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SPATIAL ANALYSIS OF PHC FACILITIES IN RELATION TO STAFFING CAPACITY USING GEO-SPATIAL TECHNIQUES IN GOMBE LOCAL GOVERNMENT AREA OF GOMBE STATE, NIGERIA

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Abstract
Health care is one of the most important facility and it helps to improve the quality of life. This study assess accessibility to primary health care facilities in Kwami LGAs using Geospatial Techniques. Location, number, staffs road data and coordinates of all the PHCs in Kwami LGAs, along with maps and data on the population was obtained at the various LGA PHC Department. The data was used for analysis of access, whereas information obtained at PHC department of the respective LGA Provides attribute information used as an inventory in creation and population of geodatabase. The network Analysis function in ArcGIS 10.1 was utilized to create an origin-destination (OD) cost matrix by integrating Road network files in to the software. The result shows that are 11 political wards and a total of 39 PHC in Kwami LGA. The spatial distribution of PHC facilities in the study area shows that 72% of the wards have atleast one PHC center or and Health Post, with 64% having atleast one Health Clinic. All health clinics in kwami didn't met the Criteria for minimum standard of staff set by NPHCDA. Only 23.5% of the Health Posts in Kwami i.e 4 out of 17 Health Posts met the Criteria. According to NPHCDA there should be one PHC center per ward, one Health clinics per neighbourhoods of 2000 persons and one Health Posts for neighbourhood of 500 people. Based on the 2014 projected population of 2006 of the wards inn Kwami LGA the minimum population of a ward is 6000 people this shows that all the wards should have one PHC center atleast 3 Health Clinics and 12 Health Posts. This is not what is obtainable in the study area. Comprehensive measures should be considered to provide more PHC to alleviate the unequal spatial access to health services.

Keywords: Accessibility; Primary Health Care Gombe; GIS

Introduction

The underutilization of the health services in public sector has been almost a universal phenomenon in developing countries (Zwi 2001). It is, therefore, in recognition of this fact that various Nigerian governments have made numerous great efforts towards the provision of health care facilities to its population. However, overt 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 within the country.

Health is a major form of human capital and there exists substantial agreement in the literatures on the relationship between health and economic development through its relationship between

Capability and poverty (Strauss and Thomas 1998). It is assumed that improvement in Health leads to improvement in life expectancy, which is a robust indicator of human development. A simple channel through which health affects human development is by improving living conditions. 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 is Wealth goes the popular saying and therefore in every country, the health sector is critical to social and economic development with ample evidence linking productivity to quality of health care. In Nigeria, the vision of becoming one of the leading 20 economies of the world by the year 2020 is closely tied to the development of its human capital through the health sector.
Access to health care services is considered a privilege in many parts of the world. Many people are either denied or are unable to acquire basic medical services. This has resulted in an increased death rate with communicable diseases killing the lives of millions every year over the world. Availability of health facilities and easy access to such facilities can make a difference between life and death. Therefore, it has become imperative that every part of population should have access to health care facilities. The distance from where we live to where we receive health treatments should be as reasonably predictable as possible.

In this regards, the Nigerian government has over the years taken pro-active measures to ensure Equal access and distribution of health care facilities across the country, putting in place policies and programmes to ensure this is achieved. For example, the third National development plan (1975-1980) (FMOH, 1991) of Nigeria focused, in part, on the inequality in the distribution of medical facilities and health human resources in the country. The fourth development plan (1981 – 1985) (FMNP, 1985) emphasized the need for more equitable distribution of health facilities and manpower in all parts of the federation. In both, unrestricted health system performance (WHO, 2000) and equity in distribution and treatment were emphasized.

The goal of the National Health Policy (1987) is to bring about a comprehensive health care system that is promotive, protective, preventive, restorative and rehabilitative to all citizens within the available resources so that individuals and communities are assured of productivity, social well- being and enjoyment of living. Good health is a precondition for socio-political and economic development of any nation. In recognition of this, the fourth National Development plan documented that good health has a direct relationship with happiness, intelligence, political stability and productivity of the citizens of a country (F.M.H, 1988). The provision of medical services in various part of the world comprises one of the main focuses, which has helped in socio-economic development. Realizing the enormous role health performs in a nation building, the World Health Organisation (1978) in Alma-Ata adopted a policy of health for all by the year 2000 and beyond.

The need to make health care delivery not only affordable but also accessible accounted for the introduction of the Bamako Initiative programme in 1987. It was in response to the deep political and economic crisis which Sub-Saharan African found herself which also culminated into child mortality rate exceeding 200/1000 live births in several countries, yet national budget for health among others were declining despite a rapidly increasing population (Paganini, 2004).

One of the main goals for spatial health care planning is to achieve equitable geographic distribution. However, public health care provision in Nigeria over the years addresses the distribution and spatial equity question mainly at the gross/regional level while neglecting the distribution of such facilities within towns and cities.

Location base services such as health present a research and policy challenge in dealing with the spatial distribution and the relation of such services to other variables including population. Universal coverage of the population and people's access vis-a-vis utilization pattern of healthcare services and facilities

constitute some of the cardinal principles of Primary Health Care (Douglason, 2011). Primary health care, often abbreviated as "PHC", has been defined as "essential health care based on practical, scientifically sound and socially acceptable methods and technology, made universally accessible to individuals and families in the community. In other words, PHC is an approach to health beyond the traditional health care system that focuses on health equity-producing social policy. PHC includes all areas that play a role in health, such as access to health services, environment and lifestyle. This ideal model of health care was adopted in the declaration of the International Conference on Primary Health Care held in Alma Ata, Kazakhstan in 1978 (known as the 'Alma Ata'), and became a core concept of the World Health Organizations goal of Health for all.

Primary health care (PHC) is an imperative strategy to providing 'health for all' and is widely acknowledged as a universal solution for improving population well-being in the world (World Health Organization and UNICEF, 1978). PHC is crucial as it is a very cost-effective method of health care (more affordable and easier to deliver than specialty or inpatient care). Therefore if PHC is equitably distributed it can play important role in preventing diseases and decreasing health inequality on a large scale in society (Guagliardo, 2004).

The study area (Gombe LGAs) is witnessing a rapid increase in population and also number of diseases. Against this background, the established number of PHCs is not commensurate with the population growth and the number of people seeking treatment. Thereby making the distribution of the PHCs not in accordance to population.

Materials and Methods

Study Area

The study area is Gombe Local Government Areas of Gombe State. Gombe LGA has an area of 52 square kilometers and a population of 266,844 according to 2006 census. The major tribes are Fulani, Bolewa, Hausa, Terawa and Kanuri. Gombe lies between latitudes $10^{0}0^{1}$ and 10^{0} 20'N and on longitudes $11^{0}1^{'}$ and $11^{0}19^{'}$E and bounded by Kwami to the North, Yamaltu Deba to the East and Akko LGAs to the East and West. The climate of Gombe is characterized by a dry season of six months, alternating with a six months rainy season. As in other parts of the Nigerian Savanna this precipitation distribution is mainly triggered by a seasonal shift of the Inter -Tropical Convergence Zone (ITCZ). The mean annual precipitation is 835 mm and the mean annual temperature is about 26°C whereas relative humidity has same pattern being 94% in August and dropping to less than 10% during the harmattan period (Balzerek *et al*., 2003). The relief of the town ranges between 650m in the western part to 370m in the eastern parts. The stratigraphy consists of the alluvium, the Cretaceous Sedimentary Formations of Kerri Kerri Formation, the siltstone, sandstoneand ironstone of the Gombe Formation, the shale and limestone of the Pindiga and Yolde Formation, Bima Formation and the basement rocks (Obaje, 1999). The Gongola river which is a right-bank tributary of the Benue, is the most important river in the region. August and September are the months when the rivers are full, the rate of rise and fall being very rapid. Vegetation in Gombe State is predominantly wooded shrub land in the central part, with the plant community comprising Anogeissus, Combretum, Affrormosia and Detarium. The approximate altitude of Gombe ranges from 400-500m above mean sea level. Topography is mainly mountainous, undulating and hilly to the Southeast and open plains in the central Northeast, west and northwest (Abbas, 2012).

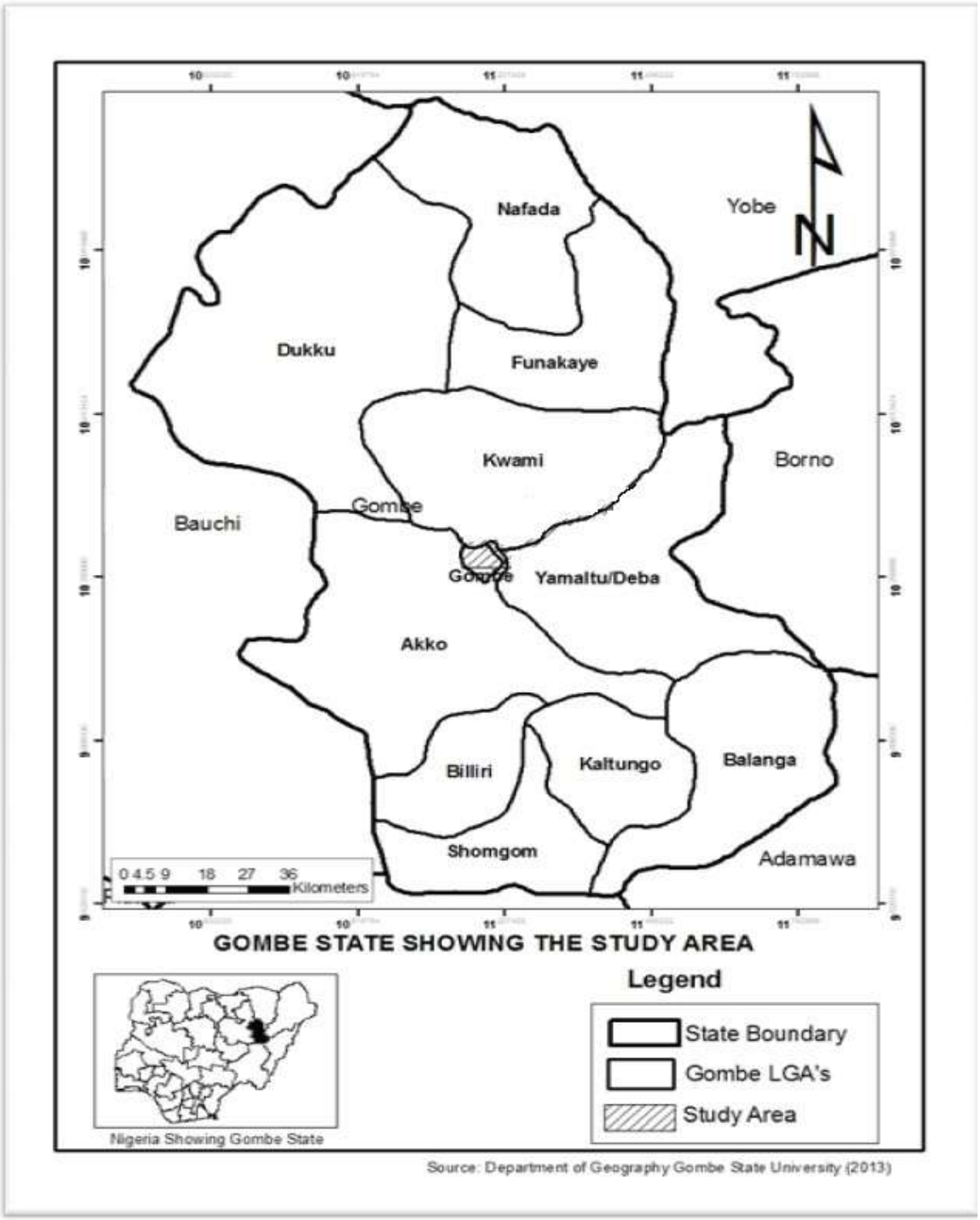

Figure 1: Gome Local Government Area

Source: Adapted and modified from Office of the Surveyor General Gombe State

Methods

The following data were obtained; location, number, attributes and coordinates and staff of all the PHCs in Gombe LGA, along with maps and data on the population by ward, Administrative Map of Gombe LGA with its political ward. Administrative map of Gombe LGA is obtained at the PHC department of the LGA. Field work was conducted to obtain the coordinates of all the PHCs in the study area. Field work was conducted to all the PHCs and the LGA PHC department to obtain the attribute information document for the PHCs in the study area which included the duty roasters of the PHCs.

3.6.1 Hardware

The hardware used are shown on table 3.1

Table 3.1: shows the hardware required and the usage

Hardware	Usage
A handheld Germin 76CSX GPS	used for capture of coordinates of PHCs
An A0 Scanner	Used for printing of hardcopy maps
A digital electronic laptop Computer	Used for processing all the information gathered in this study

3.6.2 Software

The software to be used are shown in table 3.2

Table 3.2: shows the software required and the usage

Software	Usage
Microsoft Word 2013	Used for compiling and documenting of the research document
ESRI ArcGIS 10.1	Used in mapping, analysis, querying and production of map.
Microsoft Excel 2013	Used in sorting Coordinates data to enable further query and analysis in ArcGIS 10.1

TYPES AND SOURCES OF DATA

In order to achieve the stated objectives, the following data were obtained; location, number, attributes, staffing and coordinates of all the PHCs in Gombe LGA, along with maps and data on the population by ward, Administrative Map of the study area. See table 3 for types, sources and usage.

Table 3: Types and Sources of Data

Data Required	Sources	Usage
Staff Roaster	PHC facility	To know the know the number and cadre of staffs in each facility
Administrative map of each Gombe showing political wards	The PHC department of Gombe LGA	To extract the shape file of each ward through digitizing
GPS Data	Field Survey	Taking coordinates of all the PHCs to be used for analysis of access
PHCs Information (Attribute)	The PHC department of the LGA	Provides attribute information to be used as an inventory for creation and population of geodatabase

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Data Analysis

List of all the PHCs in the study area will be obtained at the PHC department of the LGA secretariat, GPS will then be used to capture the coordinates of each Facility. The PHC coordinates are then typed and saved in to Excel format, to enable spatial queries and further processing, the coordinates are then converted to X and Y point data by projecting them to the UTM which will result in the various hospitals showing as a series of points on the map.

The administrative map of Gombe Local Governments is imported in to ArcGIS 10.1 for Geo-Referencing. This is achieved by converting the map to Universal Transverse Mercator Projection (UTM), with World Geodetic System (WGS 1984) datum. When the two layers of PHC and Administrative map are displayed the spatial distribution is observed as seen in Figure below.

4.1.1 Spatial Distribution of Health Care base on their type in the study area

Base on the literatures on the nomenclature of the PHCs according to the NPHCDA there are three types of PHCs; Primary Health Care Centre, Health Clinic/ Maternity and Health Post or formerly Dispensary.

4.3.1.1 Primary Health Care Centre

Services provided at Primary Health Care Centre includes; Community mobilization for support and utilization of health services, Mobilize the community on protection of water sources, control of endemic diseases, immunization and environmental sanitation, Antenatal, post-natal and immunization services, Treatment of minor ailments and performing minor surgical procedures, they also Provide limited in-patient services. Fig 1 shows the spatial distribution of Primary Health Care Centres in Gombe LGA.

PHCARES

FID	Shape *	s_n	ward	Facility_N	lat	long	dr	nur	midwife	cho	chew	jchew	pharm	eho	attendants	type	cce	lab	eht	eha	labtech
0	Point	1	Bolari East	FSP Clinic	10.27691	11.17968	0	2	0	0	7	7	0	0	4	2	1	0	1	1	0
1	Point	2	Bolari East	Madaki PHC	10.27704	11.18326	0	0	0	1	18	0	0	0	6	1	1	0	2	0	2
2	Point	3	Bolari West	Bolari Clinic	10.27948	11.17381	0	0	0	2	7	6	0	0	11	2	1	0	1	2	0
3	Point	4	Dawaki	Town Maternity	10.291218	11.168241	0	5	0	2	7	3	0	1	16	2	1	0	4	2	0
4	Point	6	Herwagana	Herwagana HC	10.28567	11.17163	0	0	0	2	5	3	0	0	0	2	1	0	0	0	0
5	Point	7	Kumbiya Kumbiya	Kumbiya Kumbiya Maternity	10.2845	11.16642	0	1	0	0	9	4	0	0	18	2	1	0	1	5	0
6	Point	8	Nasarawo	Nasarawo Maternity	10.28972	11.28385	0	1	0	1	8	4	0	0	11	2	1	0	1	1	0
7	Point	9	Nasarawo	Sabon Gari HP	10.28447	11.28765	0	0	0	1	1	1	0	0	1	2	1	0	0	1	0
8	Point	10	Pantami	Pantami PHC	10.26466	11.167686	0	0	0	2	10	6	0	0	9	1	1	0	6	2	0
9	Point	11	Pantami	Gabukka HC	10.27876	11.1633	0	0	0	0	8	4	0	0	5	2	1	0	0	4	0
10	Point	12	Shamaki	Tudun Wada PHC	10.30029	11.17293	0	0	0	1	12	8	0	0	5	1	1	0	3	3	3
11	Point	13	Shamaki	Tudun Wada HC	10.30219	11.16972	0	0	0	0	7	6	0	1	8	2	1	0	3	0	0
12	Point	14	Shamaki	Malam Inna HC	10.30961	11.1778	0	0	0	0	11	2	0	0	7	2	1	0	3	1	0
13	Point	15	Shamaki	Kagarawai CHC	10.30249	11.19643	0	0	0	1	3	4	0	0	3	1	1	0	4	0	0
14	Point	16	Shamaki	London Maidorowa HC	10.30388	11.15621	0	0	0	0	8	6	0	0	9	2	1	0	0	0	0
15	Point	17	Shamaki	Jauro Abare Maternity	10.314	11.162	0	0	0	0	3	2	0	0	2	2	0	0	1	0	0
16	Point	18	Dawaki	TBL	10.29272	11.16538	0	0	0	0	2	4	0	0	4	3	1	0	0	1	0
17	Point	19	Dawaki	Gidan Magani	10.29199	11.16553	0	0	0	0	2	0	0	0	0	3	1	0	2	1	5
18	Point	20	Bajoga	Idi Dispensary	10.29436	11.17289	0	0	0	0	2	1	0	0	1	3	0	0	0	0	0

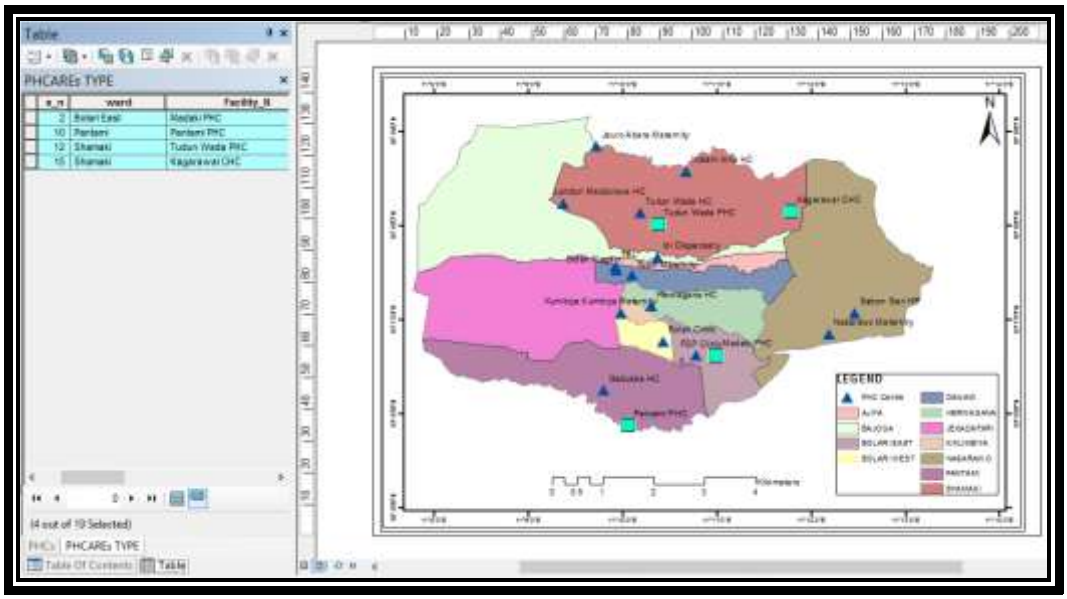


Figure 1: Gombe LGA showing the spatial Distribution of PHC facilities based on Political Wards
Source: Authors Analysis.

. Base on figure 1 above it can be seen that there are four PHC facilities in Gombe LGA 2 in Shamaki 1 each for Pantami and Bolari East Wards these wards constitute only around 27%, with most of the Wards having no PHC facility i.e around 72%.
According to the national minimum standard of NPHCDA all Primary Health care centers should have, at least 5 Nurse/midwife/CHO, 3 CHEW, 6 JCHEW, 1 Pharmacy technician, 1 Medical records officer and 1 Laboratory technician. Of the PHC Facilities in Gombe. none met the minimum requirements but has unusually high number of CHEWS as can be seen in Table 4

Source: Authors Analysis.
Base on the above tables it can be seen that there is no appropriate combination of staff based on cadre to meet the minimum requirement even though the staff number is high.
.3.1.2 Health clinic
Services provided includes Community census and at-risk registration, Community mobilization for PHC, Health education on prevailing health conditions, Follow-up antenatal between the 1st and 36th week, immunization, family planning and child welfare clinics. Figure 2 shows the spatial Distribution of Health Clinics/ centers in Gombe LGA.

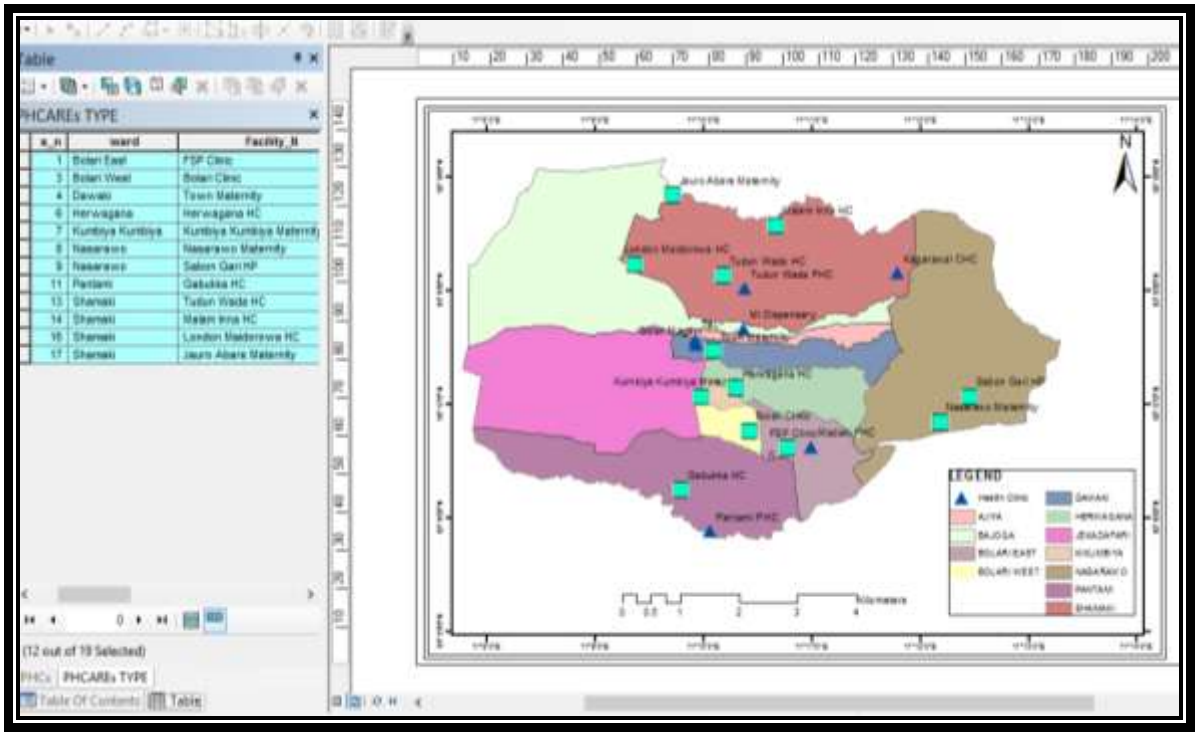
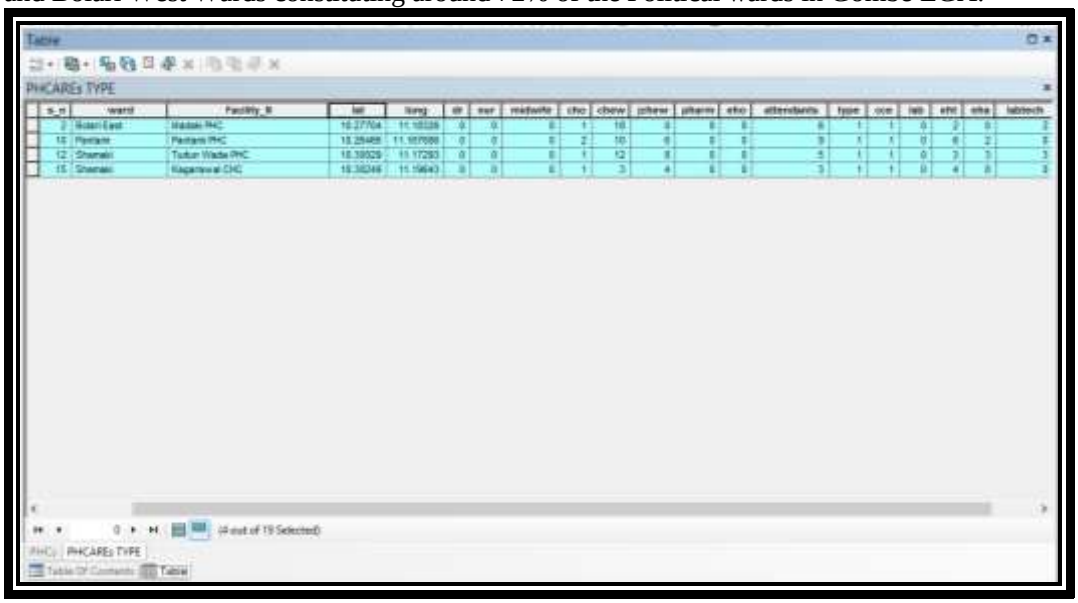


figure 3: Gombe LGA showing the spatial Distribution of Health Clinics/ centers based on Political Wards

Source: Authors Analysis

Base on figure 4.5 above it can be seen that there are 12 Health Clinics/ centers in Gombe LGA; 4 in Shamaki ward, 2 in Nasarawao, 1 each in Pantami, Kumbiya Kumbiya, Herwagana, Dawaki, Bplari East and Bolari West Wards constituting around 72% of the Political wards in Gombe LGA.



According to the national minimum standard of NPHCDA all Health Clinic/Centers should have, at least 1 Midwife/ Nurse, 2 CHEWs and supportive staff. Figure 2 shows the facilities in Gombe LGA met the Minimum staff standard.

Health post

Services provided in Health post includes Offering advice on nutrition especially locally available food materials, Teach, prepare and give ORT for mild to moderate diarrhea, Offer advice on prevention of STI's including HIV/AIDS and distribute condoms as may be advisable and Identify signs and symptoms of ailments and manage them. Figure 3 shows the spatial Distribution of Health Post in Gombe.

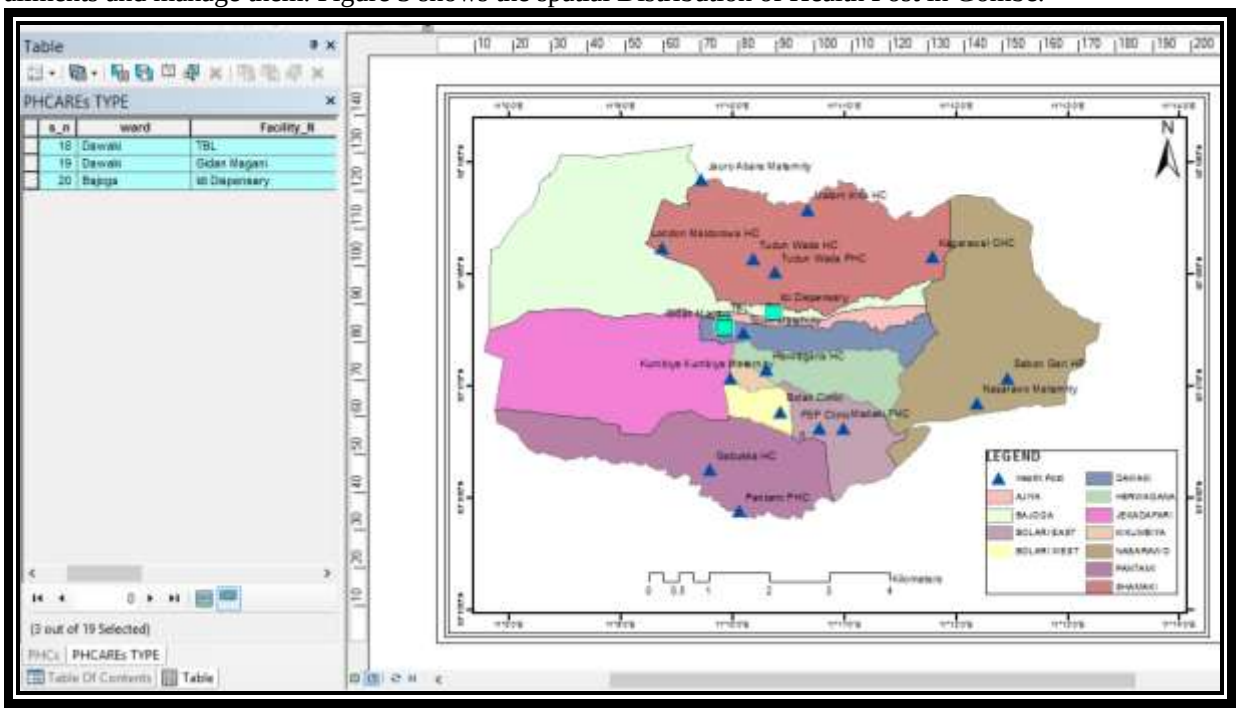


Figure 3: Gombe LGA showing the spatial Distribution of Health Posts based on Political Wards

Source: Authors Analysis

From figure 3 above it can be seen that there are 3 Health Posts in Gombe LGA; 2 of the Health Posts are in Dawaki Ward and the remaining one is in Bajoga Ward. Only around 27% of the Wards in Gombe LGA have Health Post with around 72% of the Wards not having any.

According to the national minimum standard of NPHCDA all Health Posts should have, at least 1 JCHEW to supervise the efforts of volunteer and supportive staff.

From figure 3 only 2 out of the 3 Health Posts met the minimum staff standard around 66.67% of Health Posts in Gombe LGA.

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According to the national minimum standard of NPHCDA all Health Posts should have, at least 1 JCHEW to supervise the efforts of volunteer and supportive staff.

From figure 4.10 only 2 out of the 3 Health Posts met the minimum staff standard around 66.67% of Health Posts in Gombe LGA

SUMMARY

The methods employed includes field work which was carried out, and involve collection of GPS points for all the PHCs in the study area, in addition to the names, types/class of the PHCs which is collected and inputted in Excel Worksheet, enabling spatial queries and further processing
Administrative map of Gombe LGA showing political wards is scanned to extract the shape file of each ward through digitizing. GPS is used in taking coordinates of all the PHCs. there are a total of XX PHC facilities.

RECOMMENDATIONS

Based on the findings of the study, the following Recommendations are made.
It is recommended that Government should establish GIS unit in all Departments of health at all levels of Government. And also build more hospitals to cater for the health care need of the ever growing population of Gombe.

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