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Research paper

Geospatial mapping and analysis of public health care facilities in OBIO/AKPOR LGA, rivers state, Nigeria

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Abstract

This work aims at geospatial mapping of healthcare facilities in Obio/Akpor LGA in Rivers State. The objectives are to acquire primary and secondary data sets within the study area, to create a functional spatial database on health facilities, and to perform various spatial and attrib-ute query that will aid the mapping of healthcare facilities. Primary data for healthcare facilities location was acquired with Global Positional Systems (GPS) receiver. Google earth Pro Satellite imagery was used. Secondary data was obtained from relevant government agency. ArcGIS 10 version software was used for data processing and analysis. Various spatial and attribute queries was formulated for geospatial mapping of healthcare facilities. The results show the distribution of health facilities within the study area on a digital map in form of maps and tabular data among others. Results obtained show that 10 healthcare facilities have least at 10000 populations. Four facilities were found to have no medical doctor. Two healthcare facilities were found to be located in ward 14. Fourteen healthcare facilities were found to have at least total of 10 personnel, the highest personnel per facilities and a total of 16 healthcare facilities were distributed all over the study area. A total of 37 settlements were distributed all over the study area. Over 21 settlements are left out of the service areas of 1km. PHC Ru-muokwuta and St Jude Hospital Rumuokoro have least healthcare personnel of 6 and 5 respectively. 10 healthcare facilities have at least 10000 populations to physician ratio standard recommended by World Health Organization (WHO). The creation of Geospatial health in-formation systems is useful in data collection and management of healthcare facilities within the study area and Nigeria in general.

Keywords: *Geospatial Mapping; Spatial Equality; GPS; Healthcare Facilities; OBIO/AKPOR*

1. Introduction

Over the period of last decades the interest in geospatial mapping and healthcare services has risen, acknowledging the importance of location of healthcare facilities (Premasudha, 2010). Health infra-structure can be understood in both quality of care and accessibility to health care delivery (Shaikh, 2013). 'Health facilities entails the buildings and other fixed structures such as pipe borne water, good access roads, electricity and so on within the healthcare environ-ments, whilst the technology is about the equipment meant specifi-cally for hospital use including surgeries'(Lawani, and Ojiako, 2015).

Locations of healthcare services in the urban areas require spatial (locational) planning. Equal access to basic medical and healthcare services has been recognized as "a basic right of the people" by UN in 1948. Geospatial mapping of healthcare facilities has received huge attention all over the world including Nigeria. The urban pop-ulation of Obio Akpor LGA is growing in a geometric progression while the health facilities are at an arithmetic progression. The problems facing the Obio/Akpor health system now is limited ac-cess to healthcare facilities that befit its status as an urban area. There is a geographical mal-distribution health care facility in Ni-geria in the past and the present facilities are distributed haphaz-ardly and the situation can be corrected by the use of reliable data and GIS (Abdurrahman and Nurunnisa, 2013).

In a country like Nigeria including Obio/Akpor, with its diverse cul-ture, gathering healthcare data of the swelling populace manually by going from a health service to another health service is a difficult task. Geospatial technology makes life easier as the data is con-verted to digital format. Maps on different aspects are then made and based on individual needs which are then integrated and ana-lyzed. This makes it an indispensable tool for health experts to track down all health facilities in an area and the exact position of the health services. This study focused on geospatial mapping and anal-ysis of public healthcare facilities in Obio/Akpor council area of Rivers State.

2. Study area

Obio/Akpor local government areas of Rivers State have its Head-quarters at Rumuodomaya. On 3rd day of May 1989 out of the Port Harcourt City Local Government of was created by the Military Administration of former President Ibrahim Babangida. The Obio/Akpor is situated between 270000.00m and 291000.00m Northings and 528000.00m and 542000.00m Eastings with refer-ence to UTM Zone 32N and WGS84 Datum (see Figure 1, 2 & 3). Spatial query shows area approximately 278.080276 sq.km. The Rivers state administrative map shows it shares bounda-ries with Emohua, Ikwerre, Etche, Oyigbo, Eleme, Okrika and Port Harcourt Local Government Areas of Rivers State. Due to its Urban Status, there is an influx of other nationalities to the Local Government Area. The people mainly are the Ikwerre ethnic group. Major eco-nomic activities are farming, trading, and fishing. The population of the study area is 462,350 (NPC, 2006).The study area enjoys

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tropical hot monsoon climate due to its latitudinal position (Eludoyin et al, 2011). The vegetation found in this area includes raffia palms, thick mangrove forest and light rain forest (Eludoyin et al, 2011).

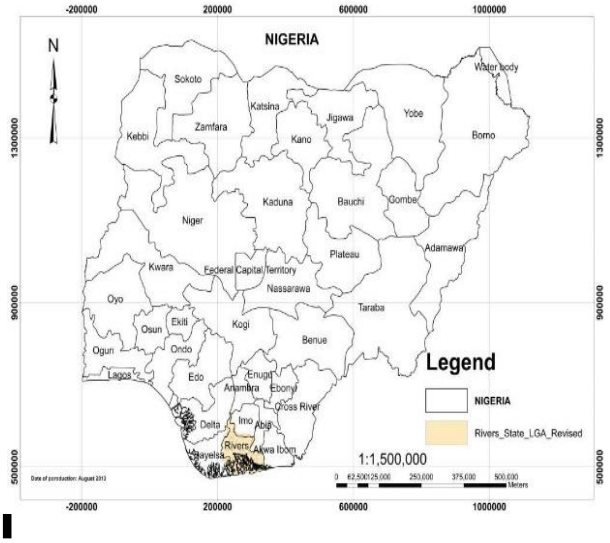

Fig. 1: Map of Nigeria and location of Rivers State.

Source: Office of Surveyor General Rivers State

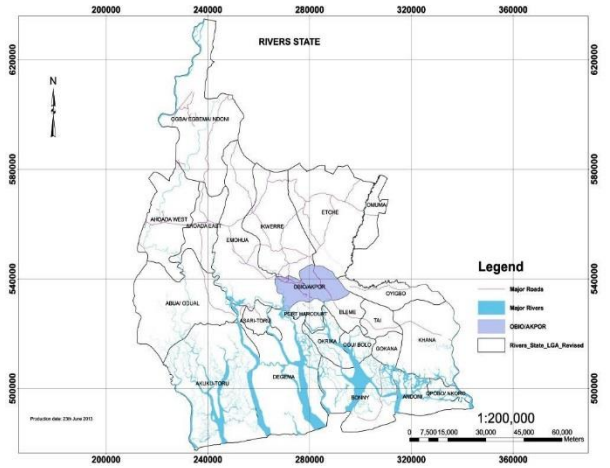

Fig. 2: Map of Rivers State with location of OBIO/AKPOR LGA.

Source: Office of Surveyor General Rivers State

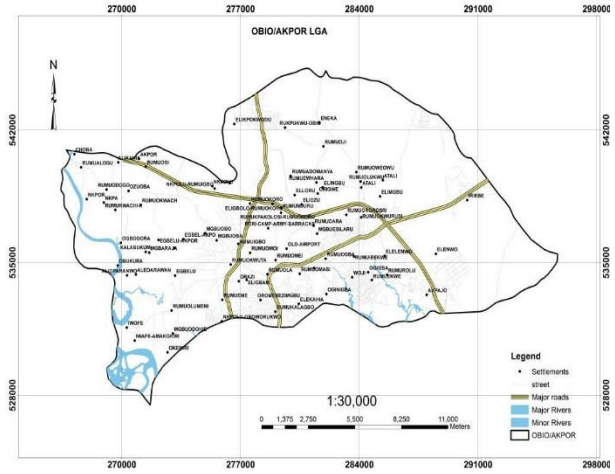

Fig. 3: Map of OBIO/AKPOR Local Government Area.

Source: Office of Surveyor General Rivers State
Figure three, above is the study area. Figure 2 & 1 is the Administrative Map of Rivers State and Nigeria respectively.

3. Methodology

3.1. Data analysis

Symbols: Geographical entity or phenomena relating to position or location are represented on a map as symbols. These entities or phenomena are model as point, line, area, and volume. Symbols are mostly used to represent attributes data. Health facilities was related to position or location and represented on a map as symbols. These facilities location was model as point, road as line, rivers as area.
Overlay operation: Overlay operations are carried out on vector and raster by the use of relational operators, arithmetic, and boolean. Personnel to population ratio was model using relational operators division.
Buffer: Buffer as a tool is used to define or identify an area around or within a distance limit of facility. Overlapping buffers indicate area under services area. Buffer tool is useful as an access indicator in a particular situation. Buffer analysis was used to determine service area around a particular healthcare facility. The study area fall under category of urban; consequently a buffer of 1km was used.

3.2. Methods

Figure 4: Below Shows Methodology Flowchart.

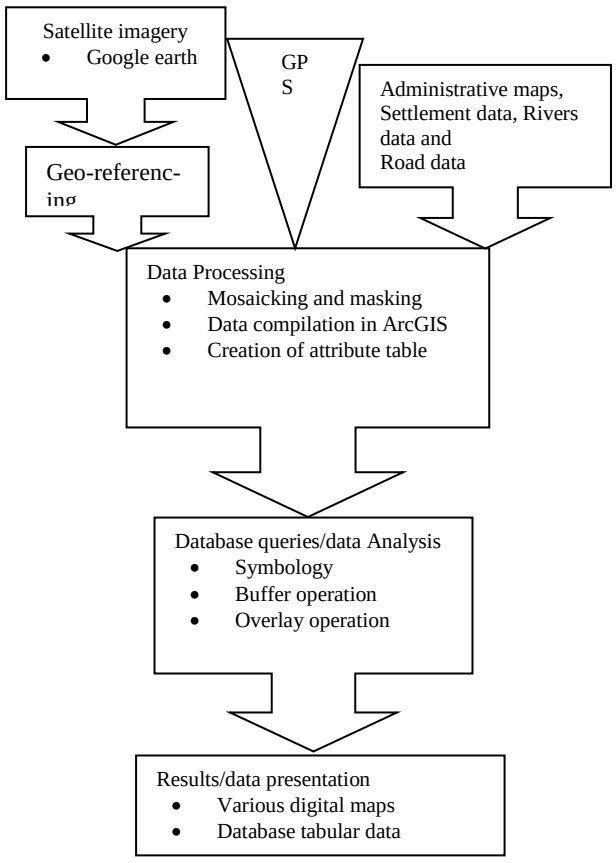

Fig. 4: Methodology Flowchart.

Satellite imagery from Google earth was geo-reference, mosaic & mask to study area using ArcGIS 10.1. GPS coordinates of healthcare facilities was captured using GPSmap 60CSx in digital format. Base map (Administrative maps, Settlement data, Rivers data and Road) in digital format was obtained from the office of the Surveyor-General, Rivers State and data compiled in ArcGIS and matched to the area of study. Creation of attribute carried out using ArcGIS – Arc catalog tools. The point data matched with its attributes in the created table. Database queries carried out on the geodatabase table. Data Analysis such as symbology, Buffer operation and Overlay operation performed. Results presented in form of various digital maps and database tabular data.

4. Results and discussion

4.1. Database view and queries

The Geospatial database on healthcare facilities in Obio/Akpor in UTM Zone 32N Projection and WGS 84 Datum and units in meter as shown in table 1

Table 1: Geospatial Database on Healthcare Facilities in OBIO/AKPOR LGA

Objectid *	Shape*	Eastings	Northings	Facility_Name	Fsettlem_Pop	Physician	Total_Personnel	Ward
1	Point	280655	538535	Mphc Eliozu	9112	1	15	1
2	Point	290901	539208	Mphc Iriebe	5092	1	16	2
3	Point	284435	536764	Mphcrumuokwurusi	22360	2	15	3
4	Point	278097	539132	Mphcrumuodomaya	6526	2	20	4
5	Point	285949	534958	Fsp-Clinic Elelenwo	12404	2	16	5
6	Point	283628	532535	Mphc Woji	9521	1	14	6
7	Point	277465	538403	St Judecatholichospi	2724	0	6	7
8	Point	281907	534609	Obio Cottagehospital	12127	2	11	8
9	Point	276373	533081	Mphc Rumueme	32461	1	23	11
10	Point	277183	536382	Mphc Rumuigbo	12360	3	24	12
11	Point	276729	534659	Phcrumuokwuta	11465	0	5	13
12	Point	282737	541379	Mphc Eneka	8920	2	20	14
13	Point	277274	541878	Mphcrukpokwu	6727	1	16	14
14	Point	270336	538766	Mpc Ozuoba	10640	2	15	16
15	Point	273359	531794	Mphcrumuolumeni	11362	1	15	17
16	Point	277569	535990	Neuro Psychiatric	12360	0	0	12

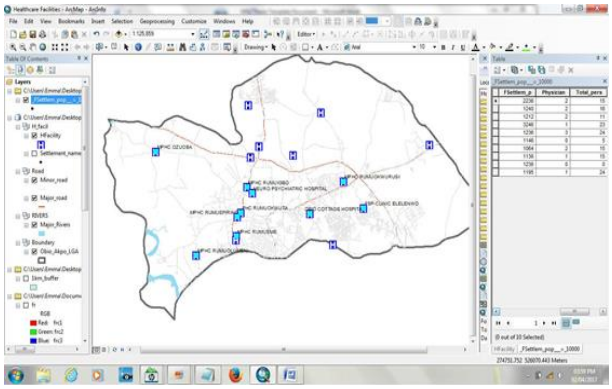

Fig. 5: Query Result to Determine the Facilities Serving at Least 10000 Populations.

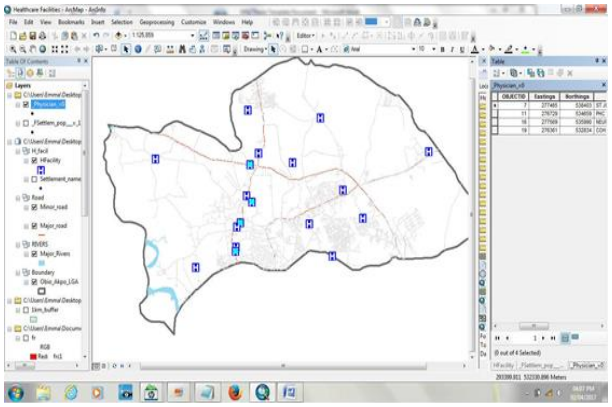

Fig. 6: Query Result to Determine the Facilities with No Physician.

This query was carried out so as to determine the healthcare facilities with no medical Doctor. Four facilities were found to have no medical doctor. They includes; ST jude hospital Rumukoro, Heuro hospital rumuigbo, PHC Rumuokwuta & COHSTECH Rumueme.

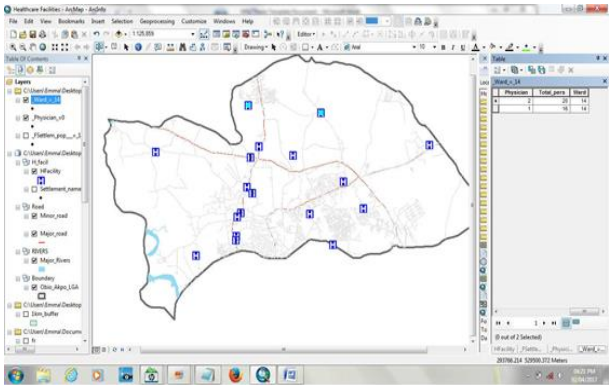

Fig. 7: Query Result to Determine Electoral Ward with More Than One Healthcare Facility.

Further query was also carried out to determine electoral ward with more than one healthcare facility. Two facilities (MPHC Eneka & MPHC Rukpokwu) were found in ward 14.

4.2. Symbology healthcare facilities and distributions

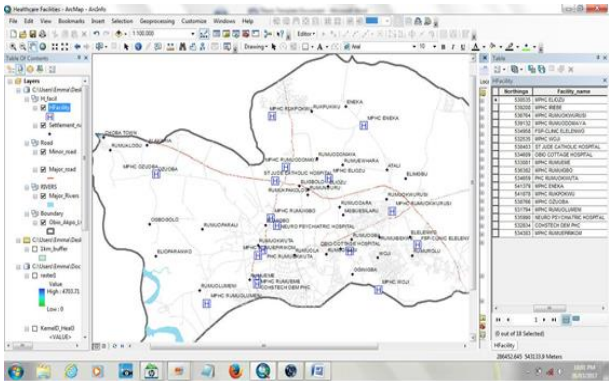

Fig. 8: These Results Shows Geospatial Distributions of Healthcare Facilities in OBIO/AKPOR LGA.

Figure 8 and 9, shows geospatial distributions of healthcare facilities in Obio/Akpor LGA with total of 16 healthcare facilities.

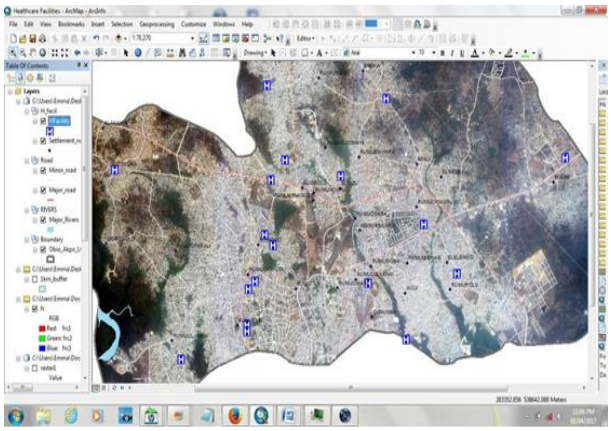

Fig. 9: This Results Shows Geospatial Distributions of Healthcare Facilities in OBIO/AKPOR LGA Using Google Earth Satellite Imagery.

4.3. Buffers healthcare facilities distributions gaps

Buffers are used to measure proximity to facilities. In Healthcare services, it represents service area from a particular facilities location. 1 kilometer service area is the recommendation for urban areas like obio/Akpor LGA. From Figure 10 over 21 settlements including Ogbogolo, Elimbu and 19 others are left out of the service areas.

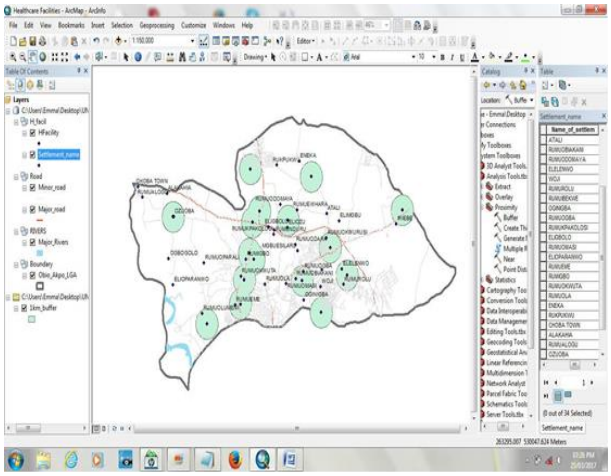

Fig. 10: This Results Shows 1km Services Area of Healthcare Facilities in OBIO/AKPOR LGA.

4.4. Density Population distributions gap

Kernel used to measure population density to facilities. It measures gap in facility lo- cation. From Figure 11 over 37 settlement population density modeled as a raster.

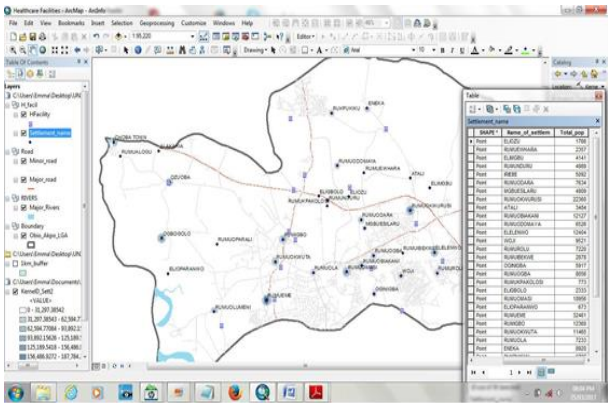

Fig. 11: The Results Shows Population Density (Kernel) Distributions in OBIO/AKPOR LGA.

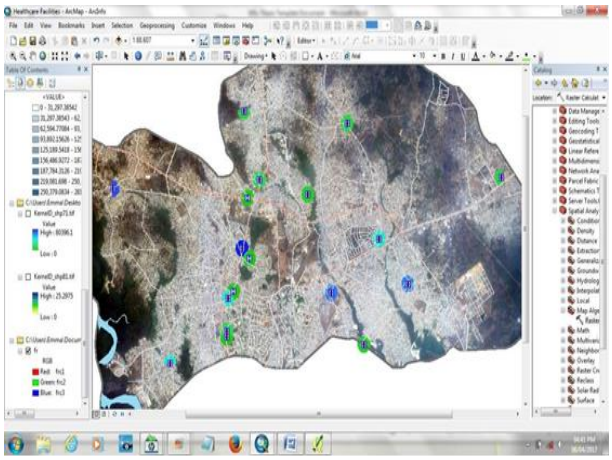

Fig. 12: The Results Shows Physician/Population Ratio Distributions in OBIO/AKPOR LGA.

Figure 12 used to measure Physician/Population ratio distributions kernel density and map algebra (raster overlay) in Obio/Akpor LGA. Results show lowest value of [0] and highest value of 0.0024. Area like Ozuoba & Atali have density ratio.

4.5. Discussion of results

This work used geospatial mapping to provide healthcare information such as healthcare facilities location, number of personnel available at each healthcare facility, health personnel to population ratio among others. Various queries and analysis carried out. Results obtained show that 10 healthcare facilities have at least 10000 populations. Four facilities were found to have no doctor. Two facilities were found in ward [14-37] settlements were distributed all over the study area, with over 21 settlements are left out of the service areas.

5. Conclusion

Geospatial technology as applied in this work examines the locational distribution of healthcare facilities in Obio/Akpor local government area, facility service area, physician to population ratio, as well as healthcare facilities deficiency in the study area. The outcomes of the various queries and analysis in this work have shown the capabilities of Geospatial technology in solving the lopsidedness in the distribution and management of healthcare facilities in Obio/Akpor local government area and Nigeria in general.

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