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MAPPING OF FLOOD PRONE AREAS IN PARTS OF OSISIOMA NGWA LOCAL GOVERNMENT AREA OF ABIA STATE, SOUTH-EASTERN NIGERIA

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ABSTRACT

This study mapped flood prone areas in Osisioma Ngwa Local Government of Area of Abia State, South-eastern Nigeria. Reconnaissance survey and field measurements were done using base map of the area. Coordinates and altitudes were obtained with Global Positioning System (GPS). The various datasets were integrated and superimposed in a Geographical Information System (GIS) environment (Arc GIS 10.1) for the mapping. A Digital Elevation Map (DEM) and Flood Vulnerability Map (FVM) were generated for the areawhich showed that most communities in the area are low-lying with exceptions at Umuaduru with an altitude of 83m above mean sea level, Okpuala, 82m and Aru-Ngwa,80m. Communities with the lowest altitudes are Umuocham, 44m, Umumba, 66m, and Amazu, 66m, thus more prone to flooding and worsened by blocked drainage systems, poor land use planning and their closeness to rivers. Consequently, the findings of this study should guidethe government and Town Planning Authority of the area in land-use development and construction of sustainable drainage systems to enhance the evacuation of flood waters and the sustainable development of the area.

Keywords: Flooding, Flood Prone Area, Mapping, Global Positioning System, Geographical Information System, Digital Elevation Map, Flood Vulnerability Map

INTRODUCTION

Flooding, which involves the submergence of a usually dry land by water, has been causing massive loss of lives and properties around the world. Flooding is the most devastating natural hazard affecting the social and economic aspect of population (Hewitt & Burton, 1971) and claiming more lives than any other natural phenomenon. It is the most common of all environmental hazards and it regularly claims over 20,000 lives per year and adversely affects about 75 million people worldwide (Smith, 1996). About one third of all deaths and one third of all damages from natural disaster are caused by flooding (International Federation of Red Cross and Red Crescent Societies (IFRC), 2008). This hazard has been linked to increase communicable diseases (Orji, 2010). Other health impacts of flooding are prevalence of communicable diseases, shortage of food supply, dispersion of house hold wastes into fluvial system and contamination of community water supplies and wild life habitation, with extreme toxic substances (Njoku *et al*., 2010). Flooding is caused by any or a combination of the following namely rains, overflow of water-bodies, strong winds in coastal areas, dam breaking, ice and snow melts, blocked drainage systems and relief. In all these, precipitation is the prime culprit, thus making flooding a climatic event. Extreme climatic events impose constraint on development (Kates & Dasgupta, 2007; Takeuchi & Aginam, 2011). This constraint on development is a common sight in the developing areas of the world. Such areas that are affected by climatic hazards have been found to face great challenges to future development (Tian, Brown, Bao, & Qi, 2015).

The problem of flooding due to sea level rise and storm surges constitutes a significant source of threat to life, property, livelihoods and infrastructure in the riverine region (Onuoha & Ezirim, 2010). Large parts of the ground in urban areas are covered with pavements which obstruct sections of natural channel and builds drains that ensure water movement to river faster than it could under natural condition (Ojigi, 2010). Also, in Nigeria flooding has been known to be caused by a combination of excessive precipitation and inadequate flow channel capacity of sewer system (Soba, 2008). For some urban areas the disaster has also been attributed to land use and land cover in adjoining pre-urban areas, directionsof slope and lack of drainage facilities as factors (Odemerho, 1988; Hardoy, Mitlin, & Satterthwgitte, 2001; Njoku, Soba, Uwazunonye, Ebe, Iwuji, & Okerie, 2010). In addition, Urban flooding are commonly found on flat or low lying terrain especially where little or no provision has been made for surface drainage, or where existing drainage has been blocked with municipal waste, refuse and eroded soil settlement (Adejuwon, 2011; Festus, 2014). Consequently, run offs associated with increasing proportion of impervious surface areheld back as pools on urban terrain.

Remote Sensing and Geographical Information System (GIS) have proved to be valuable tools to support effective early warning to disaster (Njoku, Amangabara, & Duru,, 2013). Integration of Remote Sensing and GIS provides a very effective means of delineating disaster prone areas and for communicating this to decision-makers, emergency response team and the general public (Ojigi & Shaba, 2012).The use of this new technique captures the real topography in longitudinal cross – section and generates a 3D visualization of the area (for example, Wang, Colby, & Mulcoly (2010))

Mapping of areas prone to flood disaster has not been given adequate attention in research especially in the developing nations, such as Nigeria even in the face of great importance in planning and safety. Generally, flood prone areas are areaswhich are low lying with a history of flooding (Singapore's National Water Agency, 2016).No sustainable development has ever taken place in any place or area seriously prone to flooding as lives and properties are at serious risks. This work therefore explored and produced maps showing how prone some parts of Osisioma Ngwa Local Government Area, Abia Sate, South-Eastern Nigeria are to flooding.

STUDY AREA

The study area is Osisioma Ngwa of Abia State, South-Eastern Nigeria. It lies between latitudes $5^0\,5^{'}57$" and $5^0$19' 32"N and longitudes $7^0\,15^{'}49$" and $7^0\,25'\,23$"E (Figure 1) with a land area covering about 198km^2 and a total population of 219,632 (NPC, 2006). The study area is within the humid tropical climatic zone and rain forest vegetation zone of southern Nigeria. The rainfall regime is bimodal with peaks in July and September. Between these peaks is the 'little dry season' commonly known as 'August Break'. The rainy or wet season of the area begins about March and lasts till October or early November. The length of the wet season is at least (7) seven months including the period of August-break. The dry season lasts from November to March. The area has an annual rainfall total of about 2200mm; a mean annual temperature of about 27℃; and an average relative humidity of about 80% (NIMET, 2015).

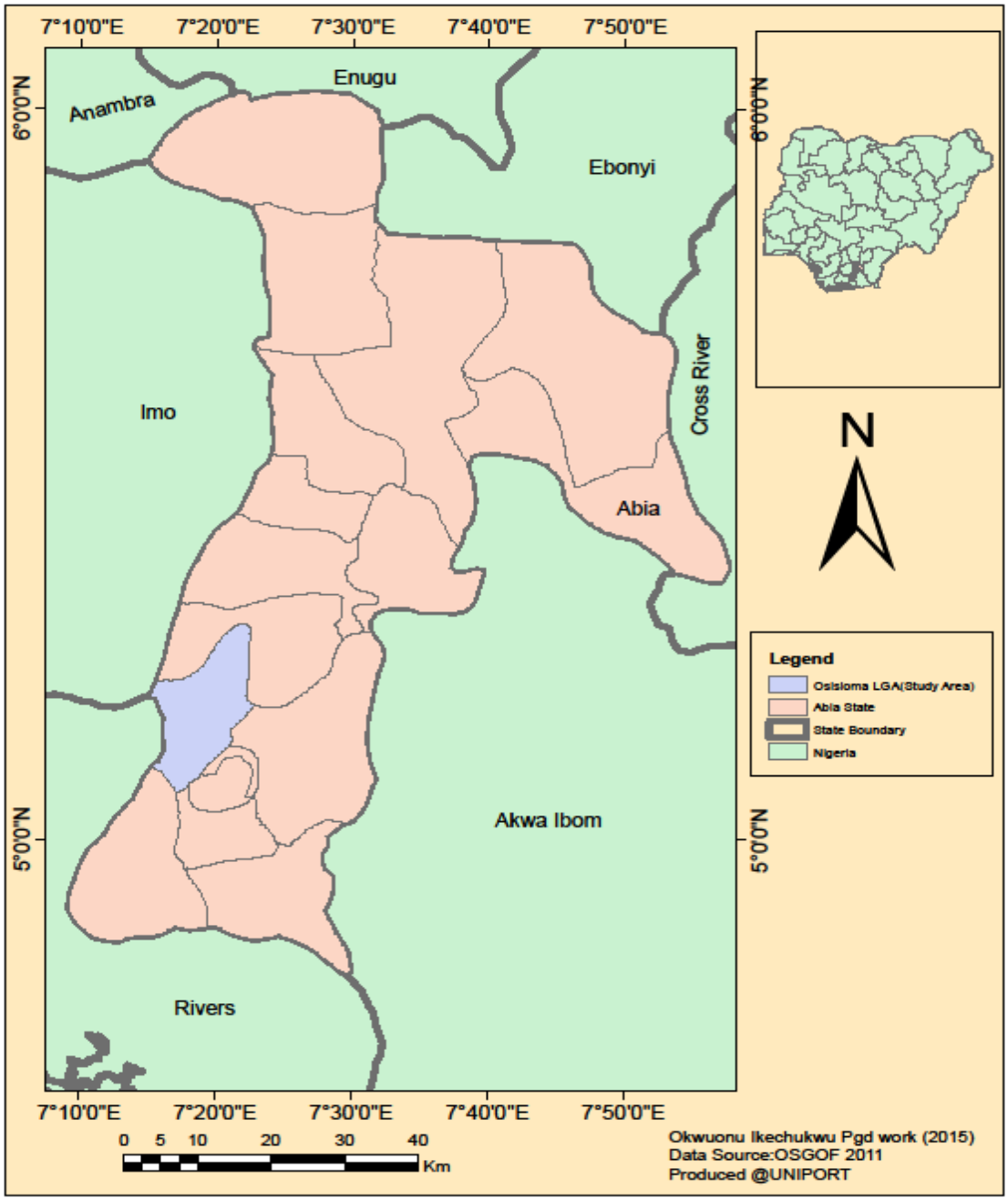

Figure 1: Abia State Showing Osisioma Ngwa L. G. A. (Study Area)

MATERIALS AND METHODS

Reconnaissance survey of Osisioma Ngwa Local Government Area of Abia State was carried out in order to familiarize the researchers with the communities that make up the local government area. The survey also helped the researchers to determine the factors of flooding in the study area viz-a-viz sustainability of development in the area.

This study employed the use of both primary and secondary data. The primary data included the use of Global Positioning System (GPS) to geo-locate the flood prone areas. The secondary data included Base Map from the Town Planning Authority of the Local Government Area, flood related issues from relevant literature, journals, magazines and newspapers.Field data on coordinates and altitudes were obtained in degrees from flood prone areas in the study area, using the GPS.Specifically, data were collected from Umuaduru, Ekeakpara, Umuarakpa, Umuimo, Mbutu-Nta, Ibeku, Amazu, Umuoto, Amavo, Aru-Ngwa, Okpuaba, Umumba, Umuagbara, Umuagbai, Egbede, Umuojima, Abayi, Umueze, and Umuocham (Figure 2). These locations were selected as a result of observed changes in terrain, elevation and slopes, and so, are critical to natural run off direction and identification of flood prone areas.

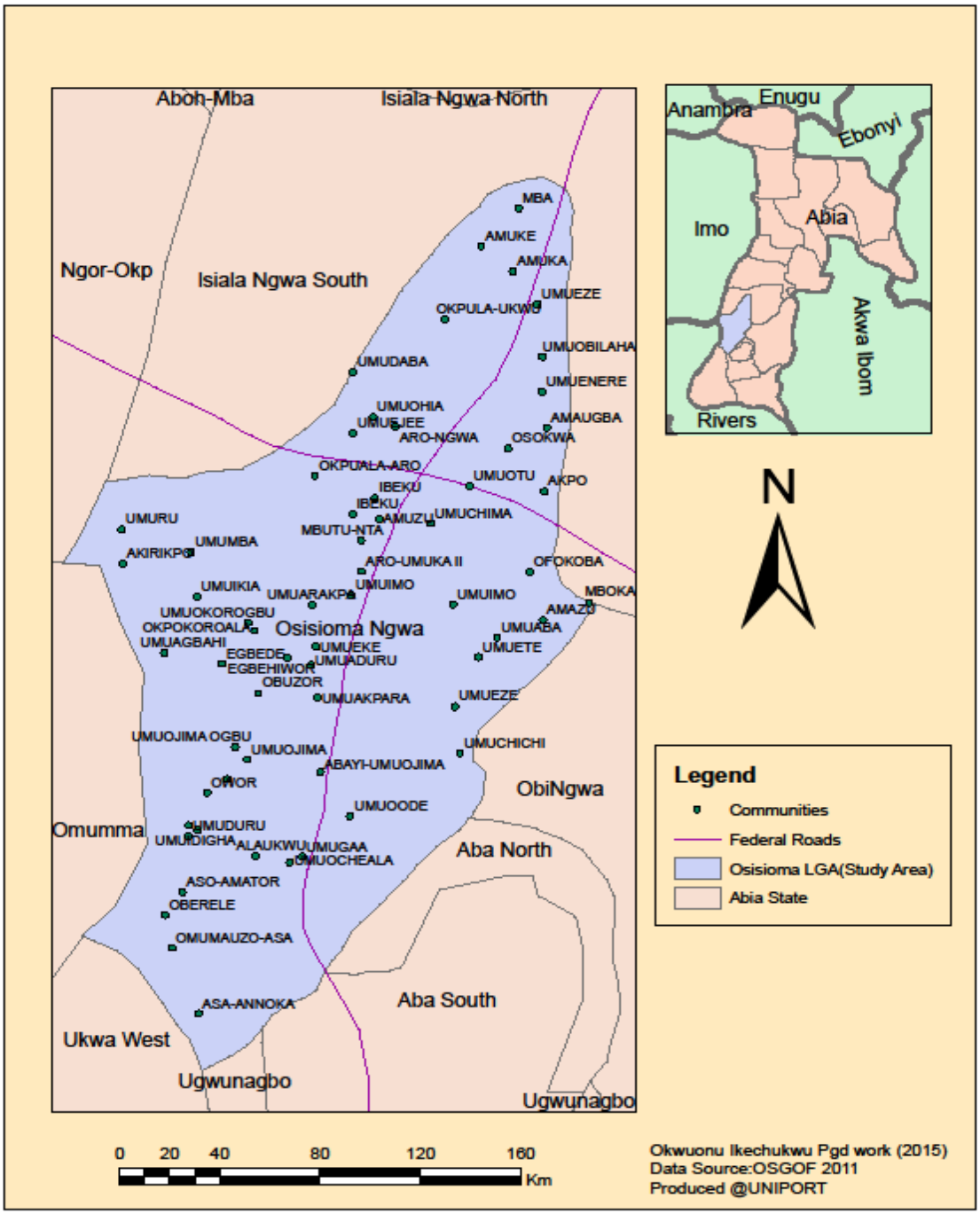

Figure 2: Osisioma Ngwa L G. A. Showing Communities

The base map obtained from the Town Planning Authority was imported and geo-referenced using Arc GIS 10.1.The co-ordinates and altitudes (Table 1) using GPS were superimposed on the geo–referenced map of Osisioma Ngwa Local Government Area.

RESULTS AND DISCUSSION

The analysis of the altitudes of various locations in Osisioma Ngwa Local Government Area showed that the area is gently undulated, thereby making most parts of it to be flood prone. Table 1 shows data on the co-ordinates and altitudes of various locations in the local government area. The table helps to identify parts/locations that are more flood prone through their altitudes. Areas of low altitudes are more prone to flooding and vice versa. For example, Amazu, Umumba, Umuocham, are more seriously prone to flooding because of their altitudes which are 66m, 66m and 44m respectively than communities higher altitudes such as Umuaduru (83 m), Okpuala (82 m) and Aru - Ngwa (80 m). These height differences, and by implication how prone each location is to flooding and non-sustainable development, are better seen in Figure 3. This can be further explained visually by the Digital Elevation Map (DEM) and the Flood Vulnerability Map (FVM) (Figures 4 and 5 respectively).

These maps show that communities with the lowest altitudes such as Amazu (44m above mean sea level), Umuacham (66m), Umumba (66m) are seriously prone to flooding, with the additional reason of being located close to natural water bodies namely the Imo and Umuocham Rivers. During the rainy season, these areas are that ordinarily with high water table for being close to rivers are easily flooded with water from these rivers because of their low altitudes. For such locations, development can only be sustainable with proper and careful execution and management of development proposals and programmes by the appropriate personnel and the understanding of the area's vulnerability to flooding. Cannon (2000) has considered the extent to which an area is vulnerable to flooding in terms of five components viz. initial well-being, livelihood resilience, self protection, societal protection and social capital. Areas become more vulnerable to flood hazards where there is no land use and development plan or a violation of it and blocking of drainage systems with buildings and refuse. This is a popular sight in most urban areas and new layouts in cities, sometimes in city centres in the developing countries. The study area here is inclusive.

Table 1: Altitudes of communities in OsisiomaNgwa L. G. A.

S/N	LOCATION	LONGITUDE	LATITUDE	ALTITUDE
		(N)	(E)	(M above mean sea level)
1	Umuaduru	5^0 9` 25. 15"	7^0 19` 35. 94"	83
2	NNPC Depot Umuaduru	5^0 9` 31. 89"	7^0 19` 24. 71"	74
3	Ekeakpara	5^0 10` 17. 19"	7^0 18` 57. 50"	78
4	Umuarakpa	5^0 10` 37. 98"	7^0 19` 14. 05"	75
5	Umuimo	5^0 11` 12. 27"	7^0 20` 18. 63"	77
6	Mbutu-Nta	5^0 11` 58. 22"	7^0 20` 6. 50"	73
7	Ibeku	5^0 12` 15. 84"	7^0 19` 53. 23"	77
8	Amazu	5^0 12` 44. 33"	7^0 20` 32. 82"	66
9	Umuotu	5^0 12` 44. 03"	7^0 20` 44. 99"	75
10	Amauo	5^0 13` 53. 44"	7^0 19` 5. 31"	78
11	Aru-Ngwa	5^0 13` 31. 51"	7^0 18` 51. 47"	80
12	Okpuala	5^0 12` 36. 36"	7^0 18` 16. 14"	82
13	Umumba	5^0 11` 48. 04"	7^0 16` 53. 10"	66
14	Umuagbara	5^0 11` 22. 77"	7^0 18` 35. 34"	74
15	Umuabai	5^0 10` 03. 52"	7^0 17` 9. 98"	78
16	Egbede	5^0 10` 01. 90"	7^0 17` 52. 26"	69
17	Umuojima	5^0 8` 10. 70"	7^0 20` 42. 90"	69
18	Abayi	5^0 8` 28. 49"	7^0 20` 40. 00"	73
19	Umueze	5^0 8` 45. 11"	7^0 20` 48. 07"	74
20	Umuocham	5^0 8` 31. 98"	7^0 21` 25. 26"	44
21	Ariaria	5^0 7` 06. 15"	7^0 20` 12. 42"	75

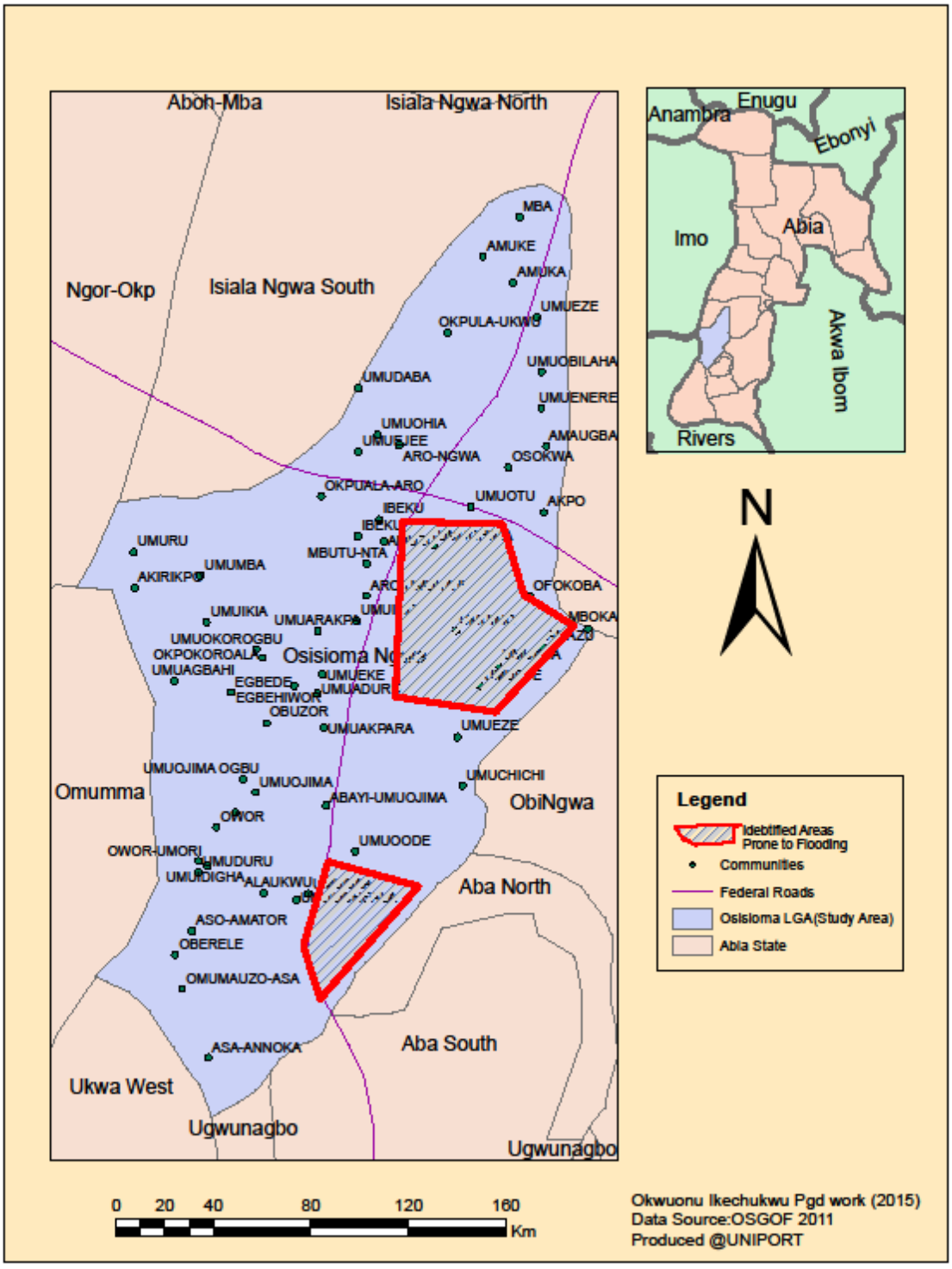

Figure 3: Identified Areas Prone to Flooding in Osisioma Ngwa L. G. A.

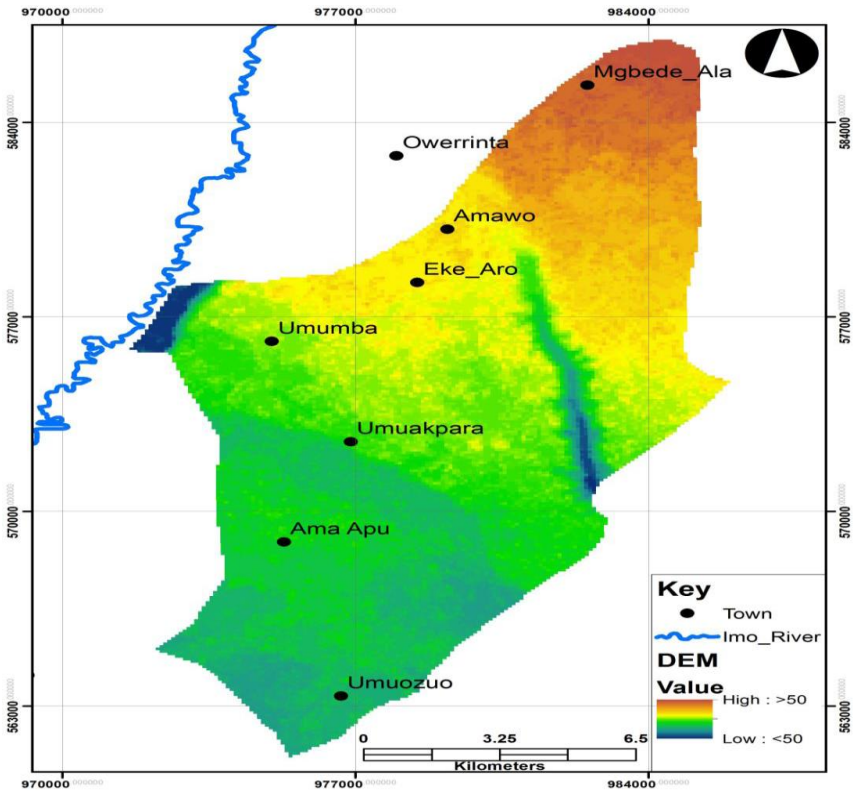

Figure 4: Digital Elevation Map of Osisioma Ngwa L. G. A.

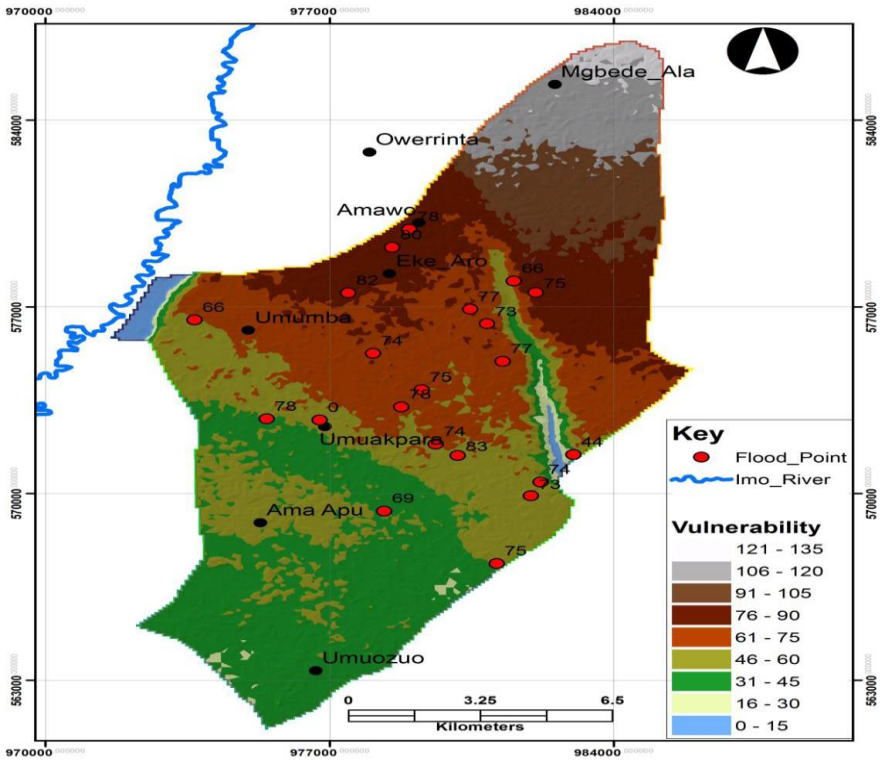

Figure 5: Flood Vulnerability Map of Osisioma Ngwa L. G. A.

CONCLUSION

In general, Osisioma Ngwa Local Government Area of Abia State, Nigeria is a relatively gently undulated land and it is without any good drainage system as it is made up of new residential and industrial layouts. Land-use developments are not properly guided by the state and local governments and Town Planning Authority of the area. This situation is worse with buildings, whether residential, commercial or industrial especially with the rapid extension of Aba City into the area as many buildings do not follow the Abia State Building Master Plan for the Local Government Area. Thecombination of this with poor drainage systemsand heavy rainfall during rainy season make the area generally prone to flooding, most especiallyUmuocham, Umumba and Amazu communities which are not only low lying but also surrounded by rivers.

Flooding is among the most destructive type of natural hazards that humans and their livelihoods the world over have been faced with. No area is immune to it, though the level of vulnerability differs. The developed countries suffer less than the developing countries if faced with the same magnitude of flooding. This situation has in no small measure imposed addition constraint on the development of developing areas, such as the study area. Ifthe seemingly uncontrolled development of the area and poor drainage systems in the face of heavy rainfallare unchecked and in good time too, sustainable development of the area may become difficult. This is because trying to undo that which has been done wrongly may not only be time consuming and expensive, but also life and property threatening with the usual resistance that follows such reversal. A major solution to this problem is the mapping of areas prone to flooding in the local government area. This study has achieved that.

RECOMMENDATIONS

Based on the above conclusion, to achieve sustainable development in Osisioma Ngwa Local Government Area, it is strongly recommended that good drainage system should be constructed, especially in the very flood prone areas, such as Umuocham with an altitude of 44m above mean sea level, Amuzu,66m andUmumba,66 m, and the new layouts to help channel water away with greater ease during the rainy season and floods from the rivers.

Also, Abia and local governments should enforce the town planning law and/or land use plan for the areawith regard to the erection of buildings in Osisioma Ngwa Local Government Area in order not to aggravate floods in the flood prone areas. This action is most expedient in view of the area's rapid urbanization.

The Federal and Abia State Fire Services, the National and Abia State Emergency Management Agencies and the Osisioma Ngwa Local Government Area Town Planning Authority should be made to be aware that some areas in the local government area are seriously flood prone as found out by this study. This will make these agencies to always be on the alert and be ready to perform their duties of saving lives and properties during flood hazards.

Finally, this work is recommended as a guide to those who in one way or the other are involved in the development of the local government area to make the area's development sustainable.

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