USING GIS AND REMOTE SENSING FOR DISTRIBUTION AND MANAGEMENT OF HEALTH FACILITIES IN AKURE, NIGERIA

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Abstract

The role of Geographical Information System in planning and management of location-based services has been underscored by several studies related to social services provision. In Nigeria the utilization of Geographical Information System techniques in provision social facilities like of health services is yet to gain much momentum after a complete survey of health units and development of a national geo-database. Planning for the provision of health infrastructure services requires quality information to rationalize the location and allocation of services in relation to population. The paper examines the location of health facilities in Akure and their proximity to residential houses in surrounding neighbourhood. Geographical Positioning System (GPS) was used to identify the health institution and obtain the coordinates of the location of each identified health facilities. These were loaded on the imagery of Akure that was digitized from Google Earth using the software of ArcGIS 9.3. Data was also collected using structured questionnaires and analyzed using descriptive statistic with the aid of Statistical Package for Social Scientist (SPSS 20).The results revealed that most people especially the poor are significantly disadvantaged in access to basic health facilities. The study therefore recommends that government should make adequate policy location and management of health facilities for proper efficiency and effectiveness.

Keywords: *Health facilities, GIS, Remote Sensing, ArcGIS, SPSS, GPS*

1. INTRODUCTION

Inadequate access to health services is a major issue confronting the poor in Nigeria. The decision of an individual on which type of medical or health facility to use greatly depends on the accessibility, proximity and affordability. Since the survival the survival of a sick or a safe

delivery of a woman in labour depends on quick medical attention that reaches them which is a function of spatial location of the health facility. To this extent, the distribution of orthodox medicine facilities requires public policy attention to ensure equitable access in terms of availability, spatial location and affordability such that the decision to use either orthodox medicine or traditional medicine will depend on users' preference. Given that affordability is a more critical factor in the rural and agriculture dependent areas because of higher level of poverty, public policy attention needs to be focused on access to orthodox medicine services all over the Local Government Area (Adeyemo).

Accessibility is the ease of getting to a place (Okafor, 1984). This therefore means that when there is no ease of reaching a place then it could be said that there is no accessibility. Accessibility is the inherent characteristic or advantage of a place with respect to overcoming some form of friction. Access to health care is multi-dimensional concept that involves financial accessibility, availability, acceptability, and geographical accessibility. Studies in the US have shown that usage of health care services is affected by the ownership of health insurance (employer i.e private or public) as well by the out-of-pocket cost of the care obligated under various types of insurance. Insurance coverage has been found to increase survival chances and significantly reduce the odds of transitions from independence to disability.
The location of facilities is critical in both industries and in health care. In industry, poorly located facilities or the use of too many or too few facilities will result in increased expenses and/or disregard customer service. If too many facilities are deployed, capital cost and inventory carrying costs are likely to exceed the desirable value. If too few facilities are used, poorly sited facilities will result in unnecessarily poor customer service. In health care, implications of poor location decisions extend well beyond cost and customer service consideration. If too few facilities are utilized and/or if they are not located well, increases in mortality (death) and morbidity (disease) can result. Thus, facility location modelling takes on an even greater importance when applied to the siting of health facilities (Mark S. Daskin and K. Dean (2004).

Good health this no doubt a prerequisite for global liveability of man and it is a critical component of societal needs, hence a need for equitable distribution of health facilities as a factor for sustaining the population in settlements. Accessibility to health facilities has a strong influence on people's earning capacity and it is fundamental to people's ability to enjoy and appreciate other aspect of life. Aregbeyan (1992) regarded accessibility to health facilities for an individual in spatial perspective and that the physical accessibility of a household member to health care facilities is of considerable importance, but it is however constrained by distance.

As general principle, it has been stated that the greater the distance between two (2) points, the lower the probability of these points being functionally related. A large number of studies have shown a regular decline in accessibility to health facilities with increasing distance in road transport journeys to hospitals. Similarly, some studies that were undertaken in different parts if Nigeria have shown variation in maximum distance which people travel to utilize health facilities, for instance, Adejuyigbe (1977) and Adeyemo (2005) noted that there is limit to the distance, which people are ready to ready to travel in order to enjoy some health services. They

further maintained that attendance at each medical centre is function of type of services available in the medical centre and the distance from other medical centre providing similar service.

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The Nigeria Core Welfare Indicator study measured Health access in terms of persons living in households with an Orthodox medical health facility less than 30 minutes away. This clearly indicates the policy emphasis placed on that availability of physical Health infrastructure in Nigeria. The literature around health inequality is extensive. Health inequalities Harttgen and Misselhorn (2006) found that access to health infrastructure is important for child mortality which is one of the health outcomes covered by MGDs. On the other hand, socio-economic factors, especially poverty, are often found to be strong determinants of health outcomes (Young, 2001).

Due to the importance of the health sector the Nigerian government at all level have share of health management. All the three tiers of government- federal, state, local and even community are responsible for the management of the health care. The Federal Ministry of Health is responsible for policy and technical support the overall health matters, the national management information system and the provision health services through the tertiary teaching hospital and national laboratories. The State Ministry of Health are responsible for secondary hospitals, for regulation and technical support for primary health services. Primary health care is the responsibility of Local Government where health services are organized through the political wards (Ojo, 2014). The organization of health sector seems to be well coordinated, but the practical working of this system is not as depicted here. There is often the duplication and confusion of roles and responsibilities among the different tiers of Government. The implication of this is the weaknesses in the coordination and tracking of performances and bench making (Oyinloye, 2014).

Health facility is one of the facilities that are mostly needed by everyone in the society. There had been many researches on Nigeria health challenges which include high child mortality rate, poor health delivery, poverty to pay for health services and lot more. Much work had been done on maternal and mortality rate, disease problems in Nigeria, and many other health related issues but nothing seems to have been done in the area of the accessibility of health facilities. This work aims to fill this gap, as it discusses the importance of accessibility to health facilities to the residential houses in the study area.

The objectives of this study are to:
 i. apply location-based analysis of access to health facilities using satellite imagery.
 ii. identify the existing health facility in Akure South local Government Area
iii. examine the utilization and effectiveness of the existing health facilities with respect to route accessibility
iv. identify the distribution of diseases between the ages and financial capability

2. THE STUDY AREA

Ondo state lies between latitude $5^0 45^I$N and $7^0 52^I$ N and longitude $4^0 20^I$E and $6^0 05^I$E. The state is bounded on the east by Edo and Delta states, on the West by Ogun and Osun states, on the North Ekiti and Kogi states and to the South by the Bight of Benin at the Atlantic Ocean. Ondo state is one of the eight (8) states of the federation with costal line and has the longest coastal line. Akure South Local Government Area is located at the central of Ondo state and it is one of the six (6) Local Government areas classified as the Ondo central constituency of the federal constituency. It is locate between latitude 7^0 21'N and 7^0 50'N and Longitude 5^0 50' and 7^0 25'. It is bonded on the north east by Akure North Local Government Area and on the North West by Ifedore Local Government Area, Idanre Local Government Area bonded it on the southern part (see figure 1).

The population of Akure in 1963 was put at 71,006 and by 1999; the total population has risen to 239,124 according to the 1991 census. By the year 2006, the total population has increased to 340,021 inhabitants (NPC, 2006). The increase in annual growth of the population has been tied to the administrative role of the town and its long standing role as a centre of economic activities attracting a large spectrum of immigrants into it.
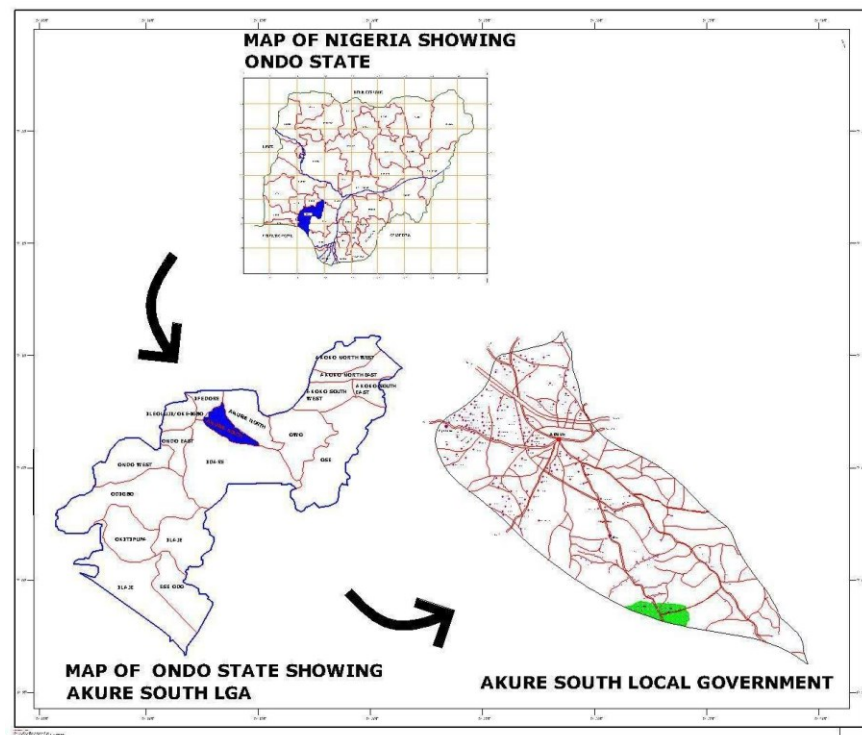

Figure 1: Map showing Akure South LGA
Source: Ondo state Ministry of Physical Planning and Urban Development

2.1 THE SCOPE OF THE STUDY

The study shall cover all the health facilities in Akure South Local Government Area. All the available health facilities are shown in the map below (see figure 2).
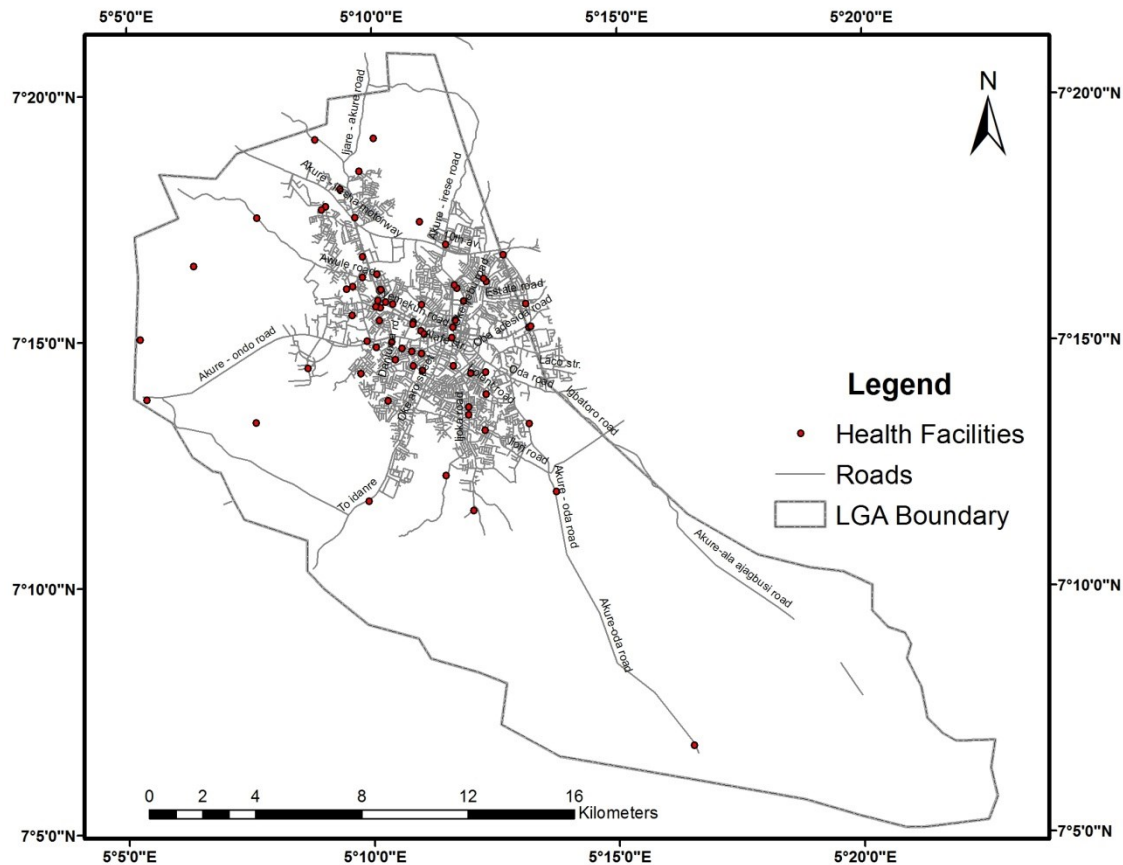
Figure 2: Map of the studied area and locations of health facilities
Source: Author's filed survey (2013)

3. DATA ACQUISITION AND METHOD

This study was interested in the location, distribution and management of Health Facilities in Akure South Local Government. This study assesses the distribution of the orthodox health infrastructure in Akure South Local Government Area. The study also looked at the distribution of diseases among difference category of people. To achieve these, data were collected using structured questionnaire which were administered on political ward basis in the study area. For the purpose of this study, a sample frame of 20% buildings in the wards was sampled using a simple random method. The study area has a total number of 11 wards and 1100 buildings. For the sake of this study 20 questionnaires were randomly administered in each ward totalled at 220. In this study 20% of the totalled health facilities of the study area which is totalled at 220 facilities were sampled. Table 1 shows the number of questionnaires administered in each of the political wards in the study area.

Table 1: Names of political ward and number of questionnaires retrieved

S/N.	Names political of Wards	No of questionnaires administered	Number of questionnaires retrieved
1	Aponmu	20	16
2	Gbogi I	20	15
3	Gbogi II	20	14
4	Ijomu	20	10
5	Ilisa	20	11
6	Oda	20	12
7	odopetu	20	13
8	Irowo	20	14
9	Oke Aro	20	13
10	Oshodi	20	15
11	Owode Imuagun	20	13
	Total	**220**	**146**

The questionnaire was administered on both staff of the health facilities and the people that patronize the health facilities. The questionnaire on staff addresses types of diseases, causes of diseases, type of staff, and year of occurrence while that of people addresses affordability of heath facility, road leading to health facility among others. GPS control points of each of the health institutions were obtained. The geographic data of the study area was captured from Google earth image. The image was geo-referenced and digitized to produce a digitized map of the study area. All these questions were carefully analysed using Statistical Package for Social Science (SPSS) in addition to GIS analysis to arrive at our conclusion.

4. Results and Discussion

4.1 Socio economic factors

Table 2: Type of Health Facility by Ownership

Type	Frequency	Percent
Private	88	60.3
Public	58	39.7
	146	**100.0**

Source: Field survey, 2013

Table 2 shows that 60.3% of the ownerships are private health facilities while 39.7% are public health facilities. The analysis shows that there are more private health facilities than public in the study area.

Table 3: Assessment of health facilities

Degree	Frequency	Percent
inadequate	80	54.8
Fairly adequate	39	26.7
ate	27	18.5
	146	**100.0**

Source: Field Survey, 2013

The assessment of the various health facilities by the health worker in table 3 shows 18.5% adequate, 26.7% fairly adequate, 54.8% are inadequate. The implication of this is that death rate will be high among the populace in the study because of inadequate health facilities.

Table: 4 Type of road that lead to the health facility

Type	Frequency	Percent
Tarred	48	32.9
Not Tarred	98	67.1
Footpath	-	-
Total	**146**	**100**

Source: Field Survey, 2013

Table 4 shows that 67.1% of the respondent said there is no good road accessibility to the health facilities and 32.9% said there is good road accessibility. This implies that the majority of health facilities the in the study area are not motorable particularly during rainy season.

Table 5:Type of staff in the Health Facilities

Type of Staff	Frequency	Percent
Qualified Nurses	62	42.5
Auxiliary Nurses, chew and heath assistance	55	37.7
Doctors	22	15.0
Pharmacists	7	4.8
Total	**146**	**100**

Source: Field Survey, 2013

Table 5 shows the assessment on the type of health workers in the study area. The study reveals that 42.5% are qualified nurses, 37.7% are auxiliary nurses, chew and assistance health workers while 15.0% and 4.8% are Doctors and Pharmacists respectively. The ratio of Doctors and Pharmacists as per population in the study area is embarrassing. There is grossly inadequate of health workers particularly Doctors, Pharmacists and enough qualified nurses in the study area.

Table 6: Time of waiting of patients

Time	Frequency	Percent
below 30 minutes	59	40.4
30-1hour	52	35.6
above 2 hours	35	24.0
Total	146	100.0

Source: Field Survey, 2013

Table 6 shows the time spent by patients before being attended to in the health facilities. The table reveals that 40.4% waits below 30 minutes, 35.6%, 30-1 hour and 24.0% 2 hours and above. This indicates that greater number of patients wait unnecessarily before being attended to. This may not have been unconnected to shortage of staff particularly Doctors in the health centres.

Table 7: Causes of long time of waiting

Cause	Frequency	Percent
lack of enough staff	55	37.7
lack of good equipment	49	33.6
ignorance on the part of patience	42	28.7
Total	146	100.0

Source: Field Survey, 2013

The table 7 reveals that 37.7% lack enough staff, 33.6% lack of equipment and 28.7% are as a result of ignorance on the part of patient. The equipment in most of these health centres is outdated.Infact some of the recommended drugs prescribed the by Doctors are not available for the patients.

Table 8: Causes of diseases in Akure South LGA

Causes	Frequency	Percent
ignorance of patience	44	30.1
poor sanitation	60	41.1
climate	42	28.8
Total	146	100.0

Source: Field Survey, 2013

Table 8 shows the causes of diseases in the study area reveals that 30.1% ignorance of patient, 41.1% poor sanitation and 28.8% climatic causes. This implies that there is high rate of poor sanitation in the study area. This in the long run generated a lot of diseases that affect the people in the study area.

Table 9: Record of Diseases (Malaria) between the years 2009 to 2013

Age group	2009		2010		2011		2012		2013	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
less than 1 years	9661	18.86	11163	21.10	23577	24.47	21357	31.45	22691	30.75
1-4 years	9495	18.53	14802	27.98	15149	27.31	20053	29.53	22213	30.10
5-14 years	12618	24.63	11780	22.27	13018	23.47	14519	21.38	14590	19.77
15 years+	19458	37.98	15155	28.65	13731	24.75	11982	17.64	14304	19.38
Total	51232	100	52900	100	55475	100	67911	100	14304	100

Source: Field Survey, 2013

Table 9 shows that 18.86% of children whose ages are less than one years where treated for malaria in 2009, 21.10% in 2010, 24.47% in 2011, 31.45% in 2012 and 30.75% in 2013. Children whose ages are from one to four years were found to be 18.53% in 2009, 27.98% in 2010, 27.31% in 2011, 29.53% in 2012 and 30.10% in 2013. Also those whose ages are from five to fourteen years have the following records from 2009 to 2013 respectively 24.63%, 22.27%, 23.47%, 21.38%, and 19.77%. The study also indicates people whose ages are fifteen years and above to have the following records from 2009 to 2013 respectively 37.98%, 28.65%, 41.71%, 25.18% and 35.56%. This shows that malaria is the most common type of diseases recorded throughout the years in the study area, though with variation or fluctuation within the age groups.

Table 10: Record of Diseases (Diarrhoea) between the years 2009 to 2013

Age group	2009		2010		2011		2012		2013	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
less than 1 years	78	46.99	275	30.35	850	43.84	850	42.93	901	38.42
1-4 years	70	42.17	315	34.77	748	38.58	677	34.19	906	38.64
5-14 years	18	10.84	214	23	192	9.90	248	12.53	345	14.71
15 years+	-	-	102	62	149	7.68	205	10.35	193	8.23
Total	166	100	906	100	1939	100	1980	100	2345	100

Source: Field Survey, 2013

The study in table 10 shows another common disease found in the study area. The table indicates that diarrhea cases from 2009 to 2013. Age less than one: 49.99%, 30.35%, 43.84%, 42.93%, 38.42% respectively. For ages one to four years 42.17%, 34.77%, 38.58%, 34.19%, and 38.64% were observed to surfer from diarrhea respectively. The research also indicates that there were 10.84%, 23%, 9.90%, 12.53, and 14.71% suffered for diarrhea ailment from 2009 to 2013 respectively. Again for the research also shows that there were cases of diarrhea for age group of above 15 years which indicate that there was no case of diarrhea in 2009, 62% in 2010, 7.68% in 2011, 10.35% in 2012 and 8.23% in 2013. The analysis indicates that children from ages

zero to four years suffer more for diarrhea between 2009 and 2013. This may not be unconnected with poor sanitation that is mostly prevalence in the study area.

Table 11: Reason for Patronage of Health Facility

Reason	Frequency	Percent
there is better service discharge	64	43.8
it is more affordable	29	19.9
nearness to residence	53	36.3
Total	**146**	**100.0**

Source: Field Survey, 2013

Table 11 shows that 43.8% of the respondents patronized their chosen health facility because of better service discharge, 19.9% because it is affordable and 36.3% because it nearer to their residence. Though people patronize health facilities because of good service provision, but most of these health facilities are too far from their place of residence.

4.2 Spatial Locations of Health Facilities in the study Area

Figure 3: Map showing location of health facility in Akure metropolis
Source: Field Survey, 2013

Figure 3 shows the imagery of the location of health facility in Akure Akure South Local Government. Most of these health facilities are scattered in the study area.
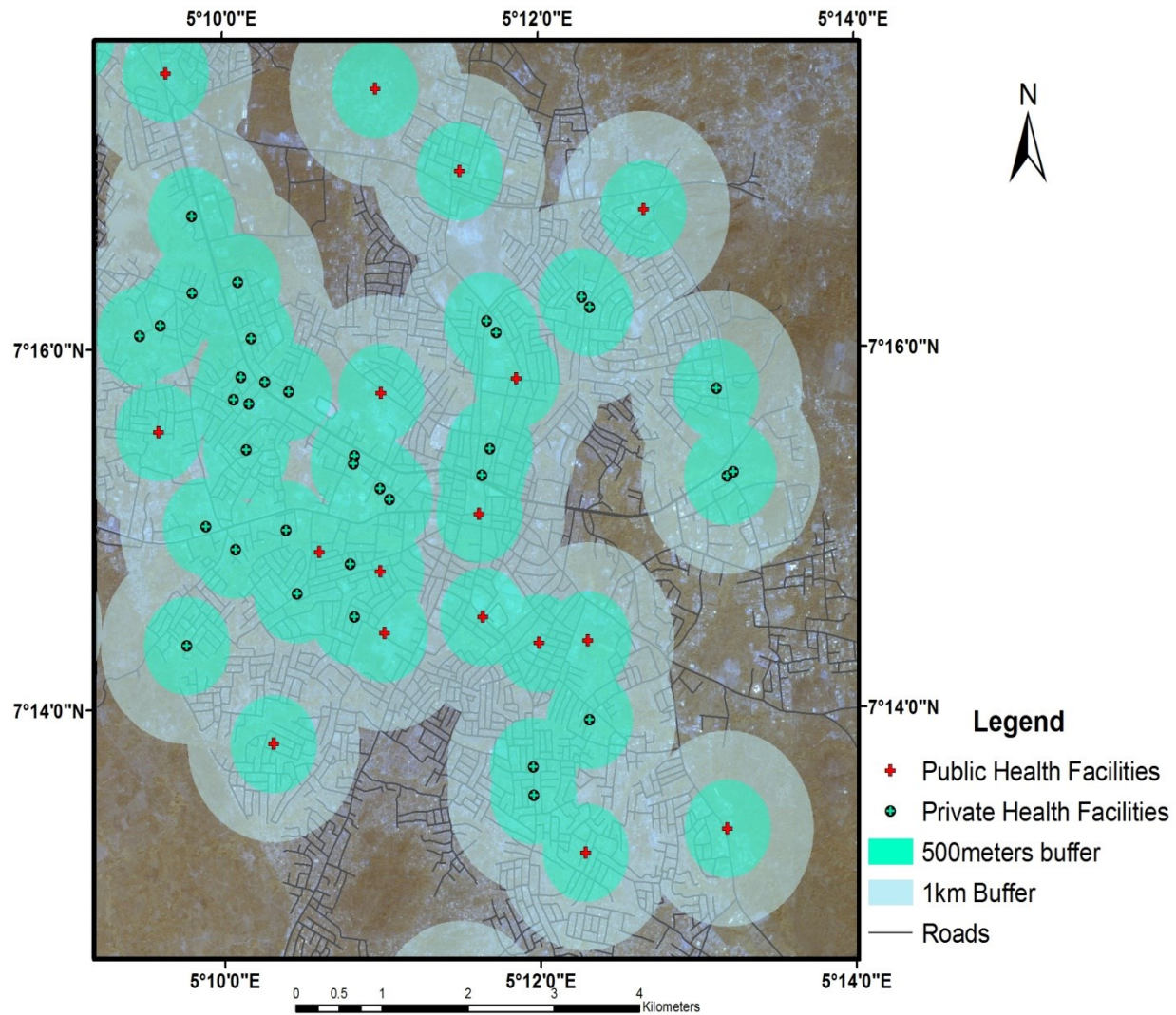

Figure 4: Map showing location of health facilities in Akure South Local Government
Source: Field survey, 2013

The map 4 shows the location of health facilities in Akure South Local Government buffered at 500meters and 1km respectively which is clearly explained in figures 5 and 6 respectively.
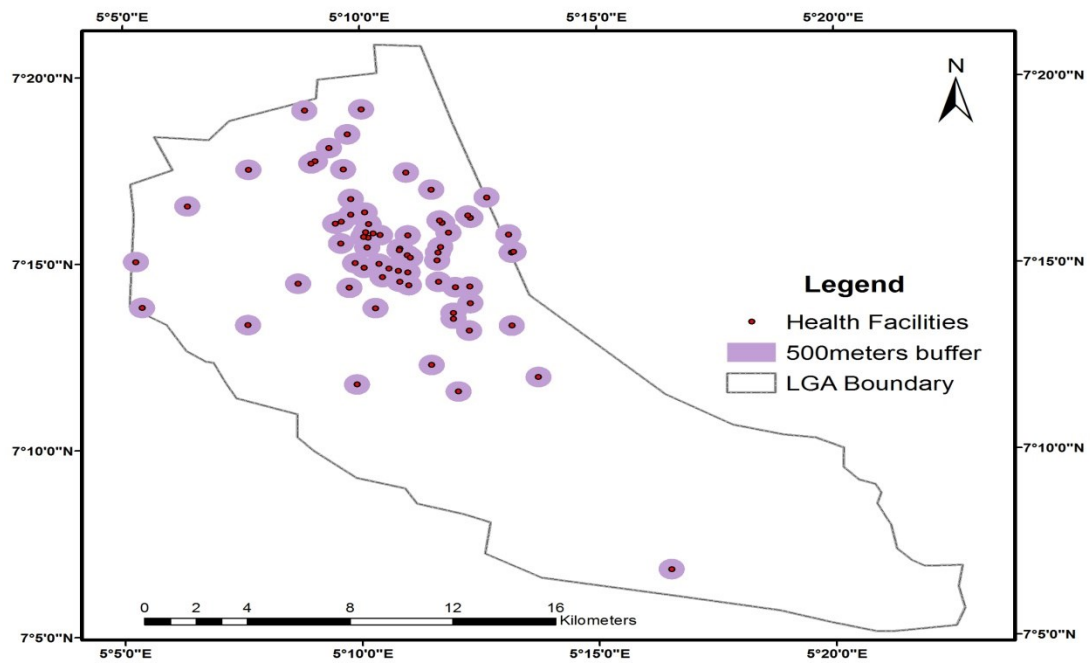
Figure 5: Map showing location of health facilities buffered at 500m distance
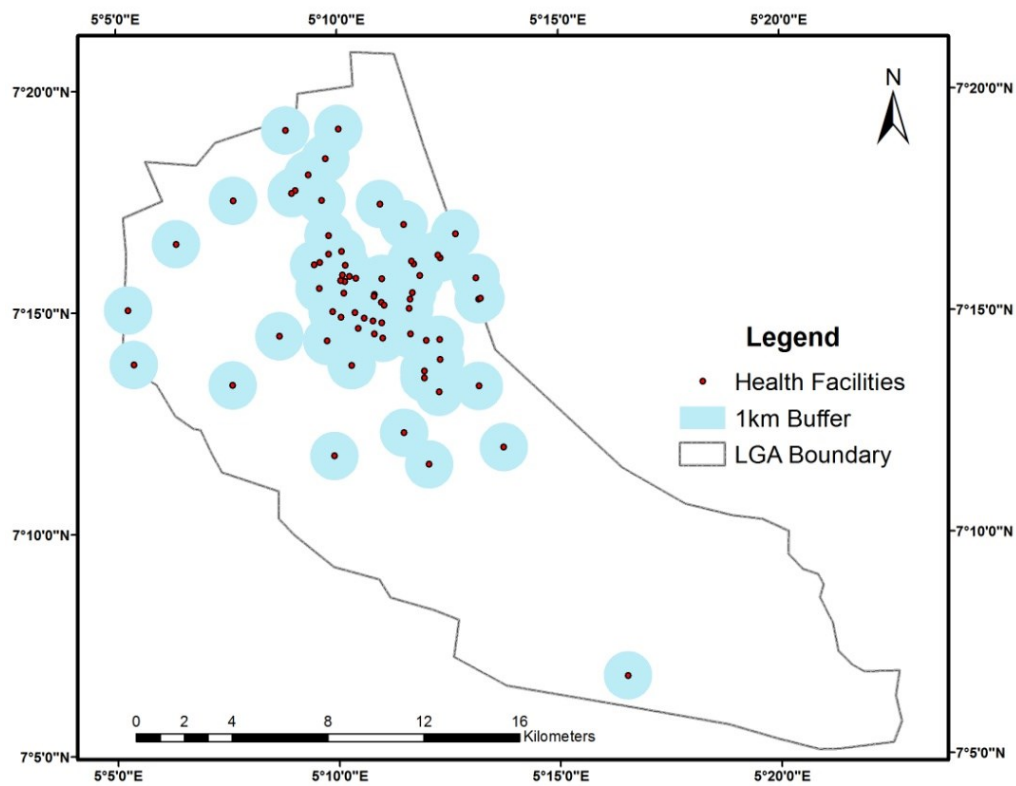*Source: Field Survey, 2013*

Figure 6: Map showing locations of health facilities buffered at 1km distance
Source: Field Survey, 2013

Figures 5 and 6 show the combined buffering of 1km and 500m radi to the health facilities. These health facilities were buffered to know how clustered the facilities are within the buffered zones. The maps show that at least two health facilitie are located within 1km radius distance and at least one within 500m radius distance in the study area. The maps also show that the health facilities are located closely to each other. Therefore there is inadequate spatial distribution of health facilities in Akure South Local Government Area particularly those located at the central wards.
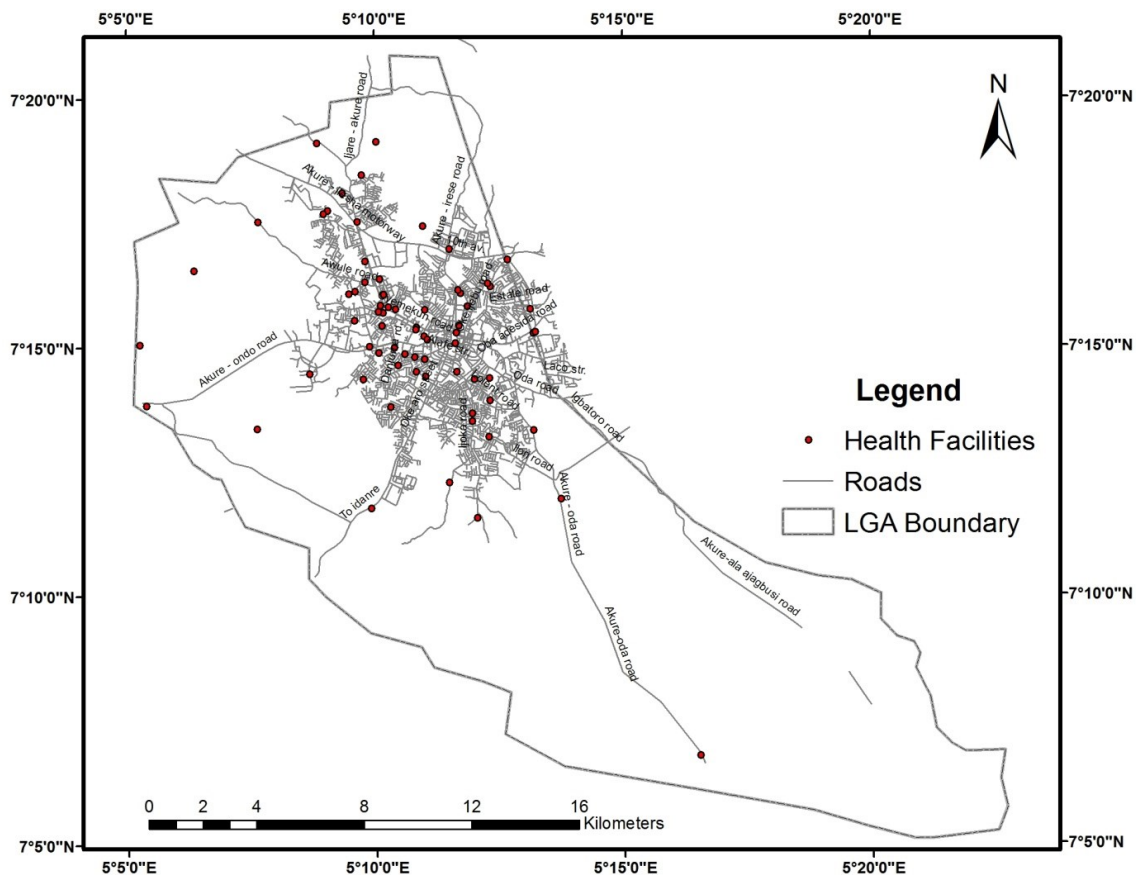

Figure 7: Map showing the accessibility of health facilities in the Study Area

Figure 7 shows all the health facilities are all connected by servicing road. The figure shows that there is inadequate accessibility to all the health facilities in Akure South Local Government Area. Most of these roads are not even motorable in a situation when there is emergency.

5. CONCLUSION AND RECOMMENDATIONS

The role of geospatial technology in planning and management of location-based such as health facilities have been discussed in this paper. The study revealed that most of the health facilities are clustered in the central wards where the population is dense while majority are scattered in

the wards outside the central wards. Accessibility in terms of roads to most of these health facilities are very poor. The study also shows that there is increase in the number of sick people for all diseases treated from 2009 to 2013. The ages five and above are mostly affected with malaria, while diarrhoea affect the children within the ages of zero to four years. The study further reveals that poor sanitation and poverty are the main reason for causes of diseases in the study area. The study further indicates that poor staffing and lack of equipments affect the effectiveness of the health facility especially the public ones.

Based on the findings, it is therefore recommended that generated waste should be given almost attention through public awareness, education and enforcement of sanitation law. There is also the need for Government to address poor staffing and equipment in Health Sector in the country generally. The budget allocated to the health sector should be more than any sectors because people say "Health is Wealth". There should be even distribution of these health facilities among the various wards. The Government agency (Town Planners) should advise the Government at various levels on location of these facilities spatially. Regulatory planning laws can be used to tackle this lopsidedness in the location of health facilities. The construction of roads and repairs of damaged ones should be embarked upon by Government without any delay. Lastly, government should pay attention to research in the health sector so as to reduce the spread of diseases in the country.

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