain. This is because, most of the roads would be flooded beyond vehicle accessibility limit, which makes trekking almost the only means of reaching destination. And where public transportation services are available, they are usually scanty and fare charges very astronomical. However, in areas where motorcycles and tricycles are allowed as means of public transportation, in addition to trekking, the use of motorcycles and tricycles was observed to be very helpful due to their ability to travel in circuit in an attempt to overcome pot holes. This was not however not without change in transportation fare. Field observation showed that transportation fare when roads accessibility was poor due to flooding increased with between 20% and 50% from the original fare.

3.7 Length of Restriction to Movement After Rain Rainfall by Zones

In terms of the how long the restriction last, it was discovered that Adolor and Okhoro-Medical zones with a proportion of 64% and 62% respectively took more time (4hours and above). Other areas of high percentage response for similar duration include Otote-Osakpanmwan, Uselu Shell and Uwelu and Uwasota-Ojo zones (Figure 3). When compared to Table 2 (of severity of flooding), it was evidence that, areas with high severity of flooding were also areas of noticeable long period of movement restriction across the study area.

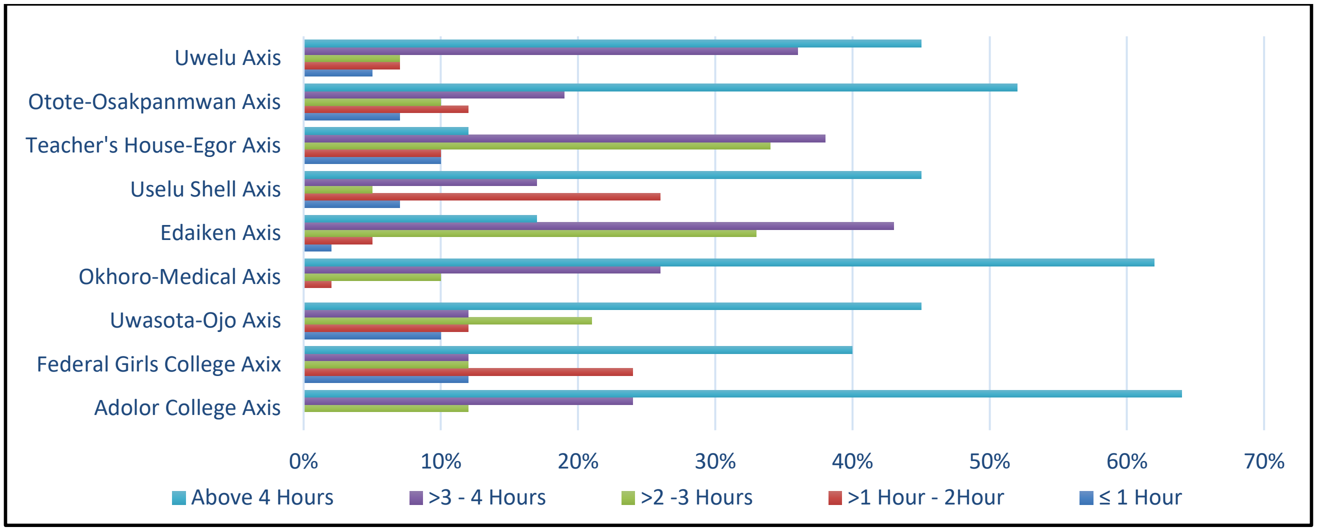

Figure 3: Length of Restriction to Movement After Rainfall by Zones
Source: Authors' Fieldwork,2023.

3.8 Impact of Flooding on Socioeconomic Life of People in the Study Area

The reported problem of flooding in the study area are enormous, ranging from the restriction of movements, forced trekking, increase in transportation cost, social exclusion, insecurity, displacement of people and property, damage to road facility, health risks due to contamination of flood water pondages, and low level of socioeconomic activities. The result from questionnaire analysis showed that there was a high level of movement restriction across all the selected locations and their environs of the study area with aggregate of 74.1% of the study population conforming this. Restriction of movement in this study was operationalized as time lag, inability to access a location at the appropriate time or total denial of access a location. Based on the report, residents of Okhoro and Adolor axes were the most restricted by flood pondages, while residents of Teachers' House-Egor and Uselu axes were the least restricted (Table 4).

Table 4. Restriction of Movement by Flooding

Restriction of Movement	Yes f/(%)	No f/(%)	Total f/(%)
Adolor Axis	38 (90.5)	4 (9.5)	42 (11.1)
Federal Girls College Road Axis	28 (66.7)	14 (33.3)	42 (11.1)
Uwasota-Ojo Axis	34 (90.0)	8 (10.0)	42 (11.1)
Okhoro-Medical Axis	39 (92.9)	3 (7.1)	42 (11.1)
Edaiken Axis	26 (61.9)	16 (45.2)	42 (11.1)
Uselu Shell Axis	27 (64.3)	15 (35.7)	42 (11.1)
Teachers' House-Egor Axis	22 (52.4)	20 (47.6)	42 (11.1)
Otote-Osakpanmwan Axis	31 (73.8)	11 (26.2)	42 (11.1)
Uwelu Axis	35 (83.3)	7 (16.7)	42 (11.1)
Total	280 (74.1)	98 (25.9)	378 (100.0)

Source: *Authors' Field Survey, 2023*

Field observation revealed that many of the roads leading to districts in the study area were almost in a state of inaccessibility during rainy season (see Plates 4 and 5). These roads are mostly the untarred local earth roads which are the most in number and connect almost everywhere in the LGA. These roads therefore, help in serving local access to residential neighbourhoods and also serve useful role in exchanging traffic between them and the major arterial roads that connect the entire urban space. But, because of their very nature in which most of them have unpaved earth surfaces, and with absence of functional drainage system that can help to reduce the effect of caving in flood waters, therefore, flood waters often damage them easily, turning them into channels through which the entire urban environment was ravaged by flood menace. According to Buren and Buma (2012), water that stagnate on roads due to lack of good drainage system or any better means to prevent flooding leads to traffic congestion and stagnation, and if the water should reach a certain level or depth, this can lead to traffic stoppage.

Plate 4: Submerged Portion of Collector Road At Egualaba Street, Beside Uselu Psychiatric Hospital, Benin City. Authors' Field Survey, 2023.

Plate 5: Flood-Ravaged Aburime Street, off Federal Government Girls College Road, Ugbowo, Benin City. **Source:** Authors' Field Survey, 2023.

Poor road accessibility has turned out several multiplier effects that are not limited to movements alone but also the pace of socioeconomic activities in the study area. In this regard, interview responses on the impact of road flooding by respondents in the study area include destruction of electricity facilities (poles), epileptic power supply, which get worsened during rainy season in many parts of the area; business inactivity and regular closure, inaccessibility of business area and general low patronage. Many of the area do not support wide range businesses and other active socioeconomic and human settlement due to low level of accessibility especially during rainy season. As a result, population threshold in these areas and their immediate environment may not be enough to sustain active socioeconomic activities. This is the reason why many flood-ravage districts cannot support businesses effectively.

Road flooding in the study area has also been found to breed psychological and mental health problem among affected landlords and even tenants especially those that flood incidents have inflicted severe damage to their property. Interview of some respondents revealed that, many residents in flood-ravaged areas suffer from flood-related apprehension that can even lead to serious health condition in areas where respite to flood problem was not in sight. Hence, flooding has been reported to breed psychological trauma among victims of flood-ravaged areas. This finding is consistent with the work of French, Waite, Armstrong and Rubin (2019) which found a strong correlation between flooding and probable mental health outcomes. It was also found that, residents in flood-prone (especially repeated flooding) areas had poorer health-related quality of life (HRQoL).

3.9 Measures of Flood Control in the Study Area

While opinion report from the respondents have shown that there is very little or no government intervention in addressing flood challenges in the study area (with 74.1% of the aggregate respondents saying there was no government support and 25.9% of the aggregate respondents saying there was government support), lesser proportion of the study population (46.1%) have however, turned to self-help to ameliorate flood problem in their locality. Among measures taken by these people include construction of local drains, sand filling, construction of local bridges and construction of flood barriers. While self-help can be encouraged especially issues that cannot wait for government bureaucratic process, opinion report however, showed that these local measures have not been effective to address flood problem in the study area. This conclusion was premised by the responses of the majority (70%), which tended towards "Not effective" in relation to the effectiveness of the local measures with only 30% stating that the local measures have been effective. This suggest that more drastic action targeted at ensuring comprehensive engagement

Source: *Field Survey (2023)*

This, however, it could not be concluded if the different were statistically significant using descriptive statistics. In determining th analysis of variance (A statistics was employed. Table 5 showed the descriptive statistics of the result. differences in the severity of flooding among the different localities

Table 5: ANOVA Table of Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.9248	5.1257	3.6300	.80520	378
Residual	-1.11093	.87186	.00000	.39905	378
Std. Predicted Value	-2.118	1.858	.000	1.000	378
Std. Residual	-2.638	2.070	.000	.948	378

a. Dependent Variable: Level of flooding

Similarly, in Table 6 (ANOVA table of significant), the p-value (.022) turned out to be less than the borderline alpha value of 0.05, which implies that there was a significant difference in the level of flooding among the selected locations in the study area. Therefore, the null hypothesis was rejected while the alternate hypothesis stating that there is a significant difference in the level of road flooding among the selected locations in the study area.

Table 6: ANOVA Table of Significant

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.484	9	.161	3.342	.022
Within Groups	4.631	368	.048		
Total	5.115	377			

Source: *Field Survey (2023).*

3.10 Model Validation

The hypothesis "there is no significant difference in the level of road flooding among the selected locations in the study area" was tested to ascertain if there was a significant different in the level of flooding among the selected locations. Although, the descriptive analysis has revealed mark of flood control is needed in the area. Unfortunately, in many instances, government only adopt disjointed incrementalist approach which only offers quick fix solutions when the problem has become wide scale, eyesore and in most cases eliciting strong criticisms from the media. And because a holistic action is not immediately taken to arrest the entire problem, very soon, the issue returns back to the original worrisome state.

4. Conclusion and Recommendations

The study was conducted to examine urbanisation and flood risk impact on road network and accessibility in Egor Local Government Area of Edo state, Nigeria. The study adopted the case study survey design, with nine zones of high rate of flooding purposely selected for the study. Data were collected through a structured questionnaire and field observation. Thereafter, forty-two copies of the questionnaire were administered in seven streets of each zone, with six copies systematically administered in each street. These were analysed using mainly descriptive statistical test while analysis of variance (ANOVA) was used to test the stated hypothesis. The result revealed that there were several causes of flooding in the study area but the lack of adequate channelization was the major reason of road flooding in Egor. It was also reported that the frequency of flooding in the study area is as high as the number of moderate to heavy rains. In terms of severity, the study revealed that flooding was severe in all the selected zones which was however, observed to be different among the zones. It was also gathered that government response to flooding in the area has been very minimal. As a result, the people have resorted to self-help method of ameliorating the problem through local measures such as sand filling, construction of local drains, bridges and sand barriers across property, with very little success achieved. The study therefore recommended that government take urgent measure in addressing flooding in the area to avoid expansion the of its scale or area of influence. It is also recommended that government intervention measure to road flooding in the area should be holistic rather than the disjointed incrementalist approach often adopted to bring palliative measures to the people.

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