GIS for sustainable living in the riverine communities in edu local government area of Kwara State, Nigeria

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Abstract

The importance of information in contemporary time is an issue that cannot be handled with levity. It implies that information has become power that pivot and propel the wheels of development. In this vein, this pilot study attempts to provide adequate information for sustainable development of riverine communities of Edu Local Government Area of Kwara state, Nigeria. Edu Local Government area was divided into three pragmatic zones based on the administrative districts. In each of the districts, Geographical Information System analytical tool was used to harvest and treat the data for subsequent interpretation. The coordinates of various locations of interest were captured, contour and slope maps of the area were generated to finally produce risk map for the area. The results revealed three distinct risk zones; High, Moderate and low-risk areas. Three settlements fall into low-risk areas with elevations above 196m, two settlements located at between 110m and196m are within moderate risk zone and six settlements in High-risk area with elevations below 110m. This study concludes that the riverine communities in Edu LGA are prone to flood risk. The study recommends public enlightenment on how man interacts with the environment and the implications, the trend in climate and weather in relation to flood and its consequences; environmental education and Stakeholder's forum should be organized as avenue for disseminating and educating the people for better and sustainable living in their various communities.

Keywords: community, flood, information, living, risk, riverine

Introduction

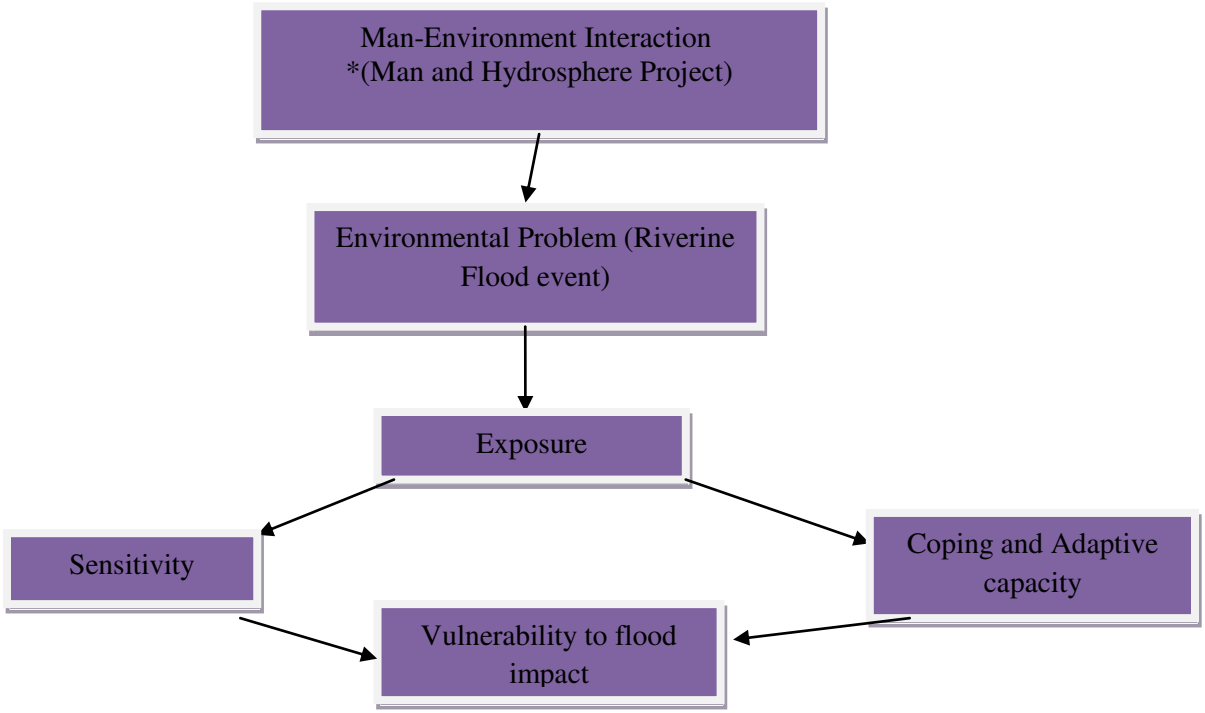
Kwara State is among the states predicted by Nigeria Meteorological Agency (NIMET) to experience flood in Nigeria (Isioma, 2013) and Edu Local Government Area had her own fair share of flood disaster in 2012 and 2013. In fact, it has almost become an annual event as observed by Olalekan (2012), leading to loss of lives, displacement of families and destruction of properties worth millions of naira (Shuaib, 2012). However, the impact of flood events on societies and economies in this area is likely to further increase as a result of two complementary trends. First, climate change is expected to increase the frequency and magnitude of flood peaks. Secondly, the economic impact of natural catastrophes is increasing due to the high number of people living in areas with a high flood exposure level, as well as the increased economic activity in these regions.

One fundamental issue is that most of the communities in the area are located along the lowland area of River Niger basin and majority of people in the area live and practice water related economic activities (Agriculture on the floodplains and fishing in the river). It is apparent that these yearly or seasonal flooding is having effect on their social and economic activities and their livelihood in general. The communities have a limited capacity to control the hydrological events ensuing from the river catchment. Therefore, the prediction of impending floods in 2013 in different parts of the country by NIMET has

continued to engage the attention of relevant stakeholders especially after 2012 disaster that left scores dead and thousands homeless in many communities of the Edu LGA (Biola, 2012).

Conventionally, man through the modification of the environment (hydrological cycle) by harnessing the environmental resources (water resource) via building of dams to reserve water for various water uses like industrial, domestic and hydro-electric power generation, creates problems in the environment. One of such problem is flood (see fig.1). This is often conceived as natural hydrological phenomena that affect human life (Emeribeole, 2015). Flood occurrence in human society has become a great concern not for individual people alone, but for organizations, government at all levels and government (Aderogba et al., 2012). However, the level of exposure, sensitivity to the problem, coping and adaptive capacity employed, will determine vulnerability level, hence, the magnitude of the impact as identified in the framework presented in figure 1. From the foregoing, the riverine communities in Edu Local Government Area are exposed to seasonal flood as a result of heavy rainfall which is exacerbated by the dams' operational activities and location of the communities. How sensitive they are depend on the available resources and skills at hand and their experience on the frequencies of the flood event and intensity of risks associated with exposure, while coping and adaptive capacity determine the potential damage that may result from high exposure. The link between coping and adaptive capacity and sensitivity indicate that at a given level of exposure, the coping and adaptive capacity affects the level of sensitivity, while the level of vulnerability is thus determined by a combination of coping and adaptive capacity, sensitivity and exposure.

Aside from the fact that flooding is one of the most common and costly disaster, flood risk can also change due to weather patterns and other anthropogenic factors (FEMA, 2015).Therefore, a study of flood assessment is imperative in Edu LGA in view of the fact that Edu LGA is one of the food baskets in Kwara, producing about 20-40% of rice, beans and onion for Kwara State. Secondly, the LGA is a home for fisheries (Eja tapa). Thirdly, a larger proportion of the land area falls within the floodplain of River Niger, and fourthly, it is one of the LGA with highest rate of rural poverty as reported by Usman et al. (2013).



Source: Adapted from Ayoade (1988) and Usman (2013)

Figure 1. *Riverine flood impact assessment study*

The study area

The study was carried out in Edu Local Government Area of Kwara State Nigeria. The Local Government is located, between longitude 40 54' 15" East and 50 31' 00" East of the Greenwich meridian and latitude 80 35' 38" North and 90 15' 00" North of the Equator (see fig 2), covering an area of 2,542 square kilometres (km2). Edu is one of the sixteen Local Government Areas of Kwara State with its headquarters in Lafiagi and a total population of 201,469 people as observed in the 2006 census (NPC, 2009). It has three districts: Lafiagi, Tsaragi and Shonga, The road distance from Ilorin the state capital to Lafiagi the study area's headquarter is about 148Km. It is bounded on the north by River Niger and shares boundary with Patigi LGA in the East (en.wikipedia.org/wiki/Edu._Nigeria, 2014).

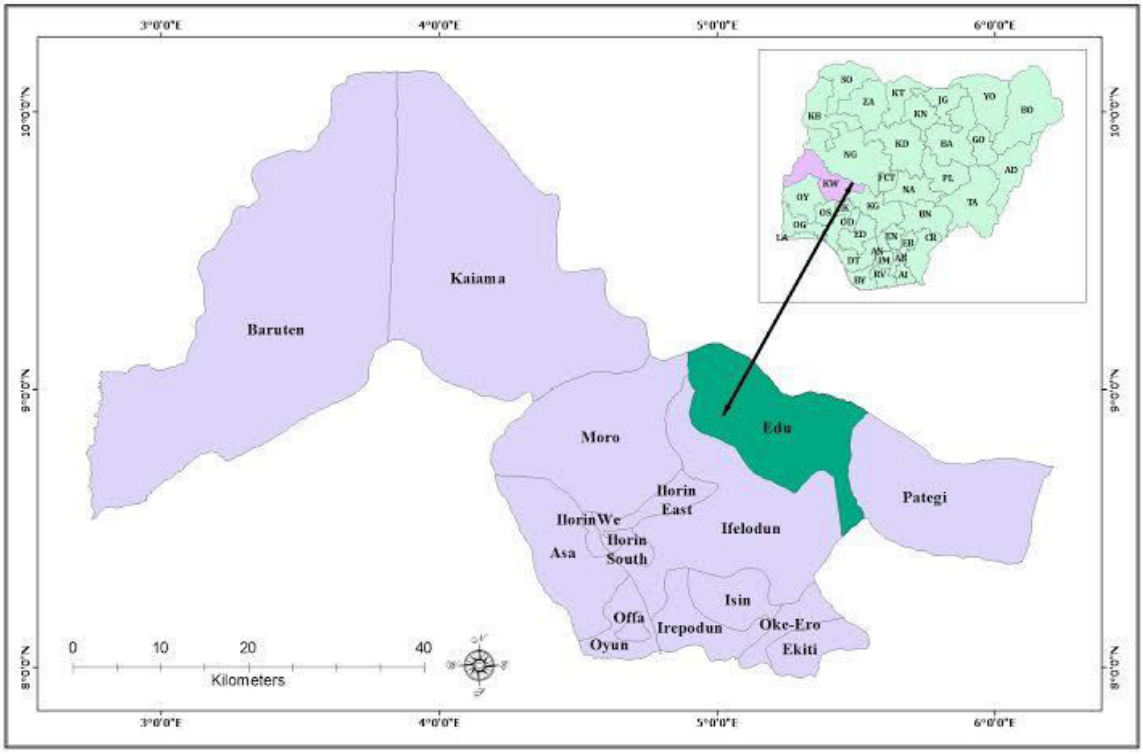


Figure 1. *Map of Kwara State showing Edu Local Government Area*

Materials and methods

This study relies on Geographic Information System (GIS) tools for data gathering and analysis (Ologunorisa and Abawua,2005), since it has been found to help in enhancing multi-criteria decision making for planning purposes (Akintoye et al., 2013). The satellite imagery of Edu Local Government Area was georeferenced and re-sized and extracted using the ArcGIS Arc-toolbox. This was classified to depict the different land use classes in the area and to highlight prominent features such as settlements, rivers, and roads.

Handheld Global Positioning System (GPS) was used to capture the locations eleven (11) purposively selected settlements from the three districts of Edu LGA. These settlements are in the riverine. The data acquire were used to create thematic maps of the area. The slope map was used to analyze in tandem with the contour map. Areas of depression and elevation were then used to produce a flood risk map of the study area. The overlay, buffer and hotspot analysis tools of Arc 10.1 Spatial Analyst Software provided

the areas liable to the flood. The Digital Elevation Model (DEM) and proximity to water bodies were employed to arrive at the three classified risk zones.

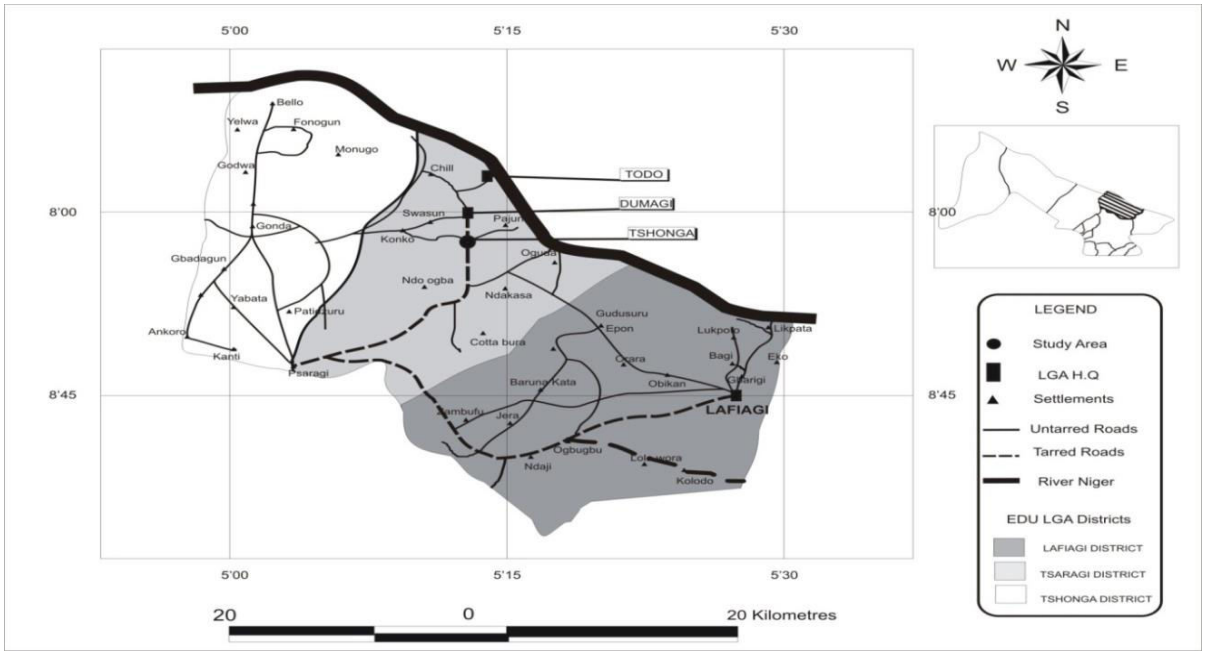


Figure 2. *The district map of Edu Local Government Area*

Results and discussion

Flood risk classification and zones

Edu riverine areas can be classified into three risk zones as presented in the flood risk maps (Fig. 3). The high-risk zones are areas that are most likely to be inundated in a flooding event while the low-risk areas are least liable to flood. Obviously, this could be explained by the geomorphology of the study area and the slope and steepness. A further explanation could be because of the slight slope angles of the area that

suggest all fields are situated very close to water levels.

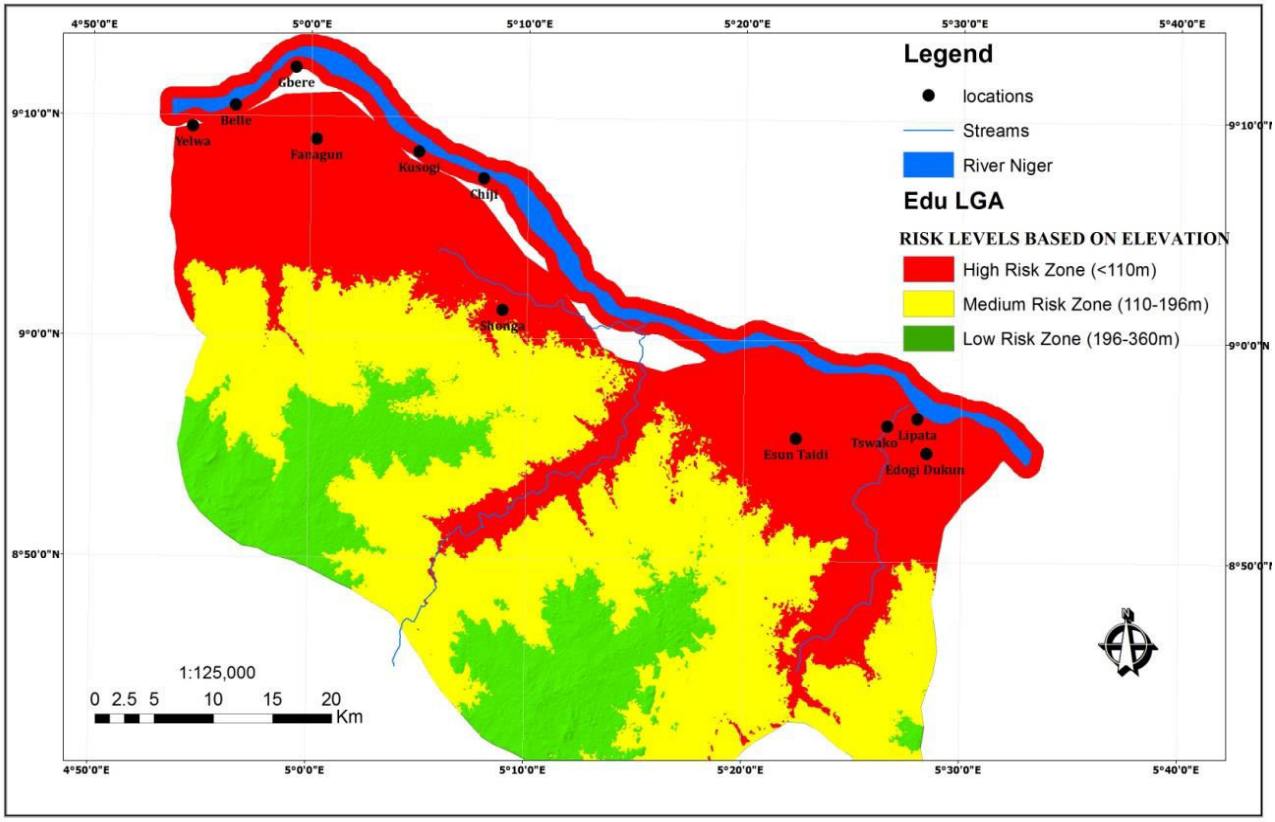


Figure 3. *Flood risk map of Edu riverine areas based on elevation*

Figure 3 clearly shows three (3) zones based on their heights and their level of risk on flood disasters. Areas with height below and equal to 110 meters (a.s.l) are areas that have a very high risk. All the sampled communities fall within this elevation while areas between 110-196 meters and 196-360 meters (a.s.l) are considered as moderate or medium risk and low-risk zones respectively. It implies that although these districts are still prone to flooding, they are not likely to experience the magnitude of the flood that the high-risk areas are liable to experience. However, areas above 360 meters (a.s.l) are considered safe with varying degrees of safety attached to them based on their height above sea levels. Oriola and Bolaji (2012) noted similar observation as they reported that decreasing nature of the elevation of the floodplain had a direct implication of speed, intensity and erosive capacity of the flood water along the plain. In this same vein, similar experience of areas of lower elevations being at high risk was reported by Njoku et al., (2013) in Aba metropolis in Nigeria.

Proximity of settlements to water bodies

Floods risk zones were also delineated based on their proximity to water bodies (Fig 4). The buffer distances used in this study are less than 1kilometer, 1-3kilometers and 3-5kilometers benchmarks. These revealed that Yelwa, Belle, Gbere, Kusogi Chiji, Lipata fall within the High-Risk Zone; Tswako and Edogi Dukun are within the Medium Risk Zone, while Fanagun, Shonga and Esun Taidi are in the Low-Risk Zone (Fig. 4 and Table 1). However, the location of Tswako and Shonga right beside waters of Oro and Oyi Rivers respectively, may increase their susceptibility to flooding despite the fact that they are some distance away from the main river (River Niger) which flood regularly. This observation is also in

line with what Oriola and Bolaji (2012:74) reported in their study of flood risk along river Aluko in Ilorin metropolis where they recorded high risk of residential, commercial, educational and religious buildings along the river channel in Ilorin. Abah (2013) noted similar observation in Makurdi where highly susceptible areas are those areas closest to the River Benue and characterized by very low relief (0 to 72 m), thus, having a high propensity to flood in the event of a torrential downpour.

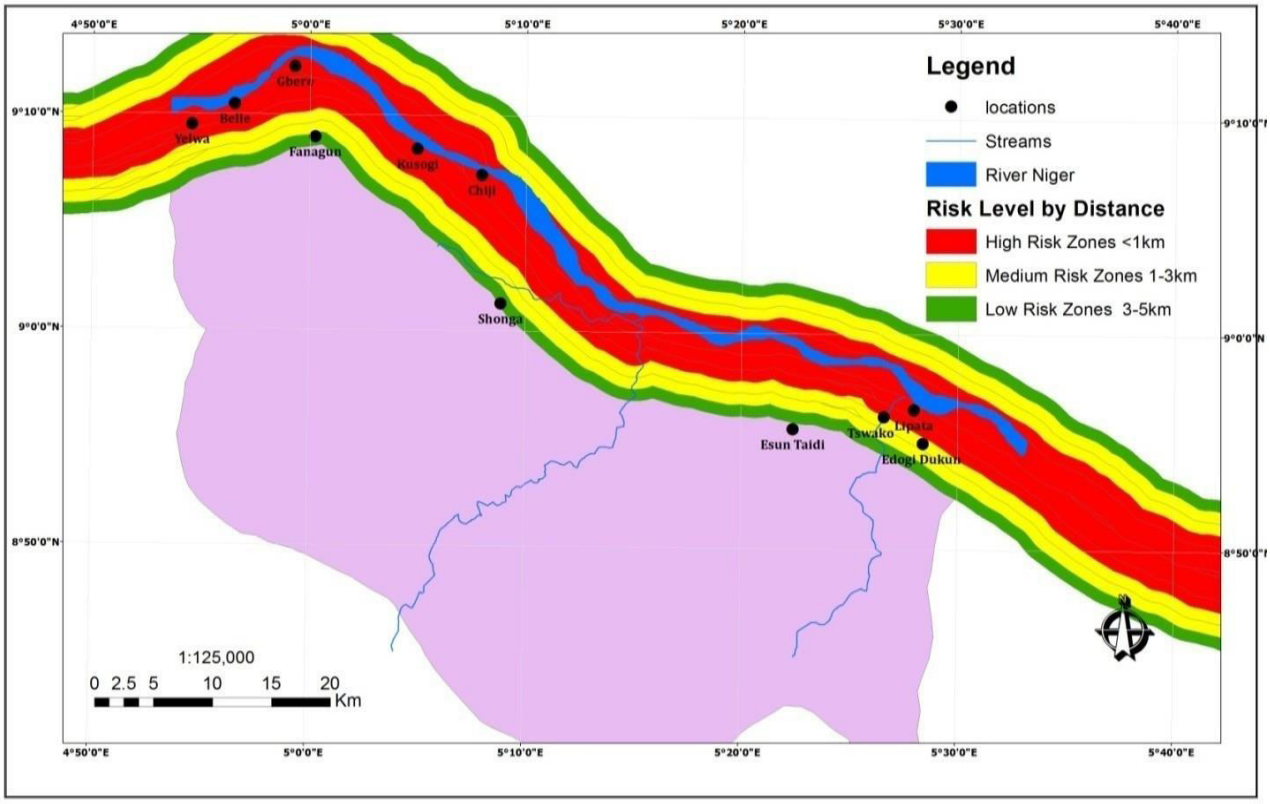


Figure 4. *Flood risk map of Edu riverine areas based on proximity to water bodies*

Table 1. Communities risk level based on the buffer distances

Level of Risk	Settlements at Risk	No of Settlements at Risk	Buffered distance used
High-risk zone (Highly vulnerable)	Yelwa, Belle, Gbere, Kusogi Chiji, Lipata	6	< 1km
Medium risk zone (Moderate Vulnerable)	Tswako and Edogi Dukun	2	1-3km
Low-risk zone (Slightly vulnerable)	Fanagun, Shonga, and Esun-Taidi	3	3-5km

Conclusion

This study concludes that the riverine communities in Edu LGA are prone to flood risk. Public enlightenment of the people on the trend in climate and weather about a flood and its implications. It is one of the strategies that can be used to carry the people along educate the people for adequate awareness and participation (Meyer et al., 2011) on any flood programme and projects that can reduce the losses and

mitigate flood hazard. It is also pertinent to have stakeholder's forum where environmental education will be adequate and resettlement of those communities that are in a high-risk zone introduced successfully.

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