MAPPING OF HEALTH CARE FACILITIES AND DATABASE CREATION USING REMOTE SENSING AND GIS IN IDAH LOCAL GOVERNMENT AREA, KOGI STATE, NIGERIA

Adamu, F., Danjuma, U. and Ojogbane, S., S.
Department of Surveying and Geo-informatics, Federal Polytechnic, Idah
Correspondence: fatimaattah9@gmail.com

ABSTRACT

Digital mapping of health care centers using Geographic Information Systems (GIS) is a significant resource for health planning and health services delivery, particularly at the local level. The ability to visualize the spatial distribution of health status determinants and indicators, can be a powerful resource for Government to improve on health care facilities and distribution. Mapping health care centers in Idah metropolis and for other agencies, are important steps towards enabling individuals and communities to improve their health and increase their control over it. A google Earth Mosaic image was used to digitize health care points which were located using Handheld GPS and Mobile topographer software for Android phones and an ArcGis 10.1 software for digitizing, creation of database and queries creation or analysis. It is discovered that the Government has very low medical attention for the local government and we have very low level of Professional Medical Personnel and very high level of Nurses running private hospitals.

Keywords*:* Digital Mapping, Geographic Information System, Spatial, Image, GPS Health, Distribution.

INTRODUCTION

An important aspect of Nigerian health policy that requires timely evaluation, is accessibility to Primary Health Care (PHC) facilities, especially in rural areas. Thus, their locations and spatial structures influence accessibility and utilization, but neither is distributed evenly in space (Wang, 2006).

A health care facility is defined as a unit owned by public and private authorities as well as voluntary organizations and which provides health care services, hospitals, health and maternity centers. Consequently,

Onokerhoroye (1999), defined health care facility as all units owned by public and private authorities as well as voluntary organizations and which provides health care services including hospitals, health and maternity centers.

A healthy population and access to healthcare services are significant factors influencing economic development and prosperity. Accessibility to health care is a multidimensional concept and can be defined as the ability of a population to access healthcare services. It varies across space because neither health professionals nor residents are uniformly distributed (Lou and Wang 2003).

The geographic inventory of healthcare comprises the analysis of spatial organization (names, type, and locations) of health services, how and why spatial features changes over time and how people gain access to health services (Fortney, Rost, Zhang and Warren, 1999). Khan (1992), identified five varied dimensions of access which were classified into spatial components, namely; accessibility, availability, affordability, accommodation and acceptability. Access describes people's ability to use health services when and where they are needed. Geographic access is an essential feature of an overall health system. It is important for health service and stakeholders to develop accurate measures of physical access to health (McLafferty, 2003). For medical conditions

that require regular contact with service providers, travel time and distance can create barriers to effective service use (Fortney et al., 1999). GIS is being used to create better measures of geographical access and to analyze geographical inequalities in access as well as those patterned along social and economic lines.

It is essential to ensure that the population, health care facilities and transportation infrastructure are spatially located where accessibility to frictions are less to ensure equal and easy access. There are many different conceptualizations of accessibility to healthcare facilities, and many different measures of accessibility have been proposed and used in literature (Talen and Anselin, 1998; Hewko, 2001).

In Nigeria, health care provision is a concurrent responsibility of the three tiers of government. However, because Nigeria operates a mixed economy, private health care providers have also 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 and Federal Medical Centers while the State Government manage the various general hospitals while the local government focuses on dispensaries (Primary Health Care), which are regulated by the federal government through the National Primary Health Care Development Authority (NPHCDA). Varying spatial distribution of the population, healthcare facilities and transportation infrastructure in an area often lead to in- accessibility to healthcare facilities, which in turn, would result in disadvantaged location and communities having poor spatial accessibility to needed healthcare facilities (Ahmad, 2012).

Thus, geographically based healthcare research commonly utilizes methodologies and measurements attainable using GIS which include network model (vector representation) and raster model (raster representation). These methods are used to measure distances and traGel time between the locations of health facilities and people (Jones, Ashby, and Naidoo 2010; Delamater, et al., 2012).

Previous studies of this type have faced a number of problems due to paucity nature of data. However, with the introduction of Geographic Information Systems (GIS) and Remote Sensing techniques, data is now available for effective study particularly on accessibility and distribution pattern in any geographic location. Currently, the increasing availability of Geographical Information Systems (GIS) in health organizations together with the proliferation of spatially disaggregate data, has led to a number of studies that have been concerned with developing measures of access to healthcare services (Higgs, 2009).

STATEMENT OF PROBLEM

The urban populace in Nigeria carries a high number of immigrants with very limited access to health facilities, yet they lack necessary accessibility to health care information and data management. Many Nigerians encounter a range of service delivery and health problems when they try to access healthcare. Such problems range from information about locations of health facilities, type of health facility found within a particular area and network accessibility to these facilities.

In the year 1987, the federal government of Nigeria launched the Primary Health Care (PHC) system as the bedrock of the health policy with the optimism that the system will reduce substantially the morbidity and mortality which afflicted our population by frequent outbreaks of preventable diseases. Several strategies were put in place to achieve these laudable dreams which include: health education and health promotion programmes, provision of infrastructure to healthcare centers; provision of adequate staff through training and recruitment, implementation, the rollback malaria through the promotion and use of insecticide treated nets (ITNs), especially to children and pregnant women; improved nutritional status of children and increase in the rate of immunization coverage to raise awareness on HIV/AIDS pandemic and tuberculosis control programme and the reduction of the present rate of infant and maternal mortality. These are done through the management of childhood illness and reproductive health programme. Tragically, two

decades since the introduction of the PHC, the provision of the PHC centres has not been without accessibility difficulties (Laah and Mamman, 2002).

Study Area

The study area is Idah metropolis. Idah is located in Kogi State. It is one of the 21 Local Governments, which lies on the Eastern bank of the River Niger, at latitude $07^{o}02'30''N$ to $07^{0}09'30''N$ and longitude $06^{0}42'00''E$ to $6^{0}46'30''E$. Idah is a town on the Eastern bank of the Niger River in the middle belt region of Nigeria. It is a Local government in Kogi East and the head-quarters of Igala Kingdom. Idah Local Government has an area of $36Km^2$ around the town and a population record of 2006 census of 79,815. Idah, an old river port, has commercial routes on the river Niger linking Idah, the Kogi State capital, to the North of the country and Onitsha in Anambra to the South, Agenebode in Edo State across the Niger to the West. Its population is primarily Igala.

It hosts a federal polytechnic, and a federal government college also within the periphery of Idah, It is a major food supplier of Kogi State and the traditional capital of the Igala Kingdom.

The climate of Nigeria, typically varies from equatorial in the South, tropical in the center and arid in the North. The terrain in the Southern lowlands merged into central hills and plateaus; mountains in the southeast and plains in the North. For Idah in January, the daily average maximum temperature is $32^{0}C$ with the average minimum is $24^{0}C$.

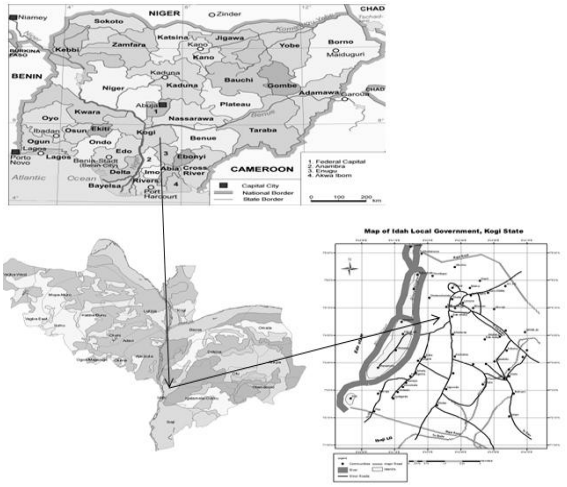

Figure 1.0, maps showing Nigeria, Kogi State, and Idah LGA.

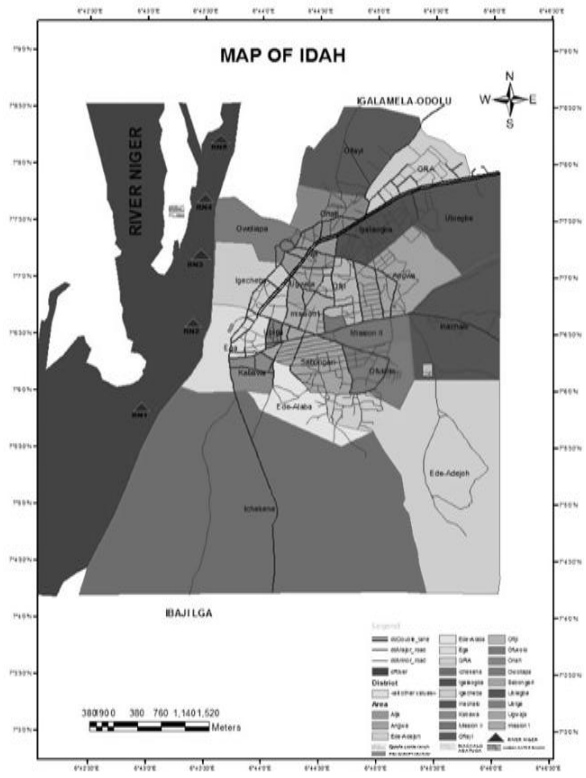

Figure 2.0, map of Idah LGA

AIM AND OBJECTIVES OF THE STUDY

The aim of this study is create a digital map of health care centers in Idah Metropolis, Kogi State using Geographical Information System technique.

However, the specific objectives of the study

are to:-

i. identify, characterize and map the healthcare facilities in Idah

ii. analyze the distribution of healthcare Locations in Idah

iii. determine the spatial accessibility of healthcare facilities in Idah

METHODOLOGY

The following procedures and methods were used in the course of this assignment.

Planning Stage

In this phase of the research, a user required analysis was carried out to determine the data that will be required for the project, The sources of the data and how they will be acquired, the suitable method to be used and the software and hardware to be used, are critically observed.

Data Requirements and Sources

The data that were used for this project include; satellite image of the study area, Idah acquired from Google Earth, GPS coordinates of the features to be mapped, health care sites got from the ground, and attribute data of the hotels.

Primary Data: GPS Coordinates of Health Care sites in the study area; **Secondary Data:** Satellite image of the study area acquired from Google Earth and road networks in the study area, digitized from the satellite image.

Hardware and Software Requirements

This refers to the devices and software for capturing, storage, processing, analysis and display of the contents of the spatial data.

Software Requirements

For the analysis and processing of the data the following were used; Google Earth Pro, ArcGIS 10.1, Microsoft Word, and Microsoft Excel.

Data Processing and Analysis: Database Creation, Geo-referencing, Digitizing, Analysis (Query)

Geo-referencing: This was the first step in the processing of the image. Geo-referencing is the process of transferring coordinates to an image so that it assumes the same coordinate as the same point on the ground. Geo-referencing of the image was done using coordinates picked from the ground.

Digitizing: Digitizing is done to extract information (attributes such as buildings, roads etc.) from an image for further analysis. Digitization is the process of converting features in scanned analogue map into digital format. A shape file is a vector data storage format for storing the location, shape and attributes of geographic features. The satellite image was digitized to extract the road network of the study area. The on-screen digitizing process was used for this process using ArcGIS 10.1. Digitizing or vectorization is done by clicking continuously (depending on the feature type, like point, line or polygon) on the feature of interest using digitizer tool as if you are tracing the object under consideration.

Data Processing: The various data collected through various means and were processed and further analyzed to give the desired result. The processes carried out are as follows: Creation of geodatabase and tourism site distribution patterns.

PRESENTATION OF RESULTS AND DATA ANALYSIS

The importance of this project is to produce a digital map of Idah which will include the location of important features such as road networks, and health care centre location. This chapter produces spatial analyses of these features with respect to their locations and road network.

This project is to make available firsthand information on the location of these special features within Idah metropolis and to create a spatial database development of query of the dominant on the Health Care Center in Idah, in order to recommend a preferable locational analysis and other attribute features within the state. This is done

to overlay all collected data that have been represented in themes for further querying in decision making.

Data availability has always been the major limitation of project development. This limitation resulted in the streamlining of data used for this project. The final data used were selected based on their ranking importance and their impact on the objective of the study. These data include the existing maps, name of health center, location, map development from the Geo-referenced satellite imagery displayed, here the following themes were generated; Vector map showing the locations of spatial features such as health center and road Network.

Imagery and Digitized work

The satellite Imagery got from Google Earth and Geo-reference is used to digitize the road network and the locations or positions of all the secondary Health centers found within Idah metropolis.

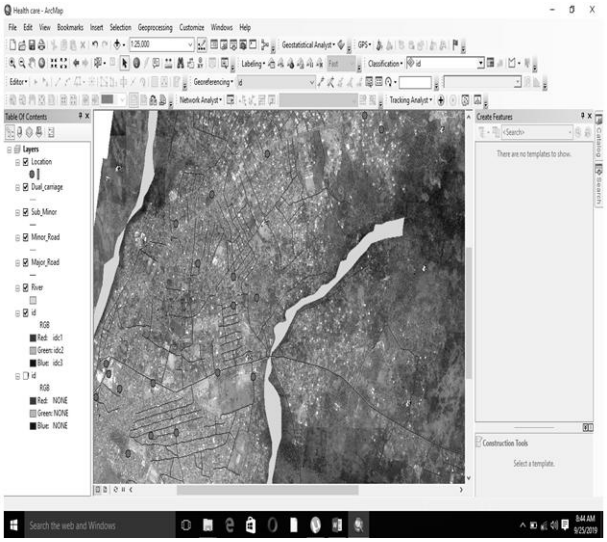

Fig 3. Google Imagery of Idah

Data Acquisition: The data acquire for query and database were gotten from visual recognizance during site location of the health care centre. Location data was collected from the Health care centre field Survey and other information from health care centre in Idah. The information acquired is shown in the table below:

Table 1

Database for Secondary Health centres

A	B	C	D	E	F	G	H	I	J	K	L	M	N
NAME	MEDICAL_DI	TYPE	NO_BUI	NO_DOC	MALE_S	FEMALE	ADDRESS	NORTHING	EASTHING	QUALIFICAT	ACTIVITY	WARD	DISTRICT
OJOCHEGBE AJA CLINIC	MRS OJOCHEGBE AJA	PRIVATE	2	4	1	2	NO 2 EDE-ALABA	785221.885	248948.393	NURSE	CLINIC AND MATERNITY	1	EDE-ALABA
													EDE-ALABA
ENEMONA CLINIC AND MATERNITY	ENEMONA	PRIVATE	1	1	1	5	HAUBU GOWON STR SABONGARI	788916.107	329170.864	NURSE	CLINIC AND MATERNITY	10	SABONGARI
ATTAH MEMORIAL CLINIC	SULEIMAN ATTAH	PRIVATE	1	2	3	6	17 AMODO AKOTE IDAH	785945.220	326563.828	NURSE	CLINIC AND MATERNITY	6	SABONGARI
OUR LADY MOTHER OF MERCY HOSP	DR. UDAH INALEGWU	PRIVATE	1	10	3	15	ST. BONIFACE CATHEDRAL SABO	786416.181	325004.495	DOCTOR	CLINIC AND MED. SERVICES	3	SABONGARI
CONAL HOSPITAL IDAH		PUBLIC	18	18			AYEGBA OMA IDOKO WAY	786498.559	249537.714	DOCTORS	ALL HEALTH TREATMENT	4	EGA
ADUA CLINIC	DR. ACHOR	PRIVATE	2	3	1	4	ODOLU ROAD	786511.558	251179.795	DOCTOR	MATERNITY	2	MISSION II
ORIO CLINIC	DR. ORIO SULE	PRIVATE	1	2	2	4	BEHIND COMMERCIAL COLLEGE	786473.030	251708.586	DOCTOR	HEALTH SERVICES	2	OFUKOLO
GOSHEN NEIGHBOURHOOD CLIN/MAT	DR. MERCI MOHAMMED	PRIVATE	1	4	1	4	OPPOSITE WILLIAMSEL GRPSIDE	787150.057	251416.568	NURSE	CLINIC AND MATERNITY	1	ANGWA
DIVINE FAVOUR	DR. UGOH STANLEY	PRIVATE	1	8	1	5	ANGWA ATEGUNE IDAH	787415.680	251416.325	DOCTOR	ALL HEALTH TREATMENT	4	ANGWA
SHARON CLINIC	MAL. MUSA ABDULLAHI	PRIVATE	1	4	3	5	17 ENAHE STREET OFU IDAH	787547.707	326084.380	NURSE	CLINIC AND SCANNING	6	OFU
EMMANUEL CLINIC	DR. REUBEN	PRIVATE	2	8	4	6	#12 ALAKA ROAD IGALA-EGBA IDAH	788565.436	251935.945	DOCTOR	CLINIC AND MATERNITY	4	GBA
OGALA MEMORIAL HOSPITAL	DR. OGALA	PRIVATE	1	6	3	7	GBA	788958.512	325131.774	DOCTOR	HEALTH SERVICES	4	GBA
PRINCESS EJODOBA EYE CLINIC	DR. EZE	PRIVATE	1	2	2	1	#58 ALAKA ROAD IDAH	788944.820	253299.337	OPTICIAN	EYE CLINIC	1	IYOGBO
ODOMA CLINIC	DR. S. ODOMA	PRIVATE	2	14	5	14	IYOGBU LAYOUT, IYOGBU IDAH	788814.645	323545.930	DOCTOR	HEALTH SERVICE	8	IYOGBO
OJOCHEGBE CLINIC & MATERNITY	DR. DANLADI	PRIVATE	1	6	1	2	OPP. ROTARACT TOWER	788428.831	250047.871	DOCTOR	CLINIC AND MATERNITY	2	OKENYA
UGBEGE OJO CLINIC	DR. OKWUTE UGBEGE	PRIVATE	1	4	1	3	UKWUTE BESIDE EZA MOSQUE	788946.181	254641.845	DOCTOR	CLINIC AND SCANNING	2	OKENYA
PRECIOUS CLINIC AND MATERNITY	DR. ENEJO	PRIVATE	1	6	2	4	BEHIND OKENYA PRISCH OKENYA	790150.956	325559.501	DOCTOR	CLINIC AND MATERNITY	3	OKENYA
ANGWA PRIMARY HEALTH CARE	HEALTH WORKERS	PUBLIC	1	1	1	1	BESIDE ANGWA CENTRAL MOSQUE	787221.846	252768.843	HEALTH WORKERS	HEALTH CARE CENTER	1	ANGWA
IDAH PRIMARY HEALTH CARE	HEALTH WORKERS	PUBLIC	4	24	-	-	AYEGBA OMA IDOKO WAY	786598.910	249493.898	DOC/HEALTH	HEALTH CARE CENTER	2	EGA
UBIGA PRIMARY HEALTH CARE	HEALTH WORKERS	PUBLIC	1	1	-	1	OPP. UBIGA HOTEL	788061.785	249703.407	HEALTH WORKERS	HEALTH CARE CENTER	1	UBIGA
OHAH PRIMARY HEALTH CARE	HEALTH WORKERS	PUBLIC	1	1	-	1	BEHIND IDAH WO PARK	788199.749	251083.789	HEALTH WORKERS	HEALTH CARE CENTER	1	OHAH

Literacy Map

Figure 1 shows the literacy map of the health care centre block. it is generated with the help of ministry of health that provides the numbers of private and public health center data. Different colours are used to show the private and public health center rate in Idah. It can be concluded from the map that 39 health care centers are found in Idah. It can be observed too that in most of the health centers found in Idah, are private health centers. It is noticed that there are more private health centers than the public health centers in Idah. This map helps in locating the hotspots where there are urgent needs to promote either public or private health care centers.

Health Centre Location Map: Figure 4.3 shows the position of health centres that are collected through GPS based field survey. The data collected

through GPS, is exported to point shape file, where each point in the map is the location of the Health care centre listed in the field data. Each Health care centre is labeled by its name.

Results of database queries were presented in form of digital maps and tables. These maps could be thematic in nature. These presentations can be in hard copy, soft copy and on screen.

Query to Determine Health Centres with Type Equal to Private.

A query to determine the health centres that are on private ("Type") = "Private". The result in Fig 4 shows that 17 health care centres out of 25 health care centres (68%) are Private Health Care centre in Idah.

This significance of the result shows that there are more private health centres in Idah than public health centres.

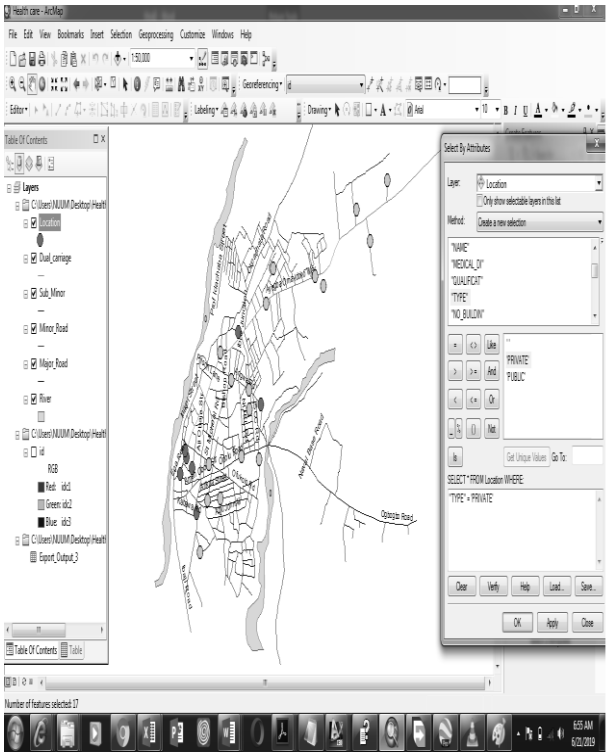

Fig 5: Map showing Health centres that are Private Health centre.

Query to Determine Health Centres District equal to Sabongari.

The results in Fig 4.5.2, show that 3 Health centres out of 25 Health centres (12%) of all the Health Care centres within Idah Metropolis, are found in Sabongari.

The significance of the result shows that there are seven Health care centres in Sabongari.

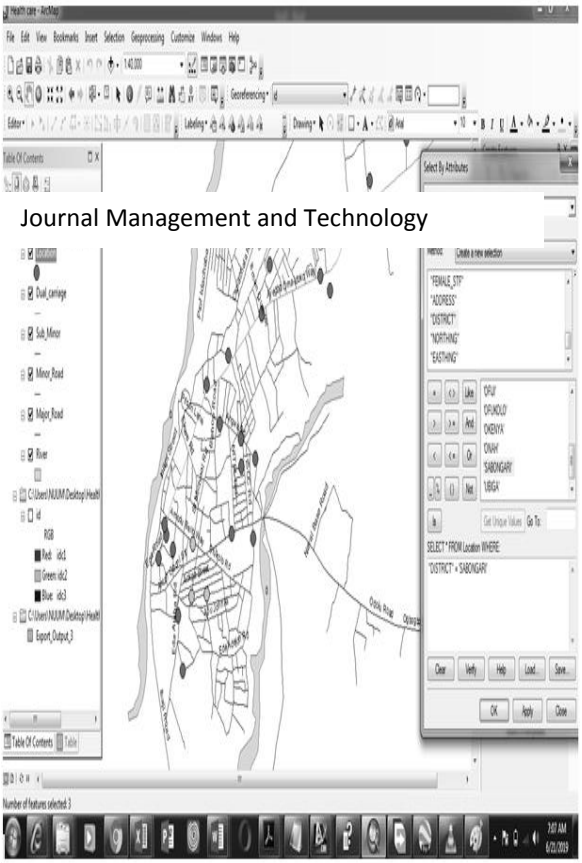

Fig 6: Map showing Health care centres that are located in Idah central.

This chapter presents the summary, conclusion and recommendations of the study. The summary highlights the distribution of Health Care facilities within Idah in terms of their pattern, availability and accessibility. The study was concluded based on findings, and recommendations were made for further studies as well as contribution to knowledge.

CONCLUSION

The distribution of Health Care facilities in Nigeria has been characterized by significant disparity. Such a disparity is shown in the ways some of these facilities are concentrated in one area at the expense of others. This often resulted in the spatial inequality that characterizes Nigeria's socio-

political landscape, hence this study assessed the spatial accessibility to Health Care facilities in Idah using multiple GIS analytical tools. The result shows that the study area is fairly provided with Primary Health Care facilities. However, it was unevenly distributed given the concentration of Health Care facilities in Idah Central, which was around the center of the town while other areas were inadequately served. Thus, this disparity in the distribution of health facilities has generated different accessibility levels to Health Care facilities in Idah. This, therefore, calls for the concerted effort by the various stakeholders in the health sector towards the provision of Health Care facilities in order to improve access to the Health Care facilities by the people.

REFERENCES

Ahmad, S. (2012). A GIS based investigation of spatial accessibility to Health Care facilities by Local communities within an urban fringe area of Melbourne. *An unpublished M.Sc. Thesis,Health of Mathematical and Geospatial Sciences, National University, Bangladesh*

Aluko-Arowolo .O (2006). The medical spiritual and historical origin of malarial disease in Falola T and Heaton M.M (Eds.) the traditional and modern health system in Nigeria, Africa world press. Trenton and Asmara: pp.247-256

ArcGIS*desktop.arcgis.com/en/arcmap/latest/extensions/network-analyst/servicearea.htm* ArcGIS *(http://desktop.arcgis.com/en/arcmap/10.3/manage data/geodatabases/what-is-a-eodatabase.htm*)

Ariyo, J.A. and Datong, M.D. (1996). Access to Health Care services and quality of life in rural areas: a case study of Pankshin local government area, *Savanna vol.17 No.1*

Fortney J, Rost K, Zhang M, Warren J.1999. The impact of geographic accessibility on the intensity and quality of depression treatment. *Med. Care* 37:884-93

Hewko, J.N. (2001). Spatial equity in the urban environment: assessing neighborhood accessibility to public amenities. *Unpublished M.Sc. Thesis, University of Alberta.*

Higgs, G. (2004). A literature review of the use of GIS-Based measures of access to health care services. Health Services and Outcomes Research Methodology, 119139.re, 127-140.

Jones, A.P., Bentham, G., Harrison, B.D., Jarvis, D. (1997). Health services acceptability and deaths from asthma in 401 local authority districts in England and Wales, 1988-92. *Journal Thorax* Vol. 52, Pp 218-222.

Katsina State Ministry of Health (2010). *State Strategic Health Development Plan* (2010-2015), Katsina State, Nigeria. Pp. 5-15.

Khan, A. A. (1992)."An Integrated Approach to Measuring Potential Spatial Access to Health Care Services." Socio-Economic Planning Sciences 26: 275-287.

Laah J. G. and Mamman M. (2002). Prevalence of Sexually Transmitted Diseases and HIV/AIDS in Kaduna State. *The Zaria Geographer, Vol. 15 No. 1 2002,* Dept. of Geography A.B.U. Zaria.

M, Ali D, Ferdousy Z, Al-Mamun A. (2001). A cost-minimization approach to planning the geographical distribution of health facilities. *Health Policy Plan.*16:264-72

Luo W, Wang F (2003). Measures of spatial accessibility to health care in a GIS environment: synthesis and a case study in the Chicago region. *Environment and Planning B: Planning and Design* 30: 865-884

McLafferty Sara L., GIS and Health Care, Department of Geography, University of llinois. *Annu.Rev. Public Health 2003.24:25-42*

Musa I.J and Abdulhamed, I. (2012). The Accessibility problems of primary health care to rural people in Jigawa State, Nigeria. Department of Geography, Ahmadu Bello University Zaria, Nigeria. *Global Advance Research Journal of Social Science. Vol. (4) Pp.3-22*

Onokerhoraye, A.G. (1999). Access and Utilization of Modern Health Care Facilities in the Petroleum-producing Region of Nigeria: The case of Bayelsa State *Research Paper No. 162 Takemi Program in International Health Harvard Health of Public Health 665*

Huntington Avenue Boston, MA 02115(617) 432-06862 W. and sons, Illustrated annotated (Eds), pp 234. 0471211761, 9780471211761

Wang F and Luo W (2005). Assessing spatial and non-spatial factors for health care access: towards an integrated approach to defining health professional shortage areas**,** *health &place* 11: 131-146*425*

Wang, L. (2011). "Analyzing spatial accessibility to health care: a case study of access by different immigrant groups to primary care physicians in Toronto." Annals of GIS 17(4): 237-251.

Wang, F. (2006), *Quantitative methods and application in GIS* Boca Raton, FL: CRC Press

White, K. L., Frenk, J., Ordonez, C., Paganini, J. M., and Starfield, (eds) (2010). The Concept and Measurement of Accessibility**.** In *Health Services Research: An Anthology*. Edited by Washington: Pan American Health Organization: Pp. 858-864

World Health Organization (2000): Health systems - Improving Performance. *Geneva World Health Report* Pp. 1-10