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Original Research Article

Distribution of Health Facilities for Disaster Management and Emergency Response in Osun State, Nigeria

A. T. Salami, K. A. Adepoju, O. O. Ogundipe

Institute of Ecology and Environmental Science, Obafemi Awolowo University, Ile-Ife, Osun State.

Corresponding Author: O. O. Ogundipe

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ABSTRACT

This work assessed health facilities for disaster management and emergency response in Osun State, Nigeria. This was with a view to developing a platform for sharing information among health institutions and the general populace in support of public health decision-making. A total of 300 health-related institutions including both government and private hospitals which were surveyed and selected on the basis of their capacity for performing basic emergency health services, were then contacted and surveyed for the study. A geospatial database was designed and implemented for 300 selected health institutions. The geographic location of selected health facility was registered with a Geographical positioning system (GPS) unit. Spatial and geostatistical analysis tools in ArcGIS were used for the assessment of disaster response capability of health facilities throughout the state in order to model the potential health disaster risk and their management. The findings revealed that there are more private health facilities 246 (82%) than the public health facilities 54 (18%) in this assessment and the distribution reveals that urban centres where high population is recorded have the larger share of the facilities. It also reveals that most of the health facilities are not prepared in response for emergency with the indicators used in this study, a total of 136 (45.3%) of the health facilities assessed have stretchers, 41 (13.7%) of the health facilities have ambulance, 18 (6%) of the health facilities have blood bank, 58 (19.3%) of the health facilities have scanner, 223 (74.3%) of the health facilities have 5 bed space or more and 19 (8.2%) are equipped with specialized services. 11 health facilities have all of the indicators in this study, 5 are public health facilities and 6 are private health facilities. The study concluded that rural inhabitant will be at disadvantage in case of serious emergency as they need to travel a long distance to get required health care.

Keyword: Emergency, Management, Database, geospatial, Disaster, GPS, geostatistical, ArcGIS, Geospatial.

INTRODUCTION

Health as defined by WHO is the absence of disease and infirmity. At a conference 1n 1948, they re-defined health to be the complete state of physical, mental and social well-being (WHO, 1848). As living conditions improve, human longevity is expected to improve and vice versa. Empirical evidence has shown that among poor countries, increase in life expectancy is strongly correlated with increase in productivity and income (Deaton, 2003).

Health facilities are established organizations that provide health care e.g hospital, clinic, maternity, dispensaries etc. The term health facility refers to a hospital, clinic, outpostor institution that provides comprehensive medical care to a significant

number of people in a given area. Health facilities play a pivotal role in the everyday life of communities. In most instances, the services they render are the primary means of addressing public health needs (America Hospital Association, 2000). The inadequacies in the access to health facilities have reduced the life expectancy of rural inhabitant and increased infant mortality (Ajala *et al*., 2005).

Concern has not been given to the need for equity in the planning and distribution of health care facilities over the years in the country. Public and private health care facilities are sparsely provided in many regions. Such region with difficult terrain and are often neglected (Onokerhoraye, 1999). This makes the distance between the rural dwellers and health care centres far apart, given the transportation problem experienced in these areas. Bour (2003) found that distance is the most important factor that influences the utilization of health services in Ahafo Ano south district of Ghana.

The importance of healthcare to individuals and governments and its growing costs to the economy have contributed to the emergence of healthcare as an important area of research for scholars in business and other disciplines. Information systems (IS) have much to offer in managing healthcare costs and in improving the quality of care (Kolodner *et al.*, 2008). In addition to the embedded role of information technology (IT) in clinical and diagnostics equipment, Information systems (IS) are uniquely positioned to capture, store, process, and communicate timely information to decision makers for better coordination of healthcare at both the individual and population levels.

The idea that place and location can influence health is a very old and familiar concept in Medicine. As far back as the time of Hippocrates, (460-370 BC), the father of Modern Medicine, when he observed that certain diseases seem to occur in some places and not in others. In 1854, John Snow demonstrated the utility of mapping disease outbreaks to gain insights as to their cause. Snow, an anaesthesiologist, mapped the highest density of cases that occurred in households, which used the public pump on Broad Street as their water source. Since the 1990s, GIS have been increasingly used in public health settings (Kaiser, 2003). The WHO and UNICEF created the Public Health Mapping Program in 1993, to establish a GIS to support management and monitoring of the Guinea worm Eradication program. This has been expanded to a much wider range of public health applications and now includes the promotion and use of GIS for other disease control program and in public health departments of a number of countries (WHO, 2002).

Geographic information system (GIS) can be used to analyse and compare such patterns. In 2000, a project in Kamataka was accomplished for dividing regions and specifying local domain of health area responsibility. Reason for performing this study, was referred to the disproportion between population of the region and location of health centres. The final goals were to control and supervise health centres operations in their responsibility region, to optimize use of available health resources and to cover clients' needs. GIS have the ability of performing spatial analyses, such as: zoning regions, finding the best location for facilities (Wen Hsiang, 2000).

Keola *et al.*, (2002) used GIS for examining effects of different factors on public health, showing disease distribution, performing specific analyses, visualization and provision of information on health care and also helping in different decision making. GIS was used as a managing system to store and recover data, display and recognize temporal and spatial association of diseases (World Health Organization, 2002).

Ismaila and Usul (2011) carried out a similar study in Yola, Nigeria and concluded that there is still gross inadequacy both in terms of health facilities and physicians and that GIS is an inevitable

tool with several functions that can help health care planners in decision making process. It further recommended the need for an urgent improvement of health care delivery system in Yola for the betterment of people's lives and adoption of GIS technology by health care planners in Adamawa state.

Chan *et al.*, (2012), also carried out a study whereby health facilities in Libya were mapped out. Okafor et al., (1997), analyze the spatial distribution and efficiency of health centres in the old Bendel (now Edo and Delta) State. He created a database for all the health centres in Benin and found out that there were discrepancies between the population distribution and the distribution of health centres.

Dzikwi and Abbas (2012), also used GIS to map the spatial distribution of rabies in Kaduna State, Nigeria. They used GIS to analyze record data obtained from the State Ministry of Agriculture and the achieved map of the state to track the spread and management of the disease in the State.

The World Health Organization (2002), describe GIS as "an excellent means of analyzing epidemiological data, revealing trends, dependencies and interrelationships that would be more difficult to discover using traditional tabular approach". Site selection and distribution of health care centres are important components of an overall health system which has a direct impact on the burden of diseases that affect many countries in the developing world. The creation of health care centres database and mapping helps in showing the spatial distribution and information about location and their physical relations to each other. The purpose of using GIS in site selection and distribution of health care centres is that maps provides an added dimension to data analysis, which helps in visualizing the complex patterns and relationships. The use of GIS for measurement of physical distribution is well established and has been applied in many areas including retail site analysis, transport, emergency services and health care services (Wilkinson *et al.*, 1998). Also in 1843, Wilkinson showed epidemically incidence of typhoid on a map which involved all of the infected houses (Burrough, 1986). Since then, GIS has been continuously used for the analysis of spatial health related data. During this period, the more GIS analytical capabilities were developed, the more advanced and comprehensive spatial models were developed by the collaboration of experts in both areas of GIS and epidemiology and health care.

The need for health care varies in space and so the organization of provision necessarily has a spatial component. Neither population totals nor population characteristics such as age, sex, income, occupation, fertility et cetera are uniform in space. In a like manner, the physical environment varies in characteristics from place to place and this invariably has implications for the pattern of demand for health care facilities. The spatial dimension is also important in utilization behavior since accessibility is a major determinant of the use of health care facilities (Onokerhoraye, 1997). Data and information are vital at each stage of the emergency cycle in order to make informed decisions and develop targeted response programs. Seemingly a simple task - the humanitarian environment poses great challenges to timely and effective information collection and management.

Fragmented workflows and the process of translating information into timely decision-making is an ongoing and well-documented challenge (King, 2005; Harvard Humanitarian Initiative, 2011). The health sector, like many others, struggles to make decision amongst a simultaneous deluge and paucity of health information, (Turoff, 2008). Studies have reported over 80% of health information are geographical in nature and timely health interventions depend upon where health facilities are located and the status of each identified facility (e.g., hospitals, primary health care centers (William, 1987). Nowadays, health

and health care are considered as models and an important factor in the quality of life of individuals. In fact, the development of public health and diseases management plays a significant role in cultural, social and economic development of any society.

The most important goals of each public health organization involve environment health, control of diseases, health education and prevention, medical and nursing actions for early diagnosis, control and management of diseases (Ghazban, 2003). In fact up-to-date information and adequate models are required to help decision makers decide regarding any parameters affecting public health. Both human settlements and activities and factors causing human diseases spread geographically. Most of the pathogenic factors are universally epidemic and do not belong to a special region or area, while some of them may occur in specific regions. Such correlations make it necessary to study and compare the spatial distribution and pattern of both the diseases, the affected population and their assumed factors.

WHO (1997) specified criteria for healthcare planning for third world countries and indicated that each service area should cover a 4km catchment area with a population of 60000 for primary healthcare in order to have adequate and equity of access to health centres. In line with WHO (1997), this study therefore aimed to map the spatial distribution of healthcare centre and also to assess their capacity to respond to emergency in Osun State, Nigeria using GIS technique. This aim was achieved by identifying, mapping and creating a GIS database for public and private health centres in the study area

MATERIALS AND METHODS

Osun State was Created on August 27th 1991 located within latitude 6°55' and 8°.10' North and longitude 3°.55' and 5°.05' East. It covers total landmass of about 12820 square kilometers. Politically, the state is divided into three senatorial, via, Osun I, Osun II and Osun III; population is around 4 million inhabitants as at 2014.

The following data were collected and used in the development of the database.

1. The study area map
2. List showing health centre names and addresses
3. Health care centre coordinates.

Data for this work was collected from two bodies responsible for managing and evaluation health; they are ministry of health and osun state hospital management board, both in Osogbo. A total of 300 health-related institutions including both government and private hospitals which were surveyed and selected on the basis of their capacity for performing basic emergency health services, they were then contacted and surveyed for the study. To obtain necessary information about the selected health facilities, questionnaires was issued to health facility managers, and the questionnaire was designed under six categories, a geospatial database was designed and implemented for the 300 selected health institutions.

The database was organized within six broad categories including basic information, evacuation capability, medical services, ancillary services, support services and personnel. The coordinates of each health facilities were obtained using a GPS, the geographic positions of facilities in urban centres was recorded with a GPS unit corresponding to the exact site, while the geo-references of health facilities in rural area was recorded as corresponding to the geographical centre of the towns and villages where they are located. ArcGIS 10.1 was used for the analysis. The spatial data were organized in layers, and the ability to query was made possible using query builder in ArcGIS. All the necessary information for each health centre was entered into its layer's/theme's attribute table. This was done by adding required number of fields (column) to the table and entering the data for all the health centres in their corresponding records (rows). The coordinate of the health care centres were

copied in Excel and saved as a text. The file was later imported into Arc Map environment. A few query performed were: (1) how many are the public health facilities selected in the state? (2) How many are the private health facilities selected in the state? (3) How many are the public/private health facilities selected have a particular indicator? Etc.

Spatial and geostatistical analysis tools in ArcGIS were used for the assessment of disaster response capability of health facilities throughout the state in order to model the potential health disaster risk and their management.

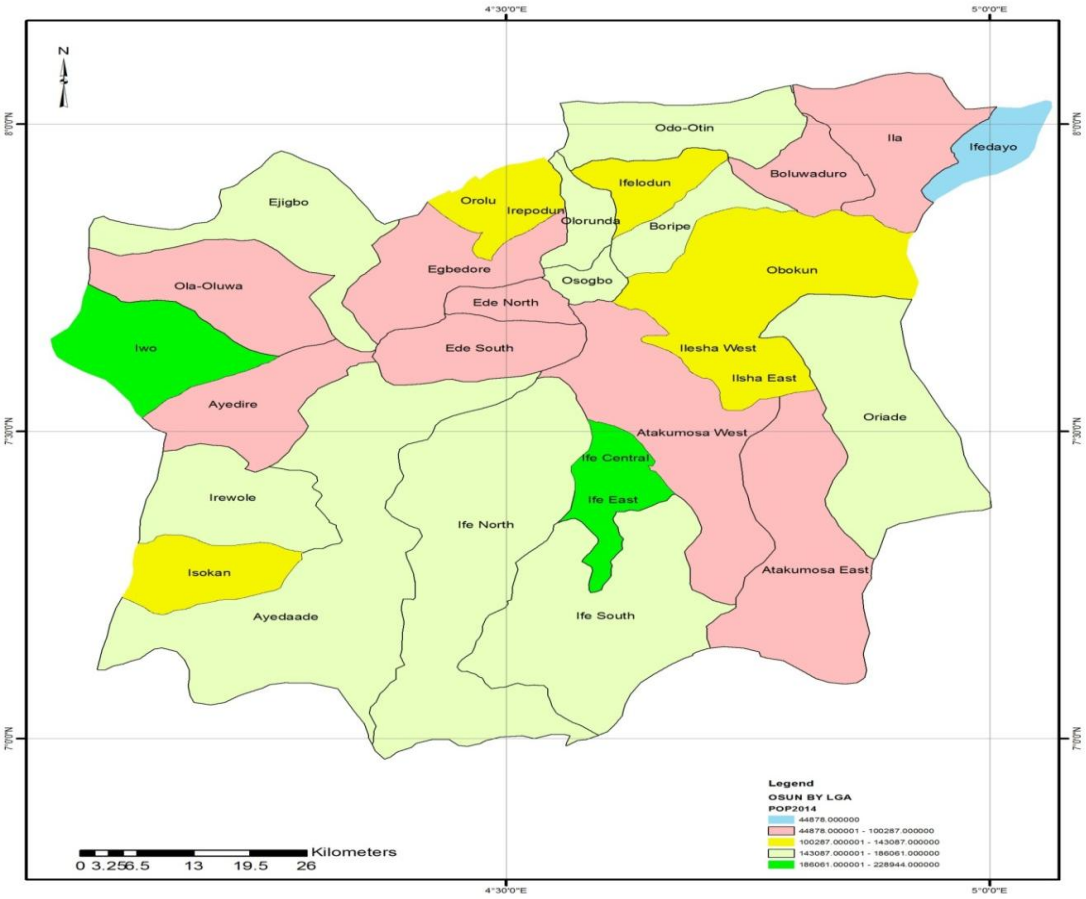

Figure 1: Map of Nigeria showing Osun State and the 30 LGAs

Table 1: Population Distribution by Local Government in Osun State.

LGA	1991	2006	2014	2020	2030	POPULATION DENSITY
Atakumosa East	48068	76105	91058	102273	120965	156
Atakumosa West	43170	68350	81779	91852	108638	140
Ayedaade	94467	149569	91302	200997	237732	168
Ayedire	48197	76309	91302	102547	121289	320
Boluwaduro	44814	70954	84895	95351	112777	559
Boripe	87629	138742	166002	186447	220523	1186
Ede North	52939	83818	100287	112638	133224	1153
Ede South	47679	75489	90321	101445	119986	386
Egbedore	46719	73969	88503	99403	117570	289
Ejigbo	83696	132515	158552	178079	210625	397
Ife East	119128	188614	225673	253467	299791	2191
Ife North	96807	153274	183389	205976	243620	185
Ife South	84944	134490	160915	180733	213764	227
Ife Central	105606	167204	200056	224696	265761	2818
Ifedayo	23690	37508	44878	50405	59617	384
Ifelodun	60914	96444	115393	129606	153292	861
Ila	39193	62054	74246	83391	98631	219
Ilsha East	67460	106809	127795	143534	169767	1521
Ilesha West	66580	105416	126128	141662	167553	1911

Continued table no.1…..						
Table 3:1 (Contd.) Irepodun	**75533**	**119590**	**143087**	**160710**	**190082**	**2136**
Irewole	90196	142806	170865	191909	226982	544
Isokan	64461	102060	122113	137153	162219	614
Iwo	120855	191348	228944	257142	304137	751
Obokun	73802	116850	139809	177492	185727	264
Odo-Otin	83420	132078	158029	102437	209931	558
Ola-Oluwa	48145	76227	91204	176915	121159	255
Olorunda	83149	131649	157516	176915	209249	1676
Oriade	93716	148379	177533	199398	235840	293
Orolu	64948	102832	123037	138190	163446	1398
Osogbo	98218	155507	186061	208977	247170	3323

* 1991-2014 Population ** 2020-2030 Projection using 3.5 percent rate (Source: National Population Commission)

RESULTS AND DISCUSSION

From the Database that was created for the selected 300 health facilities in the study area shown in Table 2 and Figure 2, there were more private health facilities 246 (82%) than public health facilities 54 (18%). Out of the 246 private hospitals surveyed, one hundred and fifty four (62.6%) were in the category of clinic/hospitals, seventy four (30.1%) were in the category of maternity centres and eighteen (7.3%) were in the category of health laboratories/ optical/ dental centres.

It was also observed that 198 (80.5%) of the private health centres were concentrated in the urban centres of the state where there is high population (Irewole, Ife-south, Osogbo, Oloruda, Ife-cental, Iwo), while 48 (19.5%) were located in the rural area of the study area where there is low populated areas (Orolu, Irepodun, Ifelodun, Obokun, Isokan). Out of the 54 public health facilities, 40 (74.1%) are in populated areas and 14 (25.9%) are in low populated areas.

A total of 136 health facilities have stretcher, 34 are public and 102 private, and most are in populated high areas. A total of 41 health facilities have ambulance, 19 public and 22 private, most are in populated areas. A total of 18 health facilities are equipped with blood bank, 15 public and 3 private, most are populated areas. A total of 58 health facilities have scanner, 7 public and 47 private, most are in populated areas. A total of 276 health facilities have 5 beds or more, 53 public and 223 private, populated environment recorded the most. A total of 19 health facilities operate specialty services, 3 public and 16 private, most of them are in populated areas.

When analyses of health facilities with at least six indicators was done, a total of 11 health facilities have all the six indicators in this study and all of them are in populated areas. The indicatorswas later reduced to three and a total of 40 health facilities have the three indicator and all are in populated areas.

This work revealed that there are more private health facilities than public health facilities. Most of the health facilities were clustered in the northern part of the state, followed by the eastern part of the state, and then the central part of the state. The health facilities were scattered in the western part of the state, which revealed that the facilities are not evenly distributed and the urban areas have more of the facilities than the rural areas, the implication is that rural inhabitants will be at disadvantage should in case serious emergency occur often. Ajala et *al.*, (2005), also reported in his study that the health facilities in the state are not evenly distributed and the distribution favours the urban areas than the rural areas.

It has been revealed in this study in Osun State that serious inequality exist in the distribution of health care centres by both private and public sectors among Urban and Rural areas. Also, it was revealed that inequality persist in the distribution of the existing facilities among the LGAs and between Urban and Rural Settlements in the state. The most deprived people are the rural inhabitant. The deprivation suffered by these people has resulted in the many

preventable deaths among the rural people. Also, it has led to reduced life expectancy, increased infant mortality, reduced man-hour in agricultural activities and increased poverty among the rural inhabitants. The basic aim of sustainable development is to achieved increased productivity on a continuous basis, retain the rural population and improve the level of living in the rural environment. All these cannot be achieved without adequate provision for health care facilities and services for the rural populace. Therefore, there is a need for serious intervention to bring about equitable and adequate provision of healthcare facilities to the entire population and particularly the rural inhabitants.

Table 2: Database for the Selected Health Facilities in Osun State

S/NO	NAME	LAT	LONG	ACCURAC	ADDRESS	TELEPHONE	ZONE	TYPE	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
1	APEX MED	7.4948	4.52357	±8	133, IFE - II	8053893999	IFE CENTR	PRIVATE	YES		1 NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
2	SEVENTH I	7.48924	4.54074	±8	LAGERE, IL	8032148532	IFE CENTR	PRIVATE	YES		3 YES		1 YES	YES	YES	YES	YES	YES	YES	YES
3	OBAFEMI	7.50306	4.57122	±7	GENERAL,	8062680863	IFE CENTR	T.H	YES		10 YES		6 YES	YES	YES	YES	YES	YES	YES	YES
4	COMPREH	7.386	4.585	±7	OKE DIO N	8035640148	IFE EAST	A STATE	YES		1 YES		1 YES	YES	NO	YES	NO	NO	NO	YES
5	ULTIMATE	7.49779	4.57638	±7	OFF ALAD	8064869678	IFE CENTR	PRIVATE	YES		1 NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
6	ZENO MED	7.5003	4.57095	±6	ALADANL	8032398360	IFE CENTR	PRIVATE	NO	NIL	NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
7	GHOSEN S	7.50114	4.57001	±8	ALADANL	8060063404	IFE CENTR	PRIVATE	YES		1 NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
8	HIS MERC	7.50194	4.57171	±7	OPPOSITE	8035848215,	IFE CENTR	PRIVATE	YES		1 NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
9	ACCURAC	7.50133	4.57146	±5	195, ILESA	08067033846	IFE CENTR	PRIVATE	YES		2 NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
10	ABITOP M	7.50393	4.57252	±6	OPPOSITE	8033955197	IFE CENTR	PRIVATE	YES		2 NO	NIL	NO	YES	NO	YES	NO	NO	YES	YES
11	GOD'SWIL	7.50518	4.57335	±8	OPPOSITE	8138376740	IFE CENTR	PRIVATE	NO	NIL	NO	NIL	NO	NO	NO	NO	NO	NO	NO	NO
12	MAYE HOS	7.49147	4.5362	±9	PARAKIN,	08037066478	IFE CENTR	PRIVATE	YES		2 NO	NIL	NO	YES	NO	YES	NO	NO	YES	YES
13	MOHAS M	7.5034	4.57417	±7	ILESA ROA	7066783407	IFE CENTR	PRIVATE	YES		1 YES		1 YES	YES	NO	YES	NO	NO	YES	YES
14	IYIOLA HO	7.50303	4.5763	±9	BEHIND M	8097950971	IFE EAST	PRIVATE	NO	NIL	NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
15	OLUWAKC	7.48885	4.54516	±8	ELEYELE, IL	36232444	IFE CENTR	PRIVATE	YES		2 YES		1 YES	YES	NO	YES	NO	NO	YES	YES
16	OAU, URB	7.48985	4.54479	±6	ELEYELE, IL	9087532134	IFE CENTR	STATE	YES		4 YES		1 YES	YES	NO	YES	NO	NO	YES	YES
17	ALAFIATA	7.49553	4.54834	±7	NUMBER 5	8033457657	IFE CENTR	PRIVATE	YES		1 YES		1 YES	YES	NO	YES	NO	NO	YES	YES
18	OLUNIFE H	7.471	4.622	±8	SABO, ILE	7034580654	IFE CENTR	PRIVATE	YES		2 YES		1 YES	YES	NO	YES	NO	NO	YES	YES
19	ODO-WAF	7.43	4.644	±9	ILODE, ILE	9035456567	IFE EAST	STATE	NO	NIL	NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
20	OLUWA LC	7.417	4.633	±9	LUKORE S	8034566993	IFE EAST	PRIVATE	NO	NIL	NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES
21	AJIGBORE	7.404	4.633	±7	ILOROMU	8077345236	IFE EAST	PRIVATE	YES		1 NO	NIL	NO	YES	NO	YES	NO	NO	YES	YES
22	TOYOSI CL	7.446	4.596	±7	ORANFE, I	7033343215	IFE EAST	PRIVATE	NO	NIL	NO	NIL	NO	YES	NO	YES	NO	NO	NO	YES

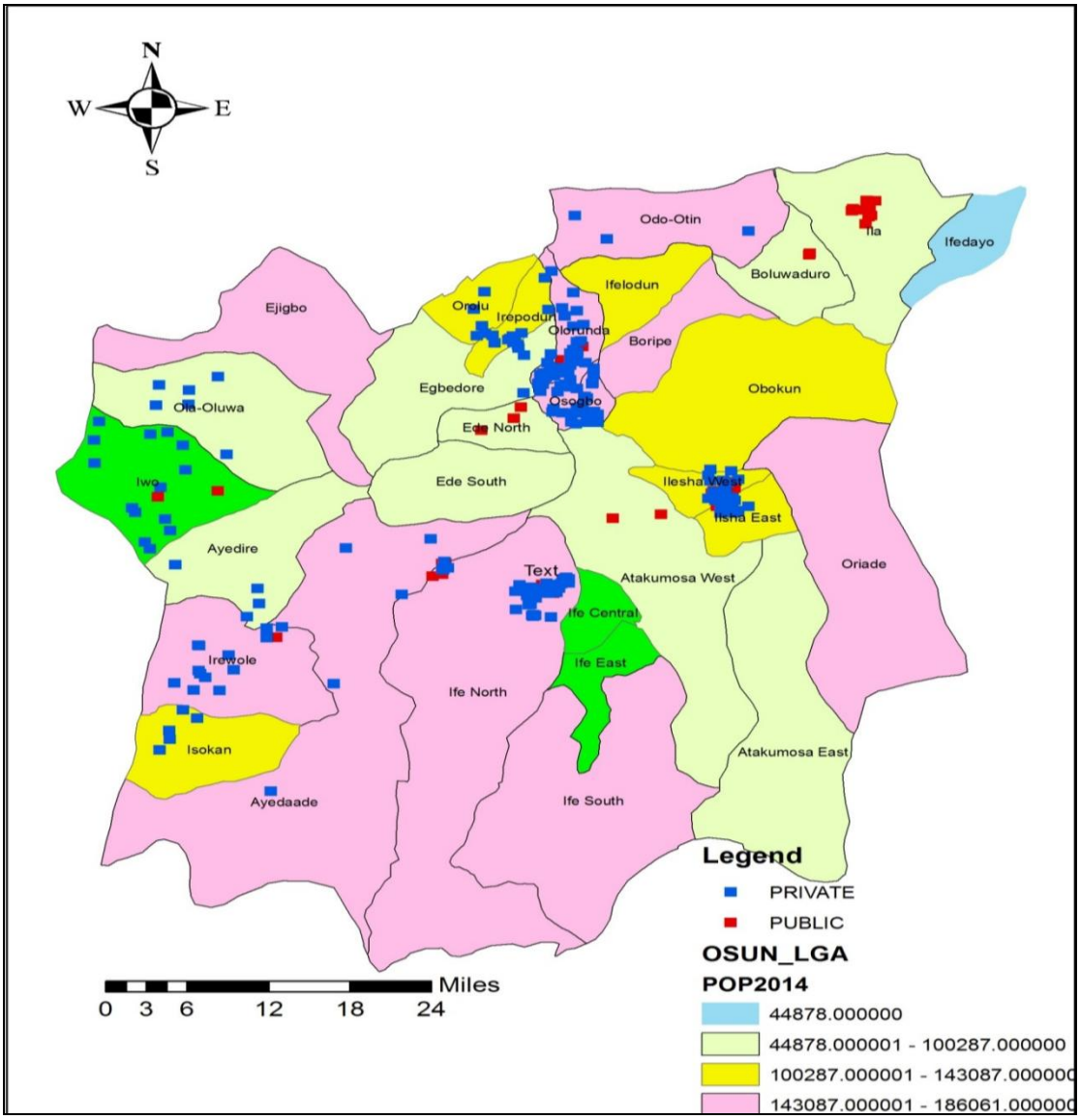

Figure 2: Spatial Distribution of both selected Public and Private Health facilities surveye

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