

Health Care Facilities Mapping and Database Creation Using GIS in Chikun Local Government, Kaduna State, Nigeria

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Abstract

The study investigated the spatial distribution of health care centres in Chikun local government area of Kaduna state, Nigeria with a view to use Geographic Information Systems (GIS) technique in health care management planning. The study used the administrative map of the study area collected from the local government as the base map. Information on the number and addresses of the health care centres in the study area were collected from the local government while the coordinates of the health care centres were obtained in the field using Global Positioning System (GPS). These data were incorporated into GIS environment and analysed using Arc Map 9.2 software. The study reveals that there were 41 health care centres in the study area with 23 (56.1

Index terms— Health care, Centres, GIS, Mapping, Database

The study reveals that there were 41 health care centres in the study area with 23 (56.1%) been private health care centres and 18 (43.9%) been public health care centres. The study also reveals the pattern of distribution of the health care centres within the study area. The study also used World Health Organisation criteria for the location of health care centres in developing countries to propose 9 new sites for the location of new health care centres to adequately cover the health needs of the people of the study area.

1 Introduction

he provision of health care centres in Nigeria is a concurrent responsibility of the three tiers of government in the country. However, because Nigeria operates a mixed economy, private providers of medical health care have a visible role to play in health care delivery. The federal government's role is mostly limited to coordinating the affairs of the university teaching hospitals, federal medical centres (tertiary health care) while the state government manages the various general hospitals (secondary health care) and the local government focuses on dispensaries (primary health care) which are regulated by the federal government. The total expenditure on health care is 4.6% of GDP, while the percentage of federal government expenditure on health care is about 1.5% (Wikipedia, 2009).

GIS (Geographic Information System) is a valuable tool to assist health research planning, monitoring and evaluating health systems. GIS can be defined as the science and technology related to the gathering, storage, manipulation, analysis and visualization of georeferenced data (Burrough, 2001).

GIS has been used by several scholars to combine different data and generate information required for decision making in health management. 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 (Law et al., 1998). Benachi and Yasui (1999) identified that there was a positive correlation between deprivation of health centres and mortality rate. In their analysis of 2,200 small areas of Spain, they obtained two indices of deprivation and they concluded that, there was excess mortality in deprived areas estimated at 35,000 deaths. Thus, they called for government intervention in the deprived small areas of the country. They also found that there are

4 B) DATA BASE CREATION

44 inequalities in other aspects related to health care, such as, waiting list times, or the access to preventive health
45 services. Olajuyin et al., (1997) investigated the effect of location on the utilization of healthcare centres in
46 Irewole local government area of Osun State, Nigeria. Data used in this research included population data, list of
47 health centres and their locations, and distance of the settlements to each health centre. They found that health
48 centres were unevenly distributed among the settlements and that the distance was a paramount factor.

49 Okafor et al., (1977) analyzed the spatial distribution and efficiency of health centres in the old Bendel
50 (now Edo and Delta) State. He created a data base of all the health centres in Benin and found that there
51 were discrepancies between the population distribution and the distribution of health centres. Adejuyigbe (1973)
52 The World Health Organization (2004), describes GIS as "an excellent means of analyzing epidemiological data,
53 revealing trends, dependencies and interrelationships that would be more difficult to discover using traditional
54 tabular approach".

55 Site selection and distribution of health care centres are important components of an overall health system
56 which has a direct impact on the burden of diseases that affect many countries in the developing world. The
57 creation of health care centres database and mapping helps in showing the spatial distribution and information
58 about location and their physical relations to each other. The purpose of using GIS in site selection and
59 distribution of health care centres is that maps provides an added dimension to data analysis, which helps
60 in visualizing the complex patterns and relationships. The use of GIS for measurement of physical distribution is
61 well established and has been applied in many areas including retail site analysis, transport, emergency services
62 and health care services (Wilkinson et al., 1998).

63 WHO (1997) specified criteria for health care planning for third world countries and indicated that each service
64 area should cover a 4km catchment area with a population of 60,000.00 for primary health care in order to have
65 adequate and equity of access to health centres.

66 In line with WHO (1997), this study therefore aimed to map the spatial distribution of health care centres as
67 well as propose sites for new health centres in Chikun LGA of Kaduna state using GIS technique. This aim was
68 achieved by identifying, mapping and creating a GIS database for public and private health centres in the study
69 area. Sites were also proposed for new health centres to take adequate care of the population.

70 The study area is Chikun local government area of Kaduna state, Nigeria. The local government covers an area
71 of about 445,659km² with a population of 368,250 people as at 2006 (NPC, 2006). Chikun local government area
72 lies within latitude 10°0'N to 10°50'N and within longitudes 7°40'E to 8°40'E. The study area covers
73 Kujama, Kakau, Chikun, Nasarawa, Gwagwada, Sabon Tasha, Kasaya, Kamazou, Buruku and Sabon Gaya
74 districts. Chikun LGA has experienced rapid urban growth, between the early 90s and 2004. The population
75 had increased from an estimate of a hundred and fifty thousand (150,000) in 1994 to an estimate of three hundred
76 and fifty thousand (350,000) in 2003 due to several reasons such which include the immigration of people into
77 the area as a result of religious crisis in Kaduna north and Kaduna central (National Population Commission,
78 2004). The population of Chikun LGA is said to have risen from three hundred and sixty eight thousand, two
79 hundred and fifty (368,250) in 2006 to an estimated four hundred and twenty six thousand, nine hundred and
80 two (426,902) in 2011 (FRN, 2007).

2 Materials and Method

82 The study used data containing the list of health care centres and their addresses in Chikun LGA. Administrative
83 map of Chikun LGA was also sourced from the local government to serve as the base map. GPS was used to
84 collect coordinate points of the health centres in the local government.

3 a) Procedure of data analysis

86 The administrative map of Chikun LGA was scanned and geo-referenced using Arc MAP 9.2. Onscreen
87 digitization was done with features such as roads, river, and rail-track in the study area digitized as line features.
88 Districts and health care centers were digitized as polygon features. These spatial data were organized in layers.

4 b) Data base Creation

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

91 i. The study area map ii. List showing health centre names and addresses as shown in table 1.1 iii. Health
92 care centres coordinates.

93 All the necessary information for each health centre was entered into its layer's/theme's attribute table. This
94 was done by adding required number of fields (columns) to the table and entering the data for all the health
95 centers in their corresponding records (rows).

96 The coordinates of the health care centres were copied in notepad and saved as a text (plain text) file format.
97 This file was later imported into Arc Map environment.

98 Queries were performed using the query builder. The queries performed were

99 ? How many private health care centres were in Chikun?

100 ? How many public health care centres were in Chikun?

101 ? Where can new health centres be located?

102 The criteria used according to WHO (1997) in selecting the proposed sites for health care centres were:

103 5 i. Proximity and Accessibility

104 According to World Health Organization (1997), the criteria for sitting new health centre based on proximity are
105 as follows:

- 106 1. The health centre should not be more than 4km from residential areas.

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- 109 2. The health centre should be of distance not more than 20m from the major road. 3. There should be easy
110 accessibility to source of water which should not be more than 250m from health the centre.

111 7 ii. Population Size

112 The condition based on the size of population for sitting new health centre is that:

- 113 1. An area with a population of 500 people should have access to at least 1 health centre.

114 8 Results and Discussion

115 The study identified the health centres on the field, collected the coordinates of the health centres and created a
116 GIS database for both the public and private health care centres in the study area as shown in table 1.1. The
117 result of the data set for private and public health centres is as displayed in table 1.1. It shows the coordinates,
118 names and addresses of the 41 health care centres in the study area. From table 1.1, it can be observed that
119 there were more private health centres 23 (56.1%) than public health centres 18 (43.9%).The spatial distribution
120 of the public health care centres as mapped is also shown in figure ??

121 9 Source : GIS Analysis

122 From table 1.1 and figure ??1, it can be observed that out of 41 health centres, there were 18 (43.9%) of public
123 health centres spatially distributed in Chikun LGA. 12 (66.7%) of the public health centres were found to be
124 clustered along the Eastern part of Chikun LGA inKamazou, Kujama, Kakau, Sabon Gaya districts while 6
125 (33.4%) of the public health centres were found at the southern part of the study area in Chikun and Gwagwada
126 districts and none existed at the north western part of the study area.

127 10 Discussion

128 The administrative map of Chikun LGA, list of health centres and the addresses were used in the analysis to
129 generate several map layers and database as illustrated in chapter four.

130 Table 1.1 shows the database of all the health centres in Chikun LGA as at 2011. There were 41 health centres
131 in Chikun LGA both public and private. From table 1.1, the coordinates of health centres are shown.

132 In figure ??1, the map of Chikun LGA shows the spatial distribution of public health centres in the study
133 area, there were 18 (43.9%). More public health centres 12 (66.7%) were located and clustered at the north
134 eastern part of the study area and few health centres 6 (33.4%) were at the southern part of the study area and
135 none at the north eastern part of the study area. It is obvious that the public health centres in Chikun LGA
136 were not equally distributed. Some factors that could be responsible for these inequalities were population size
137 of the people. For example, the areas where the health centres were located predominantly fell within urban
138 Chikun while areas with sparse health centres fell within rural Chikun. Other factors that might have influenced
139 the location were political influence and accessibility of the area to infrastructure.

140 From figure 1.2, the map of Chikun LGA shows the spatial distribution of private health centres in the study
141 area. The private health centres were 23 (56.1%). The figure displays the existence of more private health centres
142 17 (74%) at the north eastern part of the study area, 3 (13.1%) private health centres at the southern part of the
143 study area and (3) 13.1% at the north western part of the study area. Factors responsible for this distribution
144 may be because the public health centres were not sufficient to meet the demand of the populace hence private
145 investors established private health centres as a business outfit considering the fact that the population size
146 especially in districts that fell within urban Chikun was good for business. The rural Chikun had fewer private
147 health centres due to its population and lack of infrastructure.

148 Figure ??3 shows the proposed sites for new health centres. 9 health centres were proposed and sites selected
149 for them based on the criteria of the World Health Organization (WHO) in 1997 that include population size of
150 the area, proximity and accessibility to major roads, residential area and water source.

151 11 Conclusion

152 12 It has been revealed by this study in Chikun

153 LGA that serious inequality existed in the distribution of health care centres by both private and public sectors
154 among the districts.

155 This study has effectively showcased the capability of GIS as a veritable tool for decision support system
156 for site selection for new health centres. It is cost effective and fair method of selecting sites and it should be
157 encouraged and adopted for policy making and implementation.

158 Finally, GIS technology has the potential to revolutionize health surveillance. It gives health professionals quick
159 and easy access to large volume of data. GIS is valuable in strengthening the whole process of epidemiological
160 surveillance information management and analyses. Moreover, this system provides analytical support for the
planning, programming, and evaluation of activities and interventions in the health sector. ^{1 2}



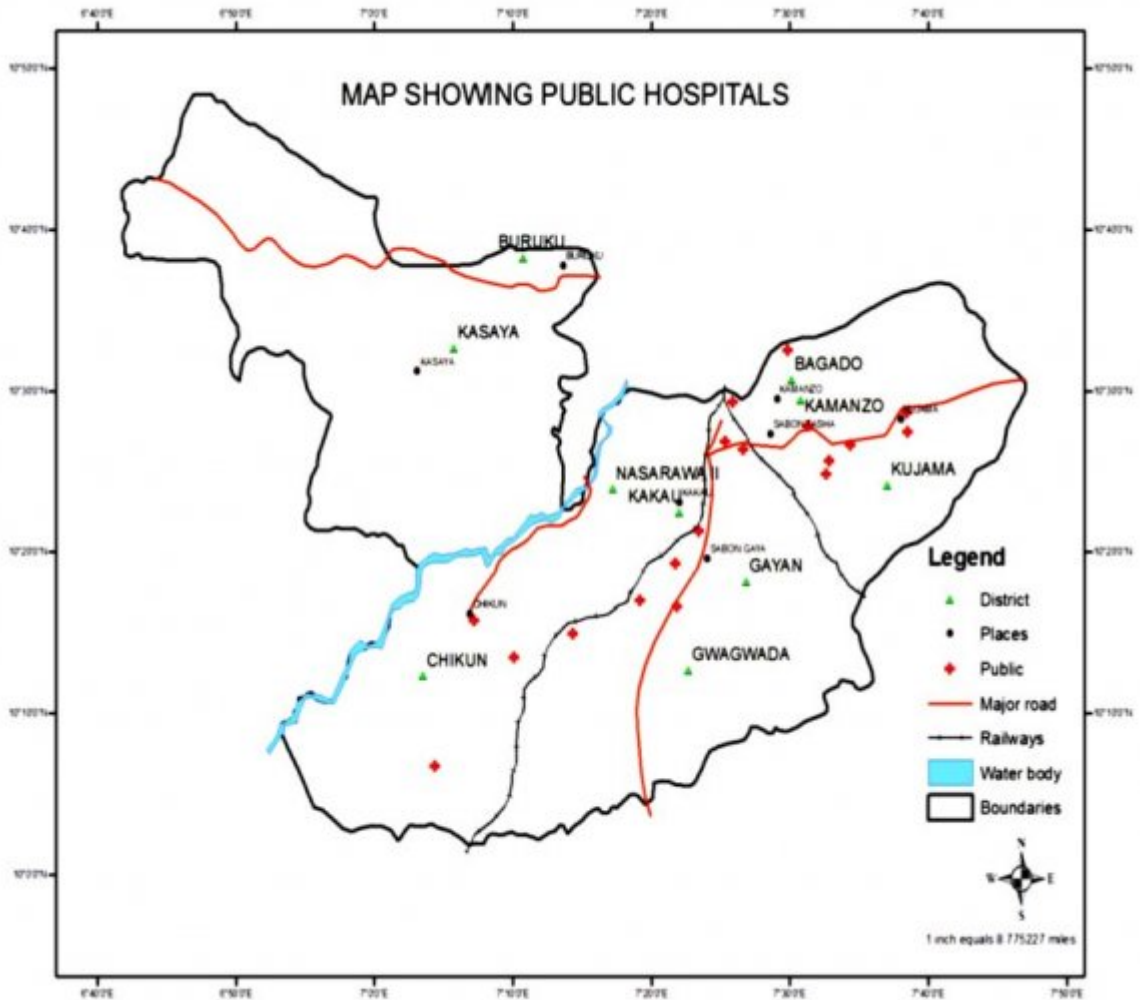
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Figure 1: Figure 1 . 1 :

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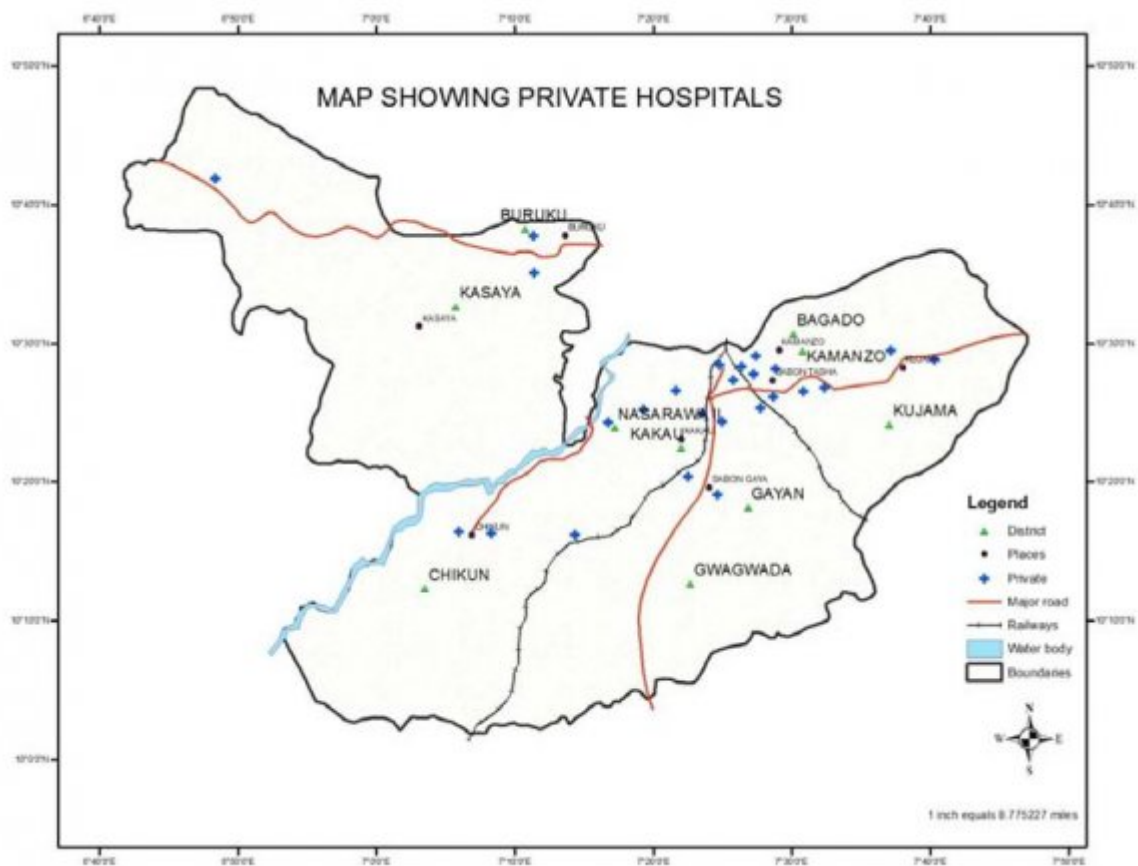
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Figure 2: Figure 1 . 2 :



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Figure 3: Figure 1 . 3 :

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Id	Easting	Northing	Name of health care centres	Address of health care centres	Owner
1	7 0 4'20.282"	10 0 6'44.925"	Public Center Katarma	Health Katarma Village	Public
2	7 0 10'3.823"	10 0 13'31.309"	Health Gadani	Center Gadani Village	Public
3	7 0 7'7.863"	10 0 15'41.185"	Public Center, Chikun	Health Chikun Village	Public
4	7 0 14'15.194"	10 0 14'50.91"	Public Center, Gwagwada	Health Adjacent Primary School, Gwagwada	Public
5	7 0 198'.461"	10 0 174'.975"	Health Kajari	Center, Opposite Sarki House	Public
6	7 0 215'1.853"	10 0 163'1.459"	Health Bakin Kasuwa	Center, Adjacent Primary School, B/Kasuwa	Public
7	7 0 213'9.284"	10 0 191'9.04"	Health Sabon Gaya	Center, Sabon Gaya	Public
8	7 0 214'3.474"	10 0 192'3.229"	Public Centre, Gari	Health Adjacent ECWA Church, Sabon Sabon Gari	Public
9	7 0 23'24"	10 0 211'6.347"	Public Center, Kakau	Health By Railway Station, Kakau	Public
10	7 0 252'1.329"	10 0 265'1.509"	Public Centre, Tasha	Health Adjacent LEA Primary Sabon School, Sabon Tasha	Public
11	7 0 264'5.12"	10 0 262'2.182"	Public Center, Romi	Health Near Police Station, Romi	Public
12	7 0 255'0.656"	10 0 292'6.521"	Public Center, Narayi	Health Opposite Bayan Dutse	Public
13	7 0 294'5.269"	10 0 323'0.86"	Taimako Clinic	Primary School, Narayi Dan bushiya	Private
14	7 0 312'1.628"	10 0 275'0.162"	NNPC Industrial Hospital	NNPC Quarters	Public
15	7 0 383'3.149"	10 0 284'4.626"	Public Center, Wada Kujama	Health Behind Kujama Market Tudun	Public
16	7 0 382'8.96"	10 0 272'9.214"	Public Center, Tokache	Health Opposite Gidan Sarki	Public
17	7 0 342'1.778"	10 0 263'8.94"	Brethren Clinic	Opposite Camp	Deeper Life
18	7 0 334'5.418"	10 0 254'8.227"	Public	Health Behind	LEA Primary

	23	7	0	10	0	Maternity Mission	Clinic
		222'9.558"		202'7.024"			
	24	7	0	10	0	Public and Maternity	Health
		163'7.638"		241'7.448"			
	25	7	0	10	0	Center, Nasarawa Freed	Medical
		191'6.84"		252'0.291"			
	26	7	0	10	0	Lab Salasi	and
		213'9.284"		263'5.702"			
	27	7	0	10	0	Maternity Shalom Clinic	
		232'8.212"		25'3.533"			
	28	7	0	10	0	Zaitun Clinic	
		245'6.192"		242'1.638"			
	29	7	0	10	0	Ramadan	
		273'9.583"		252'0.291"			
	30	7	0	10	0	Maternity Adoro Clinic and	
		304'3.923"		263'5.702"			
	31	7	0	10	0	Mternity Lafia Clinic	
		322'0.282"		265'2.461"			
	32	7	0	10	0	ECWA Clinic and	
		254'2.277"		271'7.598"			
Volum	33	7	0	10	0	Maternity Elshadai Clinic Alheri Clinic and Maternity Covenant	
XII	34	261'9.982"	7	282'0.441"			
Is-	35	0	271'4.446"	10	0		
sue	36	7	0	275'1.114"	10		
X	37	272'2.825"	7	0	29'6.525"	10	
Ver-	38	0	285'0.805"	0	281'2.062"		
sion	39	7	0	10	0		
I	40	37'5.169"	7	0	293'1.663"	10	
Global	41	401'7.888"	6	0	284'5.578"		
Jour-		0	482'0.88"	7	10	0	
nal		0	112'3.424"	415'7.398"	10		
of		7	0	0	35'2.635"	10	
Hu-		111'5.045"	0	374'6.027"			
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Figure 5:

Figure 6:

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