ANALYSIS OF HEALTH CARE FACILITIES AND HUMAN RESOURCES IN KAURA LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

BY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRATUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT (REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM)

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DECLARATION

I declare that the work in this dissertation titled ANALYSIS OF HEALTHCARE FACILITIES AND HUMAN RESOURCESIN KAURA LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA was conducted by me; it has not been presented in the department or anywhere for a degree. All quotations and source of information are duly acknowledged by means of references.

_____ _____

BONET, Sylvester Nkut Date

CERTIFICATION

This dissertation titled ANALYSIS OF HEALTHCARE FACILITIES AND HUMAN RESOURCESIN KAURA LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA by Bonet Sylvester Nkut meets the regulations governing the award of the degree of Master's of Science (Remote Sensing and Geographic Information System) of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated first of all to God Almighty, the creator of life, and to the entire mankind but most of all my beloved family.

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My profound gratitude goes to God Almighty who in his infinite mercy saw me through the period of this programme. I would not have been what I am today without Him.

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ABSTRACT

This study was aimed at analyzing health care facilities and human resources in Kaura Local Government Area, Kaduna State, Nigeria, using Geographic Information System. To achieve this, GPS was used to obtain the coordinates of the healthcare facilities; a check list was also used to obtain attribute data in each of the facility. Documentary data were obtained from textbooks, journals, the internet, theses, seminar papers, report and existing map of Kaura Local Government Area. According to the 2006 National population census, Kaura Local Government Area has population of 222,579 people. Mapping was done to show the distribution of facilities within the 10 political wards while a database was created and queried, simple percentage was used to analyze the data. The study shows that there is at least more than one facility in each of the ward with only 3 among the 10 wards having medical doctors. There is only 1 secondary healthcare facility in the area located in Kaura ward and is the only healthcare facility with 2 doctors. The research reveals that there is disparity in the spatial distribution of healthcare facilities while the population to facility ratio shows that population was not considered as a basis for the distribution of healthcare facilities in Kaura Local Government Area of Kaduna state, Nigeria, thus suggesting the possibility of overcrowding in some of the healthcare centres. The study recommended that both Kaduna State and Kaura Local Government should adopt population threshold as a yardstick for health care facility distribution as this is the only approach to ensure equity and social justice in distribution of health care and other basic facilities.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Health is a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity (Jiva, 2013). Many people do not realize the importance of good health, and even if they do, they may still disregard it. Sound health is a fundamental requirement for living a socially and economically productive life. Poor health inflicts great hardships on households, including debilitation, substantial monetary expenditures, loss of labor and sometimes death (Titus, Adebisola and Adeniji, 2015). The necessity of good health is not limited to a particular set of people, bringing good health care systems and information closer to the people is important.

A health system is referred to as the organization of people, institutions and resources to deliver health care services that will meet the health needs of a target population. It is also the prevention, treatment of illness and the preservation of mental and physical well-being through the services offered by the medical and allied health professional. In another, perspective health care is also considered as the diagnosis, treatment, and prevention of disease, illness, injury, and other physical and mental impairments in human beings. Health care is delivered by practitioners in allied health, dentistry, midwifery-obstetrics, medicine, nursing, optometry, pharmacy, psychology and other care providers. It refers to the work done in providing primary, secondary, and tertiary care, as well as in public health (Medical Dictionary, 2007; PATH 2, 2014; WHO, 2010).

Busu (2009) explained that health care systems are designed to meet the health care need of target population, stressing that there is a wide variety of health care systems around the

world. In some countries, the health care system has evolved and has not been planned, whereas in others a concerted effort has been made by governments, trade unions, charities, religious or other coordinated bodies to deliver planned health care services targeted to the population they serve.

Accessibility is a relative nearness and approachability of one place to another. It suggests the ease of reaching a destination from an origin (Jaro, 1999). Accessibility could also be concerned with the opportunity that an individual at a given location possesses to participate in a particular activity or set of activities or represents the ease with which activities may be reached from a given location by means of a particular transportation system. It is usually measured in terms of travel distance, time or cost. The less time and money spent in travel, the more activities that can be reached in a given amount of time and the greater the accessibility (Zhu and Liu, 2004).

Access to healthcare system is difficult to define. It is a multidimensional process that in addition to the quality of care, involves geographical accessibility, availability of the right type of care for those who need it, financial accessibility, and acceptability of service. Geographic accessibility, the distance that must be traveled in order to use health facility, may present an important barrier of access to healthcare. Access to healthcare facilities is a significant factor that contributes to a healthy population and an important component of an overall healthcare system and has a direct impact on the burden of diseases that affects many countries, especially in the developing world (Al-Taiaret, Allan, Joseph, and Witty, 2010).

Accessibility to healthcare facilities has been measured in different ways, depending on the context of the application, particularly in health care system and planning. Halden, McGuigan, Nisbet and McKinnon (2000) view accessibility to healthcare as the ability of a population to obtain a specified set of health care services. In this context, geographic

accessibility is often referred to as spatial or physical accessibility. Physical accessibility addresses the complex relationship between the distribution of the population and the supply of healthcare facilities (Ebener, Ray, Black and El Morjani, 2005). Spatial accessibility to healthcare refers to the ease with which residents of a given area can reach medical services and facilities (Hewko, Smoyer-Tomic, and Hodgson, 2002).

The availability and access to health care varies across countries, groups, and individuals, largely influenced by social and economic conditions as well as the health policies in place. Countries and jurisdictions have different policies and plans in relation to the personal and population-based health care goals within their societies. Health care systems are organizations established to meet the health needs of target populations. Their exact configuration varies between national and sub national entities. In all cases, according to the World Health Organization (WHO), a well-functioning health care system requires a robust financing mechanism; a well-trained and adequately-paid workforce; reliable information on which to base decisions and policies; and well maintained facilities and logistics to deliver quality medicines and technologies (Thakkar, 2013).

As detailed by Abbas, Auta, and Na'iya, (2012), that the provision of health care centers 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 healthcare delivery. The federal government's role is mostly limited to coordinating the affairs of the University Teaching Hospitals, Federal Medical Centers (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.

According to Marycelin (2012) despite the collaborative effort from both Nigerian Government, donor agencies and Nongovernmental Organizations (NGOs) to provide an efficient and effective health care delivery in Nigeria, confronting problems render these efforts much useless than desired. The National Health Policy which was aimed to achieve healthcare for all Nigerians promulgated in 1988, was the first comprehensive national health policy. The policy identified a three-tier structure for the national health delivery system with primary health care as the cornerstone. In selecting primary health care, the policy intent was to use health as a vehicle to promote development while focusing on the major causes of morbidity and mortality that are largely preventive. In 2004, the document was revised and still maintained the three tier system; the primary, secondary and tertiary levels (Campbell, 2007).

The Nigerian health care has suffered several down falls. Despite Nigeria's strategic position in Africa the country is greatly underserved in health care sphere. Health facilities (health centers, personnel and medical equipment) are inadequate in the country, especially in rural areas. Also, according to the communiqué of Nigerian national health conference, health care system remains weak as evidenced by lack of coordination, fragmentation of services, inadequate and decaying infrastructure, inequity in resource distribution and access to care and very deplorable quality of care (Manizibe, 2011).

In terms of health facilities, Kaduna State has 740 Local Government health facilities (mostly various health posts, Primary Health Care centers and cottage hospitals), 29 Secondary Health Care facilities, five tertiary hospitals, 656 private health facilities and about 2500

registered patent medicine shops. There are also academic institutions and four post basic training programs for human development without the health care service (PATH, 2014)

In Kaura Local Government Area of Kaduna State, one of the challenges facing the people in the rural areas is access to health care facilities, especially during childbirth. Under critical situations a woman may bleed excessively during birth without emergency medical treatment. The situation becomes even more critical if it happens in the night because of the difficulties in getting a vehicle at that time. Those who manage to make it to the hospital in time may not be so lucky to get emergency treatment because some of the hospitals are poorly equipped and most times there are no doctors and nurses in the healthcare centers and so cannot effectively render the necessary assistance that will safe life (Shiklam, 2013). This claim is supported by (PATH, 2014) that access to health care in rural areas is often very limited. Moreover, proper medical care is often unavailable if complication arises during delivery, putting both mother and child at serious risk.

The World Health Organization (WHO), (2004) Geographic Information System (GIS) can serve as a good technological tool in health care delivery by providing an excellent means of analyzing epidemiological data, revealing trends, dependencies and interrelationship that would be more difficult to discover using traditional tabular approach (Abbas, Auta and Na'iya, 2012). GIS has been used as means of finding hidden patterns and trends that would have remained undetected using conventional means of data analysis (Ayeni, Akinwande, and Hamit-Mosaku, 2002).

Health care provision and accessibility is of great significance to the general development of any nation. The level of availability and accessibility of health care facilities in an area is an indication of the significant level of development of that society. This study was necessitated as a result of the difficulties in accessing health care service in communities of Kaura Local

Government Area of Kaduna state. The situation is critically affecting the people negatively, thus causing a very high mortality rate. There is a rapid increase in untimely death in the communities. Life expectancy of the people is becoming shorter. An interview granted to the researcher by leaders and people of the communities, reveals how people, especially pregnant women with their unborn babies die on daily basis, as a result of bad transportation system. Worse of it all, is the lack of technical-knowhow, such as qualified doctors and nurses and the deteriorated states of the health care facilities.

1.2 STATEMENT OF THE RESEARCH PROBLEM

Urbanization in the third world countries come along with many advantages and disadvantages. The disadvantages usually have to do with difficulties in controlling urban growth and making available resource to meet the increase needs and demands for essential public services like education, housing and most especially health (Adamu, 2001).

The provision of healthcare system is largely the responsibility of federal, state and local governments within the overall national health policy in Nigeria (Akande, 2004). The effort to improve healthcare system with corresponding increase in population has led to poor access and patronage to healthcare facilities especially in developing countries, as such disease prevalence and death rate are still high (Albert, Gesler and Levergood, 2000).

Access to healthcare facilities in the communities of Kaura Local Government Area remains a serious challenge. Population is increasing and communities are expanding without corresponding increase in provision of healthcare facilities. This has led to lives been lost due to poor healthcare delivery systems. Other factors that may further hinder access to sound healthcare system are, geographical factors which include (distance, travel time, travel cost, familiarity), the nature of roads, cultural factors, social factors, educational factors and

service availability. All these factors cause hindrances to a sound healthcare system (Shiklam, 2013).

A good number of Nigerians reside in rural areas therefore they deserve to be served with all the components of PHC (Gupta, Gauri and Khemani, 2004).There is a general consensus among researchers that fewer people are willing to patronize a particular facility as the distance from it increases (Sanni, 2010). Researches on health and health care using different GIS approaches abound to arrive at various conclusions; Olajuyin, Olayiwola and Adeyinka, (1997) investigated the effect of location on the utilization of healthcare facilities in Irewole Local Government Area of Osun State, Nigeria. They found that healthcare facilities were unevenly distributed among the settlements and that distance was a paramount factor that determines the rate at which a health care facility is patronized in the area.

Ajala, Sanni and Adeyinka (2005) studied accessibility to healthcare facilities as a panacea for sustainable rural development in Osun State, Nigeria. Based on data available on the year 2001, they employed the use of comparative values of three indices, viz: population ratio per medical officer; population ratio per nurse/mid-wife; and population ratio per hospital bed space. They noted that serious inequalities exist in the provision of healthcare facilities and services by both the public and private sectors, and that the existing distribution pattern is more in favour of urban areas.

Keola, Tokunaga, Nitin, and Wisa, (2002) used GIS to show disease distribution. Data used in this study include: population data, data concerning infectious diseases and their occurrence locations. In this study, dependence of spreading disease on time was studied using statistical regression analyses. Among all examined diseases, pneumonia had a direct relation with time and highest dependence coefficient (94 %) and its distribution in crowded areas was high. World Health Organization (2002) stated that GIS was used as a managing

system to store and recover data, display and recognize temporal and spatial association of diseases.

Kibon and Ahmed (2013) conducted a GIS research on the distribution of primary healthcare facilities in Kano metropolis using the overlay analysis method. The result of the analysis shows that the distribution of primary healthcare facilities is uneven in Kano metropolis with a very poor manpower.

Healthcare provision challenge is a serious issue in any context, especially in developing countries like Nigeria with a fast growing population. The need to provide viable and functional healthcare services that will address the current challenges faced in most Nigerian society is of great significance to both individuals and governments. The researcher sought to identify the location, distribution and capacity of available health care facilities in Kaura Local Government Area of Kaduna state.

All the researches mentioned seem to lay emphasis on spatial distribution; this research took a look at what is in the healthcare centers specifically on the missing attributes on physical and human resources available in the healthcare centers in Kaura Local Government Area. This research work intended to provide answers to the following questions, which are:

i. Where are the health care facilities located in Kaura Local Government Area?
ii. What is the distribution pattern of the health care facilities in the study area?
iii. What are the available resources in the health care facilities in the study area?
iv. What is the functional state of the health care facilities in the area?

1.3 AIM AND OBJECTIVES

The aim of this research is to conduct an analysis of the health care facilities and human resources in Kaura Local Government Areas using GIS technology. In order to achieve the aim, the objective will be to:

i. map the health care facilities in Kaura Local Government Area.

ii. determine the distribution pattern of health care facilities in the area.

iii. assess the resources in the health care facilities in the area.

v. determine the functional state of the health care facilities

1.4 SCOPE OF THE STUDY

This research was restricted to Kaura Local Government area of Kaduna State. The spatial extent of the research covered Kagoro, Manchock, and Takad Chiefdoms consisting of 10 political wards of Agban, Kukum, Fada, Kpak, Kadarko, Mallagum, Kaura, Manchok, Bondong, Zankan which make up Kaura LGA. The content scope of the research covered the location, mapping, and generating of geo-database of the existing healthcare facilities (government and private) in the study area. The study was limited to the consideration of data and information of healthcare facilities (government and private) within the geographical boundaries of Kaura Local Government Area as at 2014 as provided by the Kaduna state ministry of health.

1.5 JUSTIFICATION OF THE STUDY

The study is envisaged to provide information on the composition and structures of these facilities as a base towards improving the status of health care facilities for Kaduna State ministry of health. Geographic Information Science and Remote Sensing techniques employed in the study is also expected to incorporate different layers of information on a

single map and database that provides comprehensive frame work and organization of spatial and non spatial data for planning and decision making by stakeholders of health in the state. The creation of health care facilities database and mapping helps in showing the spatial distribution and information about location and their physical relations to each other.

The present study sets out to provide up-to date information on the state of health care facilities in Kaura Local Government Area of Kaduna State, their spatial distribution, their proximity to the target settlements and the facilities in each health care centre in the study area. This study will provide additional literature to further studies in this area which is in the overall interest of the society. The study shall in addition provide Geo-referenced data for use by scholars for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, a review of studies related to this research is presented. Beginning with definition of health and health care system, concept of accessibility, access to health care, concept of health care delivery in Nigeria, national health policy, the role of health care in national development, challenges in health care delivery in developing Nations, location theory, measuring spatial accessibility to health care, GIS measurement of accessibility to health care and GIS innovation in health care in Developing Countries.

2.2 CONCEPTUAL FRAMEWORK

2.2.1 Concept of Health Care

Health care is prevention, treatment of illness and the preservation of mental and physical well-being through the services offered by the medical and allied health professional. In another perspective health care is also considered as the diagnosis, treatment, and prevention of disease, illness, injury, and other physical and mental impairments in human beings (WHO, 2010).

The National Health Policy which was aimed to achieve healthcare for all Nigerians promulgated in 1988, was the first comprehensive national health policy. The policy identified a three-tier structure for the national health delivery system with primary health care as the cornerstone. In selecting primary health care, the policy intent was to use health as a vehicle to promote development while focusing on the major causes of morbidity and

mortality that are largely preventive. In 2004, the document was revised and still maintained the three tier system; the primary, secondary and tertiary levels (Campbell, 2007).

The apex of the health care system in Nigeria is the tertiary level consisting of teaching hospitals and other specialist hospitals which provide care for specific disease conditions or specific groups of patients. It has what is known as Referral process, by which a health worker transfers the responsibility of care temporarily or permanently to another health professional, social worker or to the community (Ojo *et a*l. 1991). Many Secondary and Tertiary Health Facilities are crowded with patients that have simple ailments that can be managed at the Primary Health Centers which typically have many idle health care workers (Federal Ministry of Health, 2005.)

According to Fanan and Felix (2004) the past National Development Plans have reflected the problems of equitable distribution of health care facilities in the country while regional studies have confirmed the existence of inequality in the distribution of health care facilities in Nigeria. They authors further stressed that the national health policy aims to achieve health for all Nigerians based on the national philosophy of social justice and equity is clearly enunciated in the second National Development Plan of 1970-1974. These principles of social justice and equity and the ideals of freedom and opportunity have been affirmed in Nigeria's constitution. Thus, the national health policy was formulated in the context of these national objectives and philosophy. To this end, the primary health care is adopted as the means of achieving the national goal of social justice and equity. As defined in Alma-Ata Declaration of 1978, "primary health care brings health care as close as possible to where people live and work.

2.2.2 Concept of Accessibility

Accessibility is a relative nearness and approachability of one place to another. It suggests the ease of reaching a destination from an origin (Jaro, 1999). The concept of accessibility has also been defined as the relative ease with which a location may be reached from other locations (Morril, 1970; Storbeck, 1990; Inyang and Ogbonna, 2001).

Accessibility could also be concerned with the opportunity that an individual at a given location possesses to participate in a particular activity or set of activities or represents the ease with which activities may be reached from a given location by means of a particular transportation system. It is usually measured in terms of travel distance, time or cost. The less time and money spent in travel, the more activities that can be reached in a given amount of time and the greater the accessibility (Zhu and Liu, 2004). Accessibility may be measured in social, physical and economic terms. (Morril, 1970; Storbeck, 1990; Inyang and Ogbonna, 2001).

Access to healthcare has multiple definitions, and its meaning in a given context is too often assumed. The most basic problem is that it is both a noun referring to potential for healthcare use, and a verb referring to the act of using or receiving healthcare. This leads to confusion between ability to get care, the act of seeking care, the actual delivery of care, and indicators thereof. Concepts and communication become clearer if we think of access in terms of stages and dimensions. The two broad stages are "potential" for care delivery, followed by "realized" delivery of care. Potential exists when a needy population coexists in space and time with a willing and able healthcare delivery system. Realized care, sometimes referred to as actualized care, follows when all barriers to provision are overcome (Guagliardo, 2004)

A number of barriers can impede progression from potential to realized access. Penchansky and Thomas (1982) have usefully grouped barriers into five dimensions: availability, accessibility, affordability, acceptability and accommodation. The last three have received the

most attention in the U.S. They are essentially aspatial, and reflect healthcare financing arrangements and cultural factors. However, the first two dimensions are spatial in nature. Availability refers to the number of local service points from which a client can choose. Accessibility is travel impedance (distance or time) between patient location and service points. While the distinction between availability and accessibility can be useful, in the context of urban areas, where multiple service locations are common, the two dimensions should be considered simultaneously (Guagliardo, 2004).

Al-Taiaret, Allan, Joseph and Witty (2010) explained Access to healthcare system as been difficult to define. It is a multidimensional process that in addition to the quality of care, involves geographical accessibility, availability of the right type of care for those who need it, financial accessibility, and acceptability of service.

Halden, McGuigan, Nisbet and McKinnon (2000) view accessibility to healthcare as the ability of a population to obtain a specified set of health care services. In this context, Geographic accessibility is often referred to as spatial or physical accessibility. Physical accessibility addresses the complex relationship between the distribution of the population and the supply of healthcare facilities (Ebener, 2005). Physical distance influences accessibility a great deal since most of the inhabitants in a given area will have to spend a significant proportion of their resources, that is, time and energy, in movement (Morril, 1970; Storbeck, 1990; Inyang and Ogbonna, 2001).

Spatial accessibility to healthcare refers to the ease with which residents of a given area can reach medical services and facilities (Hewko, Smoyer-Tomic and Hodgson, 2002). Different from its aspatial counterpart, the spatial accessibility emphasizes the role of geographic

distance in the interactions between health services and population demands (Luo and Wang, 2003)

In terms of Geographic accessibility, the distance that must be traveled in order to use health facility, may present an important barrier of access to health services. Studies in developing countries have presented strong evidence that physical proximity of health service can play an important role in the use of primary healthcare. It is hypothesized that long distance can be a significant obstacle to reaching health facilities, and a disincentive even to trying to seek care (Al-Taiaret, Allan, Joseph, and Witty, 2010).

Physical access to health care remains a key issue in most low income countries in which a large proportion of the population often resides in rural areas at considerable distances from basic health services. Physical access to health care is the most important determinant of the utilization of the healthcare services WHO (2000). In addition, lack of physical access to health care is correlated with many adverse health outcomes and likely affects adherence to demanding treatment regimens (Tansler, 2002). The WHO (1997) specified criteria for health care planning for third world countries and indicated that each service area should cover a 4km catchment area with a population of 60,000.00 for primary health care in order to have adequate and equity of access to health centres.

Assessment of physical access to health services is extremely important for planning. Complex methods that incorporate data inputs from road networks and transport systems are used to assess physical access to healthcare in industrialised countries. However, such data inputs hardly exist in many developing countries (Al-Taiaret, Allan, Joseph, and Witty, 2010). Transportation attributes are dominant factors of accessibility in any given area.

Patronage of a particular health-care facility depends largely on the accessibility of the facility.

2.3 THEORETICAL FRAMEWORK

2.3.1 Classical Location Theory

In classical location theory, the spatial pattern of economic activities is explained mainly in terms of transfer costs which include both freight charges (i.e. transport cost) and the cost of insurance on materials and goods en route and losses incurred by deterioration of or damage to materials en route. The expense and inconvenience of shipping finished products to distant customers and procuring raw materials from distant sources induce producers to locate near their markets or raw materials (Akhimien, 2005). Which of the market or raw material source eventually attracts an activity depends on the relative cost of assembling materials and distributing finished products. Many industrialists, therefore, tend to locate where aggregate transfer costs are at a minimum (Omole, 2001). The notion of transfer costs has strong implications for the spatial distribution/location of public facilities. Public facilities have many important characteristics, two of which are particularly relevant for our present purpose (Omole, 2001).

i. The services they produce are mostly for final consumption

ii. Public services generally require personal contact between producers and consumers.

As a result of these two characteristics, public facilities generally locate primarily with an eye to distribution, and are thus oriented towards the consumer market. Location theory also makes important points about the spatial distribution of producers and consumers. The locational relation among producers competing for markets is usually one of mutual

repulsion. This is largely because producers search for markets where competition is at a minimum (Omole, 2001).

2.3.2 Central Place Theory

Central place theory concerns, among other things, the location and spacing of service centers. It might be instructive, therefore, to highlight some concepts, especially the locational concepts, which have direct relevance for the issue of spatial efficiency of public facilities. Central places are essentially places that provide a convenient point of focus for consumers for the purchase of goods and services, and centrality is the essence of the point of focus. Centrality refers to a state of high accessibility, the quality of being at the centre of the transportation system (Inyang and Ogbonna, 2001). Thus, it follows that the term central place is a relative one. It describes the relationship between a point and other points in the surrounding region, and the central place is that point which can be most 'easily' reached from other locations in the region (Agarwal, 2001).

This idea has relevance for the geographic distribution of public facilities since the primary concern of central place theory is with devising a spatial arrangement of central places which would minimize the travel costs of the population in gaining access to the services they require. Centrality implies that consumers generally use service centers that will enable them satisfy their wants with the minimum effort. In other words, consumers tend to prefer locations that involve the least expenditure of travel time or transport costs. Among the factors frequently suggested as affecting trip patterns, travel costs have received the greatest consideration. It is argued that the travel behavior of consumers is influenced by the expense in money, time or effort that is involved in traveling to various service centers offering the goods and services desired (Aderamo and Aina, 2011).

2.3.3 The Principle of Least Effort

The arrangement of objects or activities in space is directly linked with the principle of least effort enunciated by Zipf (1965). Man strives to accomplish his tasks and satisfy his wants with the least possible effort. It is for this purpose that activities tend to be located at central places. An optimal location and spacing of service centres in an area implies that consumers will, in aggregate terms, expend the minimum amount of effort required to use the services or facilities. The principle of least effort can be expressed by an objective function in situations where it is, for instance, desired to minimize the total cost of movement in a system. This problem of minimizing the value of the objective function subject to certain constraints can thus be placed directly in a spatial context (Ayeni, 1991).

Theoretical guidelines for the efficient location of public facilities therefore abound in planning, geographic and other literature. However, the efficiency of the spatial pattern of facilities depends largely on the locational objectives. Thus, the researcher, for the purpose of this study agrees with the Central Place and the Least Effort Location theories because Kaura LGA is a rural settlement where virtually all the health care facilities are owned by government. Here the centrality of the health care facilities is paramount. The Central Place Theory has some locational concepts, which have direct relevance for the issue of spatial efficiency of public facilities. The public can access the health care facilities easily from different locations when the theory is applied accordantly (Ayeni, 1991).

On the relevancy of the Least Effort locational theory to this study, health care seekers are more likely to patronize health care facilities closer to them because of the higher cost of travelling to distant facilities. This is very true even for areas with low income levels. It is in view of this that WHO (1997) specified criteria for health care planning for third world countries and indicated that each service area should cover a 4km catchment area with a

population of 60,000.00 for primary health care in order to have adequate and equity of access to health centres to reduce travelling distance.

2.4 LITERATURE REVIEW

Healthcare provision is a very important component of an organized society as it is the bedrock for a healthy, functional and effective population. WHO (1997) specified criteria for health care planning for third world countries and indicated that each service area should cover $4km^2$ catchment area with a population of 60,000 for primary health care in order to have adequate and equity of access to health centers.

2.4.1 GIS Based Measures to Access to Healthcare Services

Increasing advancement in GIS in healthcare organization, together with the availability of data, has supported studies related with developing measures of access to healthcare services. Ebener *et al*. (2005) stated that GIS is suitable in measuring spatial accessibility to healthcare as they enable researchers to input, store, manage, manipulate both spatial and attribute (textual) data, and visualize spatial information. Literatures like Bagheri and Benwell (2005), Guagliardo (2004) and many more have explained about measuring spatial dimensions of access, availability and accessibility. Measuring straight line distance (Euclidean distance) and creating thiessen polygons are some simple methods in assessing physical access. For more detailed analysis, sophisticated network analysis can be done calculating travel time, distance and mode of transport in GIS. Bugheri, Benwell et al. (2005) calculated driving time to primary healthcare (destination point) from patient's house (origin point) to apply least cost path analysis model using network analysis in Arc Info 9.1

GIS software provides spatial analysts that offer excellent tools for spatial data management and visualization. Amer (2007) used GIS to identify and visualize trend like socially progressive or regressive pattern in distribution of healthcare facilities. GIS in combination with other software like Flowmap is useful in identifying suitable location of facilities for certain number of facilities to a defined population or territory. This can ensure the optimal distribution of service in space considering the concentration of demand (people). Amer (2007) mentions that more sophisticated GIS-based analytical techniques, for instance GIS-based 'what if' in his study, can be used to evaluate and support improvement of healthcare service in terms of spatial equity and efficiency which can further support strategic planning of urban health services delivery

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2.4.2 Measuring Spatial Accessibility

According to Guagliardo (2004) most published measures of spatial accessibility (SA) to healthcare can be classified more simply into four categories: provider-to-population ratios distance to nearest provider, average distance to a set of providers, and gravitational models of provider influence.

Provider-to-population ratios, also referred to as supply ratios, are computed within bordered areas. They are the most popular type of SA measure because they are highly intuitive, the data are also the measurement type that has been used in the sentinel literature on ambulatory care sensitive conditions (ACSCs). Ratios are computed for bordered areas, such as states, countries, metropolitan statistical areas, or health service areas. These are the geographic units of analysis. The numerator is some indicator of health service capacity, such as number of physicians, clinics, or hospital beds. The denominator is the population size within the

area. This is most often taken from census files, but may be taken from insurance plan enrollment files, e.g. Medicare, depending on the population of interest. Bordered areas are then analyzed for associations between provider-to-population ratio values and some indicator of healthcare utilization (e.g. rate of immunizations) or health status (e.g. disease prevalence rates).

As indicators of availability, supply ratios are good for gross comparisons of supply between large geopolitical units or service areas, and are used by policy analysts to set minimal standards of supply and to identify underserved areas. Unfortunately, supply ratios have some serious limitations. First, they do not account for patient border crossing, which commonly occurs for small geographies such as urban census tracts and postal code areas. Second, supply ratios are blind to variations in accessibility within bordered areas. Finally, they do not explicitly incorporate any measures of distance or travel impedance. Consequently the results and interpretations stemming from bordered area studies can vary greatly depending on the size, number and configuration of the areal units studied. This problem is well-known to geographers and spatial analysts as the modifiable areal unit problem (MAUP).

Travel impedance to nearest provider is another very intuitive and commonly used measure of SA. It is typically measured from a patient's residence or from a population center, such as the geometric centroid of county of residence, depending on the resolution of the available data. Travel impedance, sometimes referred to as travel cost, is often measured in units of Euclidean (straight line) distance, travel distance along a road and/or rail system, or estimated travel time via a transportation network.

Travel impedance to nearest provider has been assumed to be a good measure of SA for rural areas, where provider choices are very limited and the nearest provider is also the most likely

to be used. However, Fryer, Drisko, and Krugman (1999) have provided evidence to the contrary. Regardless of suitability for rural areas, this measure is probably not suitable for urban settings because it is insensitive to the fact that in congested areas there is usually an array of provider options at similar distance from any reference point. In fairness, all reasonable options for the potential patient should be factored into SA measures. Therefore, travel impedance is a poor indicator of availability. Combined measures of travel impedance (accessibility) and supply (availability) are necessary to properly understand spatial accessibility.

Average travel impedance to provider is intriguing because it is a combined measure of accessibility and availability. It, too, is measured from any patient or population point of interest. From that point the travel impedance to all providers within a system is summed and averaged. The "system" might be a city or county. To the author's knowledge this measure has only been used once for a health services study. It has two shortcomings. First, it over-weights the influence of providers located near the periphery of the study area. To illustrate for a large city, providers at the northern periphery may not be a practical option for residents near the southern periphery. Including these providers inflates the average distance, thereby decreasing apparent SA for those residents. An additional problem concerns border crossing. As with the provider-to-population ratios, patients routinely cross geopolitical boundaries to seek nearby healthcare services.

Gravity models are also a combined indicator of accessibility and availability. A modified version of Newton's Law of Gravitation, they were initially developed to predict retail travel and help with land use planning. They can provide the most valid measures of spatial accessibility, be the setting urban or rural. Gravity models attempt to represent the potential interaction between any population point and all service points within a reasonable distance,

discounting the potential with increasing distance or travel impedance. Because gravity measures take into account all alternative service points, they are sometimes referred to as cumulative opportunity measures. The simplest formula for gravity-based accessibility is:

$A_i = \sum_j \frac{S_j}{d_{ij}^{\beta}}$ Guagliardo (2004)

Other authors have these to say on measurement of spatial accessibility: Simple measures of spatial accessibility could be travel distance or travel time of a population to the nearest health service (Brabyn and Skelly, 2002). More sophisticated methods include: the Two Step Floating Catchment Area Method (2SFCAM) (Luo and Wang, 2003), and the kernel density method (Wang and Rois- man, 2010). In general, these methods attempt to formulate distance-dependent interactions between health services and population demands, while representing competition among populations for limited resources. A service-to-population ratio is finally calculated for each population of interest to gauge its healthcare accessibility (Yang, Goerge, and Mullner, 2006). These accessibility measures, then, help identify under-served areas and suggest optimal allocation of health resources (Rosero-Bixby, 2004).

2.4.3 Challenges in Health Care Delivery in Developing Nations

According to Berman (1998), upon independence, most sub-Saharan African countries attempted to provide universal health services to the population through primary healthcare provisions. But the emerging situation where the carrying capacity of existing public health systems declines in the face of a growing need for essential/basic health care simply reveals the rapidly diminishing ability of governments to provide public resources for effective healthcare delivery. The provision of adequate basic health services in developing countries is becoming increasingly difficult by the day. Rapid population growth, widespread poverty

and lack of financial resources for the provision of health facilities/infrastructure are identified as the key factors responsible for the poor health care delivery systems in the developing world.

In the health sector, much concern has been expressed pertaining to the pattern of distribution of heath care facilities and level of utilization. According to Inyang (1994), distributive equity in healthcare facilities indexes accessibility. In other words, the level of access to health care facilities is a function of the degree of fairness in spatial distribution of the facilities. According to Atser and Akpan (2009), inequality in facilities' distribution is of crucial significance particularly in developing societies where there are dual problems of limited facilities and low personal mobility. Accessibility in this context has spatial theme and signifies the ease with which potential health care seekers get to the health facilities where health care services are delivered (Fanan and Felix, 2004).

From a study done by the Directorate of Food, Roads and Rural Infrastructure in 1987, Nigeria has about 100,000 villages and autonomous communities but there are about 10,711 health establishments at the primary health care level including health and maternity centres, health clinics and dispensaries. This means that there is roughly one facility per every 10 villages/communities and this makes accessibility to health services very poor especially in rural areas. This is reinforced by the established fact that in health care services, patients are not prepared to travel more than 5km or a half-hour journey on foot to receive health care services. Additionally, further stressed that for preventive services such as immunization and health education, the distance people want to travel to receive services is much less than 5kms or half hour journey (Fanan and Felix 2004).

Guagliardo, (2004) identified the following as the factors militating against bridge-building between the levels of healthcare services:

i. A fragmented health system with multiple players
ii. Absence of guidelines and protocols on the functioning of the referral system
iii. Lack of trust in lower levels of care by the populace especially urban dwellers
iv. Low awareness among the health staff and the communities on the referral mechanism
v. Lack of orientation and training of all health care providers, at all levels of the health care system, on the functioning of the referral system
vi. Poor communication and transport facilities

Primary healthcare provides the first contact with the health system where the majority of cases of morbidity are treated. The poor national health indices may be attributable in part to the inability of the health system to sieve life-threatening cases from others and refer to the level that will provide appropriate care. Instituting a mechanism for prompt referral of cases will ensure that people enjoy an optimal level of care.

However, considering some researches similar to this study; Sanni (2010) employed the technique of Locational Quotient to investigate the existing distribution pattern of healthcare facilities in Osun State. The result showed that variations exist in the distribution of the healthcare facilities and personnel in the State. The researcher observed that though the observed pattern of distribution of health care facilities and personnel in the state appeared to be significantly better than what was obtained in 2001. For instance, while as high as 13 local government areas have no registered Pharmacist, and eight have no Laboratory Scientist, 29.1% of the 282 Medical Doctors, 28.3% of the 53 Pharmacists, and 40.3% of the 72 Laboratory Scientists in the State are all located in Osogbo, the State capital. Though these

happened to be the most unevenly distributed of the variables under study, the distribution pattern of other facilities, amenities and personnel is far from being encouraging. However the researchers observed that the observed pattern of distribution of healthcare facilities and personnel in the state appeared to be significantly better than what was obtained in 2001.

Bronwyn *et al*. (2011) carried out a research on inequities in access to health care in South Africa. The researchers collected data on: health status; Utilization of outpatient and inpatient services and health insurance status. The researchers examined the access dimensions of availability, acceptability**,** and affordability. The research reveals that transportation costs and travel distance emerged as key access barriers, especially for black Africans, poor, and rural residents. Although the Clinic Upgrading and Building Programme has improved service availability, there was access barriers relate to the geographic inaccessibility of health facilities, particularly in largely rural and poorly resourced provinces. However, within the same geographical setting, different households cope differently with illness.

Similarly, Abbas, Abdulkadir and Bello (2014) carried out a research on mapping the spatial distribution of healthcare facilities of the millennium development goals (MDGs) in Kaduna North and South Local Governments, Kaduna State, Nigeria. They concluded that there were no detailed working plans and criteria for the provision of healthcare facilities at the local level peculiar to the need of the generality of the people in the past.

2.4.4 Geographical Information Systems Innovation for Health Care in Developing Countries

Geographical information system (GIS) technology is increasingly being used in many areas of health care research and planning. Applications range from the study of "classic" infectious diseases such as malaria, schistosomiasis, and tuberculosis, to cancers such as

leukemia. One important area in which GIS is increasingly being applied is in the design and evaluation of health care programs. This application is becoming more common not only in communities of industrialized countries, but in economically marginalized communities of developing countries as well. The increasing availability of remotely sensed data sets and other digital databases, combined with declining hardware and software prices and improvements in Global Positioning System (GPS) accuracy, have encouraged more widespread use (Albert, Gesler, & Horner,2000).

The elevated disease burden in developing countries and proportion of that burden attributable to infectious diseases (often with well-defined and spatially varying covariates) make the inherent potential of GIS in developing countries considerable. In addition, due to infrastructure and cost constraints, many developing countries suffer from a lack of reliable statistics and disease reporting. GIS can help significantly in this area by filling the gaps with empirical disease modeling techniques. Public health practices need information to implement appropriate actions, and GIS is an innovative technology for generating this type of information. GIS is therefore considered an appropriate technology for developing countries, despite the fact that it appears to contradict the principles of appropriate technology (because it can require high costs and levels of expertise) (Cromley,&McLafferty, 2002).

Tansler (2002) focused on the applications of GIS and Remote Sensing technologies to a diverse range of environmental and health problems.

Improved access to primary health care is required for the successful attainment of at least three of the United Nation's Millennium Development Goals(reduce child mortality; improve maternal health; and combat HIV/AIDS, malaria,and other diseases). The effective deliveries of healthcare in developing countries, and the development of systems to provide it, remain problematic. Malaria and tuberculosis are examples of diseases that thrive in the absence of

effective health systems. Knowledge and understanding of health care usage and population distribution is vital for health resource allocation and planning. Good health system management depends on informed decisions regarding resource allocation. These decisions, however, often occur in the absence of data that allow the pattern of resource allocation to be assessed. This analysis of resource patterns is one area in which GIS can contribute significantly through its ability to incorporate layer of multiple data sets from different data sources at different scales (using space as the unifying framework) to provide an evidence base from which to assist the decision making process (Tanser, 2002).

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 INTRODUCTION

This chapter gives a general overview of the study area and the methodological approach used to collect data, as well as the procedures used to analyzed data in order to achieve the set objectives of the study.

3.2 STUDY AREA

3.2.1 Location and Extent

Kaura Local Government Area lies between latitudes 9˚ 30' N and 9˚ 45' N of the Equator and longitudes 8˚ 20' E and 8˚ 35' E of the Greenwhich Meridian. Kaura Local Government Area has an estimated landmass of 485 km². This land area is bounded to the South by Jama'a L.G.A. and Zango Kataf L.G.A. to the North, Kauru L.G.A. to the Northeast, and to the East by Riyom L.G.A. in Plateau State. The Local Government Area is subdivided into different

wards for administrative purpose; these includes; Agban, Kukum, Fada, Kpak, Mallagum, Kadarko, Kaura, Manchock, Bondong aand Zankan wards. See Figure 3.1.

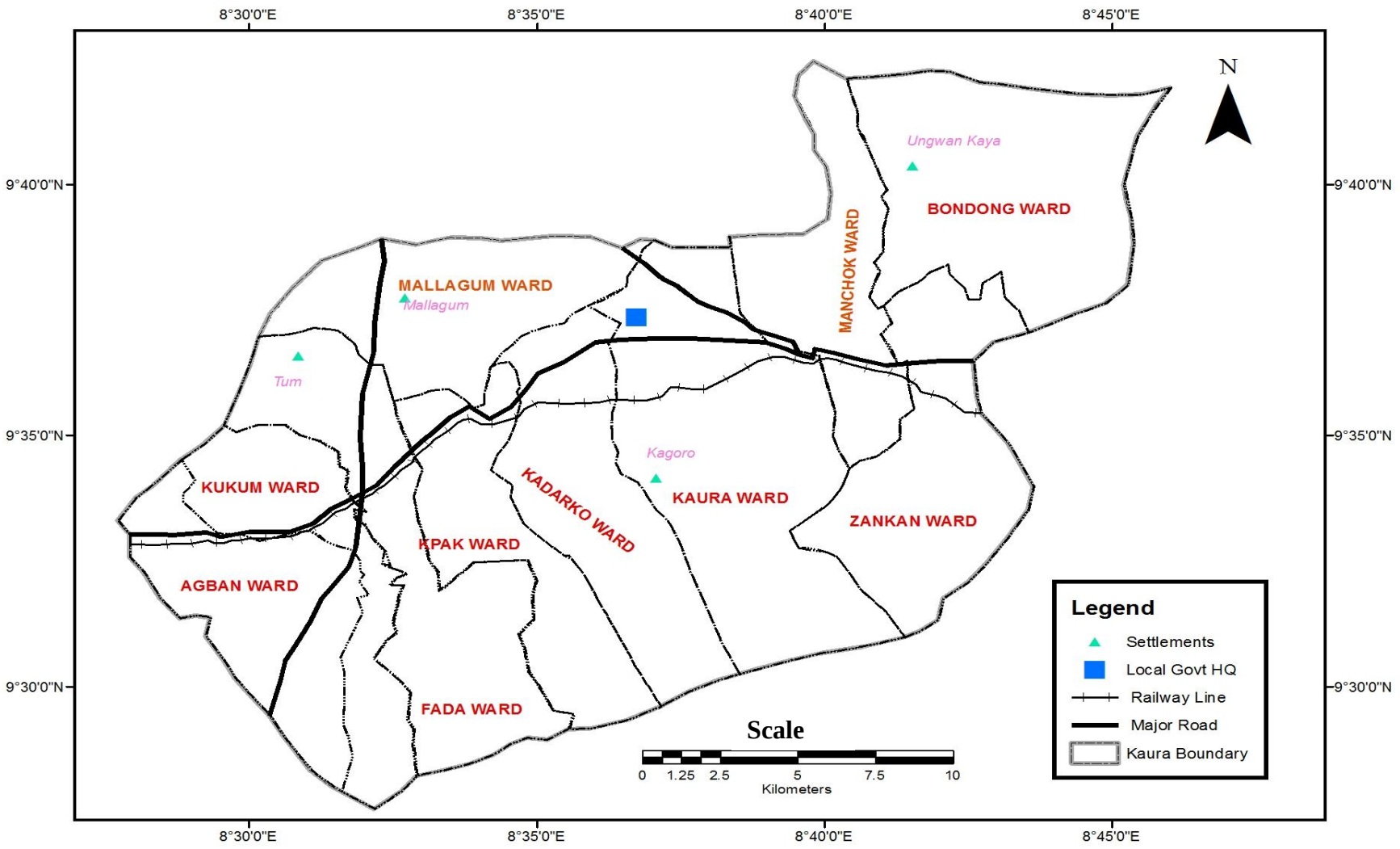


Figure 3.1: Kaura Local Government Area

Source: Modified from Administrative Map of Kaura Local Government Area

3.2.2 Climate

The climate of Kaura Local Government Area is the AW type according to the Koppens classification system (Mugu, 2015). Rainfall is seasonal and moderate with a mean annual amount of 1524 mm. Rainfall usually commences in March and ends in October and for the rest of the year dry season prevails. Temperatures vary between less than 15˚C around December/ January and 32˚C in March and April with its annual mean between 24˚C and 28˚C. The relative humidity varies with the season with highest values in the rainy season and lowest values during the harmattan.The mean annual relative humidity is 57% (Yanet, 2012).

3.2.3 Relief and Drainage

The relief is composed of undulating highlands to average height of about 1,800 m above sea level in the study area. There are two major rivers in the area. These are River Kaduna at the NE of study area and River Assob at the SE. Most of the streams are seasonal. The course of these rivers seems to suggest features of structural significance, aided by fractures normal to direction of regional strike and drains to River Kaduna with its tributary at the north-eastern part of the study area (Yanet, 2012).

3.2.4 Geology

The study area lies within the crystalline hydrogeological province of northern Nigeria belonging to the Younger Granite and Basement Complex suites. These rocks lack primary porosity where groundwater could accumulate for exploitation. For these rocks to store water, therefore there must exist in them secondary porosity, which invariably results from weathering and fracturing (Yanet, 2012).

3.2.5 Soils

The predominant soil parent materials within the area are derived from pre-Cambrian granite gneisses and magmatites of the basement complex but these have been modified by weathering and are frequently overlain by gravel materials probably eroded from further upslope. In other places lateritic iron pan probably formed in late tertiary times and associated concretionary gravels overlie the insitu rocks. In some parts of the area, there are localized deep accumulations of unconsolidated materials which are probably due to mass movement. The surface horizons of many of the soils are sandy which could be explained by biological re-working in materials brought up from the weathering zone by termites and other soil fauna. Due to the marked seasonal rainfall the water table fluctuates and the sandy surface horizon of many of the soils drain rapidly particularly where it is underlain by gravel material (Mugu, 2015).

3.2.6 Vegetation

The study area is situated in the tropics within the Guinea Savannah region. Savanna here is defined as vegetation in which perennial helophytic grasses of at least 80mm high with flat basal and cauline leaves play an important role. Although most of the grasses form tussocks, isolated from one another when fully grown form a more or less continuous layer dominating any lower stratum (Mugu, 2015).

The vegetation consists of broad-leaved savannah woodland and when properly developed, the trees may attain heights of 10-15 m. relatively denser gallery forest occurs along some streams. The dominant trees within are *Isoberlina doka* while *Khaya senegalensis, Danielia oliveri, Perkia* and *Ficus sycomotus* are common. There are abundant grasses with annual types dominating the uplands while the perennial type such as *Hyparrhenia spp* and *Andropogon spp* are also common. Sugarcane and other garden crops, mostly vegetable, are

cultivated along streams courses. The perennial streams in the area sustain such cultivation in the dry seasons via shadoof irrigation systems. Dominant food crops found in the area include root crops e.g. yams and cassava while stem tubers include potatoes. These are sometime intercropped with millet and maize (Yanet, 2012).

3.2.7 Population

The Local Government Area was created on 29th of May, 1989 by the General Ibrahim Babangida's administration, It was carved out of the then Jama'a Local Government Area. The administrative headquarter is located at Kaura, a town situated between Kagoro and Manchok. The 2006 National population and housing census put the population of Kaura LGA at 222,579 people with 115,369 males and 107,210 females. The population is spread over the entire wards of Local Government Area with a 2.5 percentage of growth rate (National Population Commission Gazette, 2007).

3.2.8 Economic Activities

The area is traversed by good roads network which are the Jos –Kagoro Kaduna road that runs East-West. Others are the Kagoro-Kafanchan road, Kagoro –Manchok Jos road and Kagoro- Mabushi road Manchok-Jankasa Mabushi roads. In the central part of the .study area, Rail line traverses from Kafanchan-Kagoro to Jos Terminus in Plateau State (Yanet, 2012). Subsistence agriculture is the major occupation of the inhabitants. Farm produce include; millet, rice, guinea corn, yam, cocoyam, potatoes, cassava, hungry rice, tomatoes, pepper, groundnut, sugarcane, ginger, maize, etc. Fruits available are; mango, orange, banana, grape, pea, pawpaw, date palm, palm fruits, etc., these produce serve as cash crops to the inhabitants. Rearing of livestock, such as goats, pigs, dogs, cattle, chicken, etc. is also carried out on subsistence level.

Commercial facilities available in the area include two major markets which are operated on a weekly basis. The Kagoro market which is operated on Saturdays and the Manchok market operated on Fridays.

3.3 METHODOLOGY

3.3.1 Office Preparatory Stage

At the preparation stage, the researcher acquired and installed appropriate software packages such as ArcGIS 10.1 and other support packages as well as relevant maps of the study area. Acquisition of a Geographic positioning System device, assemblage and review of the relevant literature materials. A reconnaissance survey of the study area was carried out to have an adequate knowledge of the study area. This was embarked upon to pave the way for a detailed field survey

3.3.2 Reconnaissance Survey

A reconnaissance survey of the study area was carried out. It involves the identification and tour of the proposed study facilities. The researcher acquainted himself with the area and facilities as well as interacted with the host community.

3.3.3 Types and Sources of Data

In order to achieve the set objectives of this study, both first hand and documentary sources of data were used, the data used for this research are as follows:

i. List showing the names of all the healthcare facilities and their addresses in the study area was acquired from the Kaura Local Government Health Department, which was used to identify the healthcare facilities for mapping.

ii. Coordinates of each healthcare facility were obtained using the Garmin 76C5X Handheld GPS Receiver, which were overlaid on the map of the study area.

iii. Attribute data which includes healthcare facility name, address, available amenities, and staff strength were collected from the Local Government Health office and the various health care centres and used to develop the database.

iv. The administrative boundary map of Kaura Local Government Area was acquired from Department of Works at the Kaura Local Government Secretariat.

v. Existing literatures from journals, textbooks, conference proceedings, seminar papers, theses, reports and web references.

3.3.4 Data Collection Procedure

The study involved fieldwork in which the healthcare facilities were visited and their geographic coordinates were captured using the Garmin 76C5X Handheld GPS Receiver with an accuracy of 3-5 meters, the locations were picked and stored in the GPS. Field survey was also carried out to conduct an interview using a prepared checklist to collect attribute data of the healthcare facilities. Documentary data were also obtained from different journals, past projects and theses, and the internet.

3.3.5 Techniques of Data Processing

The study acquired a comprehensive list showing the names of all the healthcare centers and their addresses in the study area. This was then copied in Microsoft excel and saved as CSV (comma delimited) format which is recognizable and acceptable to the Arc Catalog extension of Arc GIS. The coordinates of the healthcare centers obtained using the Garmin 76C5X Handheld GPS Receiver as well as the attributes of the facilities acquired during the field exercise were typed in Microsoft excel and saved as CSV (comma delimited) format which is

recognizable and acceptable to the 4ArcCatalog extension of ArcGIS. The administrative boundary map of the study area was scanned and imported into ArcGIS 10.1 for geo-referencing. The map was then converted to Universal Transverse Mercator (UTM) projection system with World Geodetic System (WGS) 84, 32N Minna datum.

Table 3.1 Political Wards and their Respective Population Figures.

Wards	1991 Population	2014 Population Estimate
Agban	17501	34892
Kukum	21715	43293
Fada	28240	56302
Kpak	33254	66298
Mallagum	7097	14149
Kadarko	9111	18165
Kaura	10540	21014
Manchok	15838	31576
Bondong	14940	29786
Zankan	5348	10662
Total	**163584**	**326137**

Source: Adopted from NPC

3.3.6 Data Analysis

A combination of descriptive and overlay analysis were employed in the analysis of the data. The descriptive statistics such as appropriate maps/diagrams and tables were employed to illustrate the distribution of healthcare centers in the study area.

To identify and map healthcare facilities in the study area, the name and address of each healthcare facility was used to identify each facility in the study area. With the aid of Garmin

76C5X Handheld GPS Receiver, the actual coordinates of each facility was captured. The coordinates and other attributes of the healthcare facilities were copied to Microsoft excel and saved as CSV (comma delimited) format, and then imported into ArcGIS 10.1 using the add XY, Command at the tools menu. This overlaid the points (coordinates) on the geo-referenced administrative map of the study area to show the spatial distribution of the healthcare facilities in the area

To analyze the spatial distribution of healthcare centre in the study area, the location of each healthcare centre was used to determine general spatial distribution of healthcare facilities within the administrative wards in the study area. This was done by overlaying the coordinates of the health care facilities on the base map of the study area. This process is referred to as a point on polygon overlay. The Global Moran's I index was used to determine the pattern of distribution of the healthcare facilities.

All the necessary attributes for each healthcare centre were entered into its layer's/theme's attribute table. This was done by adding required number of fields (columns) to the table and entering the data for all the healthcare centers in their corresponding records (rows). Attributes collected included; facility name, address, name of town or ward, district, number of doctors, number of nurses, midwives, community health workers (CHW), drivers, beds, theatres, source of water supply, availability of drugs among others.

The coordinates and attributes were copied to Microsoft Excel and saved as CSV (comma delimited) format which is recognizable and accepted by the ArcCatalog extension of ArcGIS. This file was later imported into Arc Map environment using the add XY, Command at the tools menu. The system can be updated to reflect changes in any healthcare attributes as well as appending more attributes in ArcGIS interface by an authorized ArcGIS application user.

To assess the characteristics of the healthcare facilities, queries were carried out on the database using the query builder. This was done to identify the facilities in the healthcare centers such as the number of doctors, number of nurses, and number of midwives among others.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter focuses on the results obtained from data analysis and discussion of the results. It covers results on the identified existing healthcare centers in Kaura Local Government Area, their spatial distribution and database created as well as the facilities available in the healthcare centers. Kaura Local Government Area is made up of 10 political Wards, and these wards forms the basis for consideration of distribution pattern for healthcare facilities across the study area.

4.2 DISTRIBUTION OF HEALTHCARE FACILITIES IN KAURA LGA.

In this study; a total of 38 Healthcare centers were identified and mapped across the study area. Identifying geographic patterns is important for understanding how geographic phenomena behave. One can get a sense of the overall pattern of features and their associated values by mapping them. The result in Table 4.1 shows that Bondong, Kaura and Zankan ward had the highest number of healthcare centers with a total of 5 healthcare centers each which makes up 13.5% for each. However, in comparison to the population figures it showed a ratio of 1:4202 for Kaura ward, 1:5957 for Bondong ward and 1: 2132 for Zankan ward. The results from the table signifies that Kpak ward with the highest population figure of 66298 persons among the wards but with only 2 healthcare centers has the lowest population to facility ratio of 1:33149. Although it is not beyond the acceptable threshold of 1 facility to 60,000 persons, but the situation signifies that population was not the basis for the location of

Ward	Number of Healthcare Facilities	Percentage (%)	Ward Population	Ratio	Rank
Agban	3	8.1	34892	1:11630	8
Kukum	4	10.8	43293	1:10823	7
Fada	3	8.1	56302	1:18767	9
Kpak	2	5.4	66298	1:33149	10
Kadarko	4	10.8	14149	1:3537	2
Mallagum	3	8.1	18165	1:6055	5
Kaura	5	13.5	21014	1:4202	3

healthcare facilities in the study area. Table 4.1 displays the number of healthcare facilities located in each administrative ward in the Local Government Area compared to the population figures of each ward.

Table 4.1 Distribution of Healthcare Centers in Kaura Local Government Area

Manchok	4	10.8	31576	1:7894	6
Bondong	5	13.5	29786	1:5957	4
Zankan	5	13.5	10662	1:2132	1
Total	**38**	**100**	**326137**		**10**

Source: Field Survey, 2016

A careful consideration of the results in Table 4.1 shows that the distribution of healthcare centers in Kaura Local Government did not take cognizance of the population in the area. A ranking of population to facility across the wards shows that Zankan Ward has a better ranking of 1 with a ratio of 1:2,132 persons per facility and closely followed by Kadarko ward ranking 2 (second position) with a ratio of 1:3537 persons per facility while Kpak is the least in ranking as it is placed in 10^{th} position with a ratio of 1:33,149 persons per facility. Although, the results did not indicate that based on the United Nation standard of 60 persons across $4km^2$ for a healthcare facility there is no ward that exceeded the acceptable population threshold, but in terms of the available equipments and human resources, that may not be the case, as such placing Kpak Ward at a disadvantage in terms of the quality of service rendered. This result is similar to the outcome of the work carried out by Abbas, Auta and Na'iya (2012), which found great spatial unevenness in the distribution of healthcare facilities in

Chikun Local Government Area of Kaduna State. The consequence of this is that marked spatial variation among areas usually creates spatial disparity in the living standard both within and between regions and locations (Madu, 2007). However, this is not a surprise because spatial inequality or inequality in the accessibility of infrastructure within population of a society has existed since the dawn of civilization (Aderamo and Aina, 2011).

4.3 AVAILABLE FACILITIES IN HEALTHCARE CENTRES IN KAURA LOCAL GOVERNMENT AREA

The study identified the healthcare centers in the study area. The geographical coordinates of all the healthcare centers with their corresponding attribute data were collected and a GIS-Database was generated and was presented based on the administrative wards in the LGA as displayed in Appendix II.

The categorization of the healthcare centers shows that Kaura Rural Hospital is the only Secondary Healthcare facility which is meant to offer secondary healthcare services for referral patients in the area as all the remaining 37 serve as primary healthcare centers serving as first contact for healthcare services which are by far limited in their capacity to offer any form of advance healthcare services to the teeming population of the area while some of them do not have the adequate capacity of a primary healthcare in terms of equipments and human resource. Figure 4.1 gives a visual pattern of distribution of the healthcare centers among the various wards in the study area.

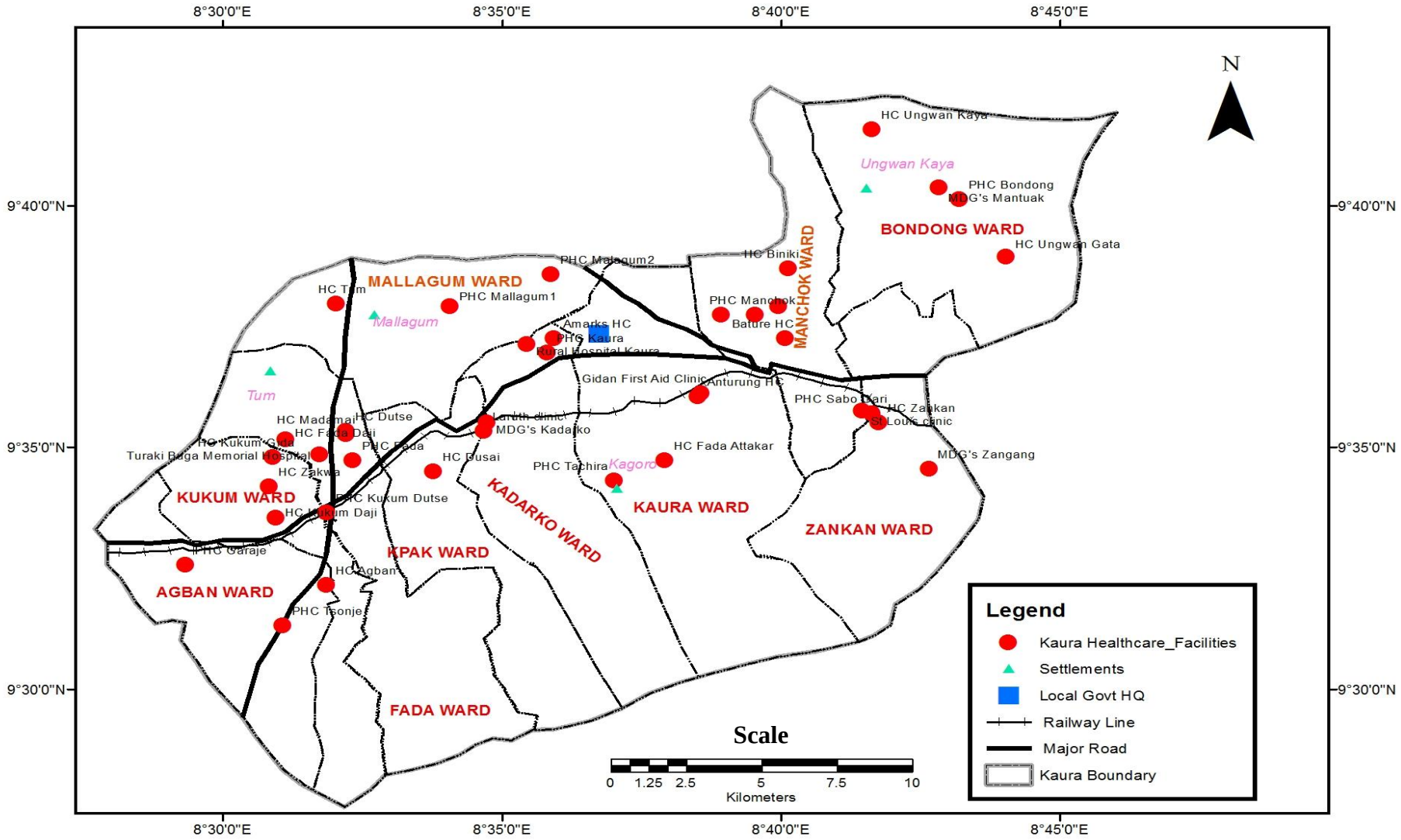


Figure 4.1: Spatial Distribution of Healthcare Facilities across Political Wards in Kaura LGA

Source: Author's Analysis, 2016

From the results obtained in Appendix II (database), it also reveals that in all the healthcare centers, there are only 6 medical doctors in the entire local government area, with Rural Hospital Kaura boasting of 2 which makes up 33.3 percent of the medical doctors in the study area while Amaks Healthcare Centre Kankwot, TBMH Kpak, DM and DC Manchok and Manco Clinic Manchok boasting of 1 doctor each constituting 16.7 percent respectively. The database also reveals that there are only 2 healthcare centers that enjoy the services of a consultant, Amaks Healtcare Centre Kankwot and Bature Healthcare Centre Manchok having 1 consultant each. There are 42 nurses in the study area with only 4 healthcare centres having more than 2 nurses; PHC Tachira and HC Dusai have 3 each accounting for 7.1 percent each, TBMH Kpak have 7 nurses making up 16.7 percent, with Rural Hospital Kaura having the highest figure of 10 which constitute a total of 23.8 percent of the available nurses in the study area. It is important to note that 19 (50 percent) of the healthcare facilities in the study area do not even have a nurse.

The study area boasts of 28 midwives across the 38 healthcare centres, while some have more than 1 others have none. Only Rural Hospital Kaura and TBMH Kpak can boast of 7 midwives each which is about 25 percent respectively. Also, HC Zakwa and PHC Manchok both have 3 each constituting 10.7 percent respectively, while 28 of these healthcare centers in the study area accounting for 73.7 percent do not enjoy the services of a midwives as they do not have one. Based on this study, it reveals that one doctor services an average of 54,356 persons in this study area. This phenomenon suggests that there is an overburden of healthcare infrastructure in the study area and confirms the findings of Ujoh and Kwagshende, (2014), that some communities are in disadvantaged positions while others are advantageous in terms of number of healthcare resources. The consequence is that many individuals and families in the most vulnerable communities cannot attain minimum

standards of living due to very poor access to supportive health facilities. Thus, the situation presents a discernible imbalance in the relationship between population and number of health care facilities. The observed deficiency in the distribution of health facilities in the study area is counterproductive towards poverty alleviation.

4.3.1 Medical Doctors

Medical doctors are an essential an integral part of any healthcare facility; they are the soul in quality healthcare delivery. The quality of healthcare services in any healthcare centre to a great extent relies on the availability of doctors manning those facilities. It is actually pathetic to note that many of the healthcare centers in this area do not have doctors as they are manned by nurses and in some cases community health workers (CHW). Table 4.2 gives the distribution of Medical Doctors in Kaura Local Government Area of Kaduna state.

Table 4.2: Distribution of Medical Doctors across the Wards in Kaura LGA

Ward	Population	Doctors	Percentage (%)	Ratio
Agban	34892	0	0	0:34,892
Kukum	43293	0	0	0:43,293
Fada	56302	0	0	0:56,302
Kpak	66298	1	16.7	1:66,298
Kadarko	14149	0	0	0:14,149
Mallagum	18165	0	0	0:18,165
Kaura	21014	3	50	1:7,004
Manchok	31576	2	33.3	1:15,788
Bondong	29786	0	0	0:29,786
Zankan	10662	0	0	0:10,662
Total	**326137**	**6**	**100**	

Source: Field Survey, 2016

Results in Table 4.2 shows that the number of Doctors in the study area is poor with only six (6) Medical Doctors servicing a population of 326,137 persons across a total area of 485 km^2

in a time where healthcare challenges are becoming more complex as population continues to expand. The results shows that only 3 out of the 10 wards actually enjoy the services of a Medical Doctor, with Kpak Ward having 1 Medical Doctor (16.7%) of available medical doctors in the area, Manchok Ward is immediately behind with 2 doctors (33.3 %) while Kaura Ward has the highest with 3 Medical Doctors which accounts for 50% of Doctors in the area. In terms of Doctor to population ratio, Kaura Ward enjoys a better ratio of 1 Doctor to 7,004 persons followed by Manchok Ward with a ratio of 1:15,788 persons with Kpak ward having a ratio of 1:66,298 persons. Unfortunately, 7 out of the 10 political wards in the study area do not even have a Doctor. The consequence of this scenario is likely to be overcrowding and lack of detailed attention to patient. This confirms the findings of Ujoh and Kwagshende (2014) that the implications of the mal-distribution of healthcare facilities manifest in overcrowding and consequent lack of proper attention to patients as well as poor service delivery since the quality of services rendered is related to the level of manpower available.

4.3.2 Facilities with and Without Doctors

A query performed for healthcare centers with and without the services of Medical Doctors was carried out as shown in appendix III revealed that Rural Hospital Kaura which happens to be the only secondary facility in the area is the only facility with 2 doctors which is the highest figure for a single facility in the area, with Amarks Healthcare Centre having 1 Medical doctor; these are all located in Kaura Ward. Turaki Buga Memorial Hospital, Deki Medicals and Diagnostic and Manco Clinic all have 1 medical doctor each. A query of the database for healthcare facilities without a doctor was carried out as shown in Appendix IV. The query shows that there are 35 healthcare centers with no doctor services in the area. This means in an emergency case where a doctor’s expertise is needed these centers cannot

provide the required healthcare service. Figure 4.2 shows a distribution of healthcare facilities with Medical Doctors as well as those without the services of Medical Doctors in the area.

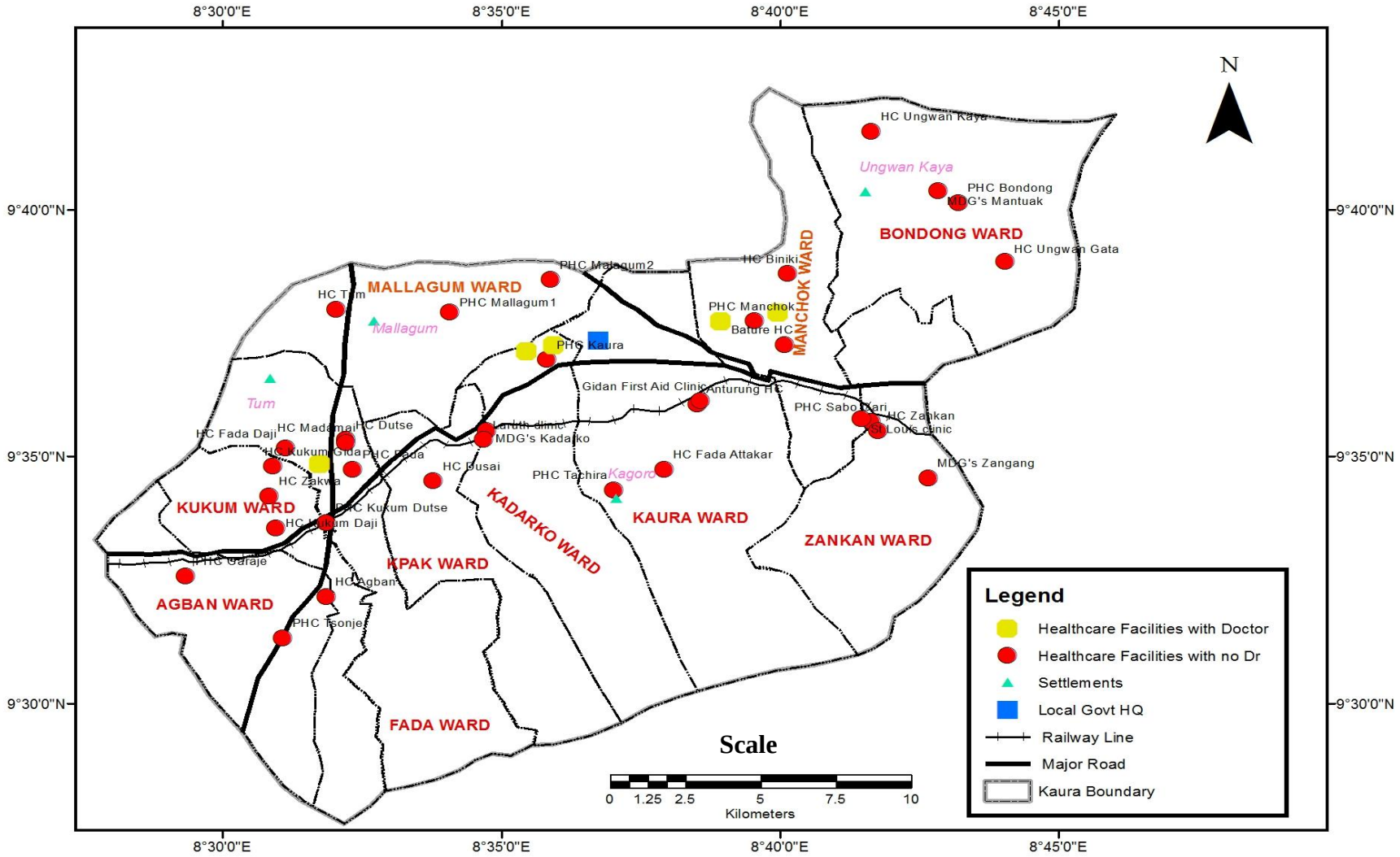


Figure 4.2: Healthcare Facility with and without Doctors in Kaura LGA

Source: Author's Analysis, 2016

4.3.3 Nurses

Nurses are an integral component of an effective and efficient healthcare system and healthcare delivery is almost impossible without the nurses. They provide the detailed care in the healthcare system. Nurses are required to give proper care and attention to patients to aid their recovery and report to the doctors the condition of the patients. The size of nurses in any healthcare reflects the level of care a patient is likely to receive. Table 4.3 gives the distribution of nurses across the 10 wards in Kaura Local Government Area.

Table 4.3: Distribution of Nurses across the Political Wards in Kaura LGA

Ward	Population	Nurse	Percentage (%)	Ratio
Agban	34892	2	4.8	1:17,466
Kukum	43293	3	7.1	1:14,431
Fada	56302	2	4.8	1:28,151
Kpak	66298	7	16.7	1:9,471
Kadarko	14149	7	16.7	1:2,021
Mallagum	18165	2	4.8	1:9,083
Kaura	21014	14	33.3	1:1,501
Manchok	31576	1	2.4	1:31,576
Bondong	29786	1	2.4	1:29,786
Zankan	10662	3	7.1	1:3,554
Total	**326137**	**42**	**100**	

Source: Field Survey, 2016

From the results in Table 4.3; Manchok and Bondong Wards had the least number of Nurses with a nurse to population ratio of 1:31,576 and 1:29,786 respectively. Kadarko has a ratio of 1:2,021; Zankan is having 1:3,554 while Kpak Ward has a ratio of 1:9,471. Kaura Ward has

the best Nurse to population ratio of 1:1,501. Figure 4.3 gives the spatial distribution of health care facilities with and without Nurses in Kaura Local Government Area.

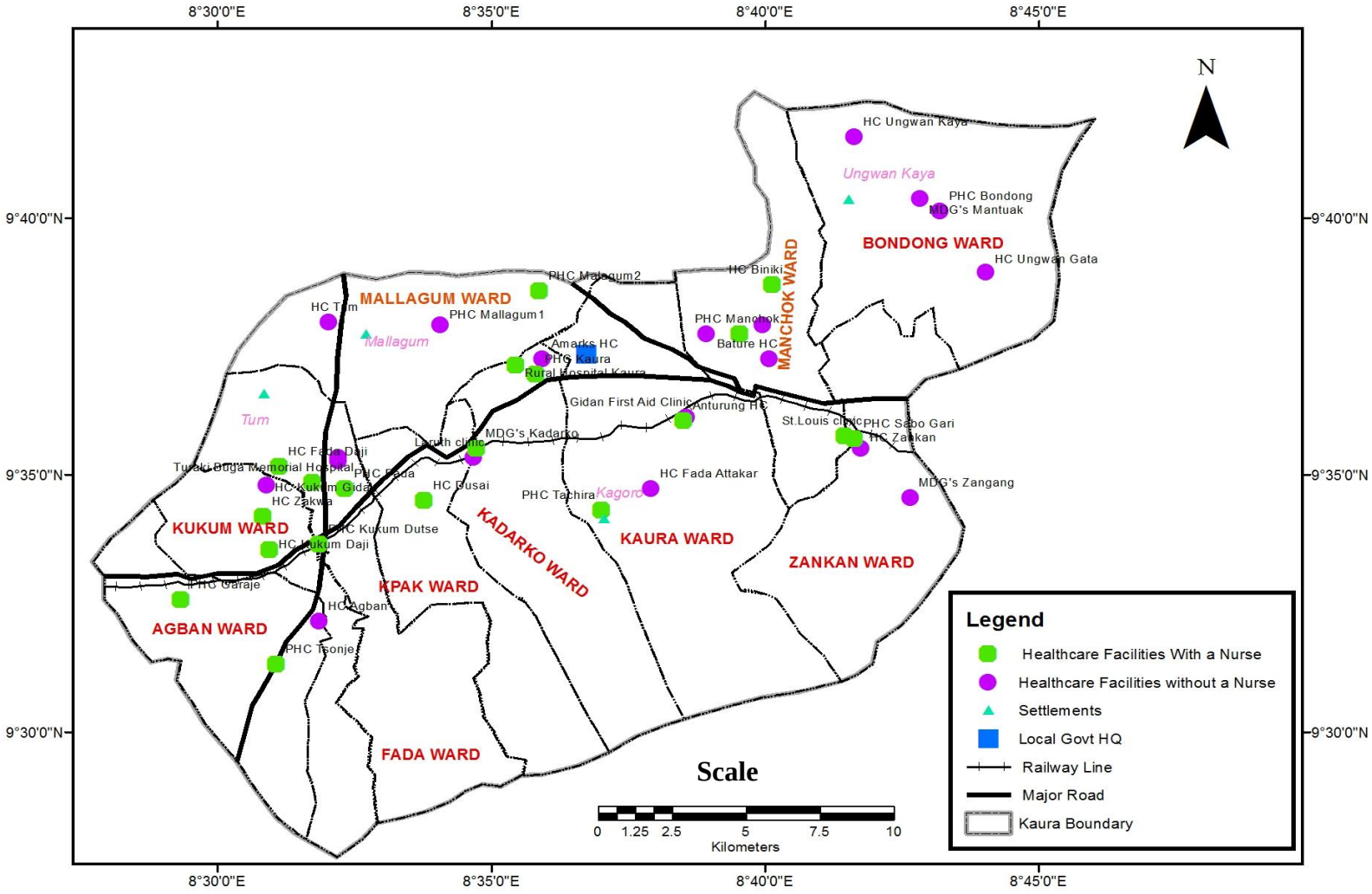


Figure 4.3: Healthcare Facility with and without Nurses in Kaura LGA

Source: Author's Analysis, 2016

4.3.4 Healthcare Facilities with and Without Nurses in Kaura LGA

Appendix V is a query generated from the database; it shows that only 20 of the 38 healthcare centers that have the services of Nurses in the study area. Considering the essential services given by Nurses in any healthcare center, it is disheartening to see that 19 of the healthcare facilities in the study area do not have a Nurse to provide care to patients. This is very surprising and speaks volume of the quality of healthcare provided in these facilities.

4.3.5 Midwives

Maternal healthcare has been a serious concern in this generation as it is responsible for a large number of deaths especially among pregnant women. The challenge for safe delivery and welfare of mother and child has made anti natal and post natal care very paramount. Also many deaths have been attributed to poor care and attention from midwives who are specially trained to assist in the handling of births. The importance of this group is enormous as Nigeria struggle to reduce to the barest minimum the incidence of maternal mortality. Table 4.4 shows the distribution of midwives population in the 10 Wards.

Table 4.4: Distribution of Midwives across the Political Wards in Kaura LGA

Ward	Population	Midwives	Percentage (%)	Raito
Agban	34892	1	3.6	1:34,892
Kukum	43293	4	14.3	1:10,823
Fada	56302	2	7.1	1:28,151
Kpak	66298	7	25	1:9,4761
Kadarko	14149	1	3.6	1:14,149
Mallagum	18165	2	7.1	1:9,083
Kaura	21014	7	25	1:3,002
Manchok	31576	3	10.7	1:10,525
Bondong	29786	0	0	0:29,786
Zankan	10662	1	3.6	1:10,662
Total	**326137**	**28**	**100**	

Source: Field Survey, 2016

Table 4.4 indicates that Bondong Ward with a population of 29,786 has no midwife while Agban, Kadarko and Zankan Wards with a population of 34,892; 14,149; and 10,662 respectively boast of 1 midwife each with a ratio of constitute only 3.6 percent respectively. Fada and Mallagum Wards have a population of 56,302 and 18,165 respectively actually have 2 midwives personnel each, Manchok Ward with a population of 3,576 has 3 midwives. Kukum ward with a population of 43,293 lies second with 4 midwives with Kpak and Kaura Wards having 7 midwives each with a population of 66,298 and 21,014 persons respectively. In terms of Midwives to population ratio, Kaura ward has the best ratio of 1:3,002, followed by Mallagum Ward and Kpak Ward with a ratio of 1:9,083 and 1:9,476 respectively. Agban ward has a ratio of 1:34,892 only better than that of Bondong ward with 0:29,786.

4.3.6 Pharmacist

The pharmacists play a vital in achieving a comprehensive healthcare delivery as they ensure the administration of prescribed drugs at the right dosage to the patients. Table 4.5 gives the distribution of Pharmacists by political wards and in terms of resources to population ratio.

Table 4.5 Distribution of Pharmacist by Political Wards in Kaura LGA

Ward	Population	Pharmacist	Percentage (%)	Ratio
Agban	34892	0	0	0:34,892
Kukum	43293	0	0	0:43,293
Fada	56302	0	0	0:56,302
Kpak	66298	1	25	1:66,298
Kadarko	14149	0	0	0:14,149
Mallagum	18165	0	0	0:18165
Kaura	21014	3	75	1:7,004
Manchok	31576	0	0	0:31,576
Bondong	29786	0	0	0:29,786
Zankan	10662	0	0	0:10,662

Total	**326137**	**4**	**100**

Field Source Survey 2016

It is one aspect of healthcare that has not received the required attention in the Nigerian healthcare system. It is disheartening to note that there are only 4 pharmacists in the entire healthcare system in Kaura Local Government Area as shown in figure 4.5. Kpak ward with a population of 66,298 persons has 1 pharmacist constituting 25 percent of the total number of pharmacists in the study area while Kaura ward with a population of 21,014 persons boast of 3 pharmacist constituting 75 percent of the entire pharmacists in the study area. The issue is that in all the healthcare centers it is obvious that drug administration is not done by pharmacists.

4.3.6 Ward Attendants

The healthcare system in Kaura Local Government area has 88 ward attendants across the 10 political wards in the area. Ward attendants are vital components of the healthcare system. They are in charge of management in the ward as they look after the livability of the ward and ensure that the place is in order for efficient healthcare delivery. Table 4.6 gives the spatial distribution of ward attendants across the 10 political wards.

Table 4.6: Distribution of Ward Attendants by Political Wards in Kaura LGA

Ward	Population	W/Attendants	Percentage (%)	Ratio
Agban	34,892	7	8	1:4,985
Kukum	43,293	7	8	1:6,185
Fada	56,302	6	6.8	1:9,384
Kpak	66,298	4	4.5	1:16,575
Kadarko	14,149	11	12.5	1:1,286
Mallagum	18,165	9	10.2	1:2,018
Kaura	21,014	22	25	1:955
Manchok	31,576	9	10.2	1:3,508
Bondong	29,786	8	9.1	1:3,723
Zankan	10,662	5	5.7	1:2,134
Total	**326137**	**88**	**100**	

Source: Field Survey 2016

From the figures available in Table 4.6, it shows that Kpak ward has the least number of Ward Attendants as it has only 4 with a ratio of 1:16,575, Fada Ward is next in lower ranking with 6 Ward Attendants, a population of 56,302 and a ratio of 1:9,384. This is closely followed by Kukum Ward with 7 personnel and a population of 43,293 persons which gives a ratio of 1:6,185, while Agban Ward also has 7 Ward Attendants and a population of 34,892 and personnel to population ratio of 1:4,985. Kaura ward has 22 Mid Wives personnel and a population of 21,014 thus enjoys a better ratio of 1:955. Kaura enjoys a higher advantage because of its strategic location as the local government headquarters and also housing the only secondary healthcare center in the area.

4.3.6 Community Health Workers (CHW)

Kaura Local Government Area healthcare system consists of 118 community health workers. Community health workers are mostly associated with primary healthcare centers. Table 4.7 displays the distribution of Community Health Workers in Kaura Local Government Area.

Table 4.7: Community Health Workers (CHW) in Kaura Local Government Area

Ward	Population	CHW	Percentage (%)	Ratio
Agban	34892	10	8.5	1:3,489
Kukum	43293	6	5.1	1:7,216
Fada	56302	13	11	1:4,330
Kpak	66298	9	7.6	1:7,366
Kadarko	14149	26	22	1:544
Mallagum	18165	8	6.8	1:2,271
Kaura	21014	14	11.9	1:1,501
Manchok	31576	13	11	1:2,429
Bondong	29786	12	10.1	1:2,482
Zankan	10662	7	5.9	1:1,523
Total	**326137**	**118**	**100**	

Source: Field survey, 2016

The figures in Table 4.7 shows that Kukum ward with a population of 34,892 persons has only 6 community health workers contributing a total of 5.1 percent and it is the least among the wards. Zankan is next with 7 community health workers contributing 5.9 percent of the midwives personnel while boasting of a population of 10,662 persons. Mallagum ward has a population of 18,165 persons with only 8 community health workers making about 6.8 percent while Kpak ward with a population of 66,298 has 9 community health workers accounting for 7.6 percent. Agban ward with a population of 34,892 persons has 10 community health workers constituting 8.5 percent; Bondong ward has 12 community health workers and contributes 10.1 percent; Manchok and Fada wards with populations of 31,576 and 56,302 persons have 13 each constituting 11 percent respectively. Kaura ward has 14 and a percentage contribution of 11.9 with a population of 21,014 persons while Kadarko boast of the highest number of community health workers with a total of 26 personnel and a percentage of 22 while it has a population of 14, 149 persons. In terms of the ratio of Community Health Workers to population, Kadarko Ward with 22 personnel enjoys a better

ratio of 1:544 immediately followed by Kaura Ward with a ratio of 1:1,501 while Zankan Ward has a ratio of 1:1,523. Kpak and Kukum Wards have the lowest ratio index with a ratio of 1:7,366 and 1:7,216 respectively. The implication here is that Kadarko and Kaura Ward are likely to have prompt and better services with regards to community health services which may be opposite in the case of Kadarko and Kaura Ward considering the personnel to population ratio.

4.5.7 Hospital Wards

There are 66 wards across 38 healthcare centers in Kaura Local Government Area of Kaduna state. These 66 wards house all the patients that have patronized these healthcare centers. The wards are necessary as it provides a form of segregation for patients of similar cases to receive treatment, care and attention. Table 4.8 gives the distribution of the Healthcare wards in the healthcare centers in Kaura Local Government Area as distributed among the 10 political wards in the area.

Table 4.8: Healthcare Wards in Kaura Local Government Area

Ward	Population	H /Wards	Percentage (%)	Ratio
Agban	34892	6	9.1	1:5,815
Kukum	43293	9	13.6	1:4,810
Fada	56302	4	6.1	1:14,076
Kpak	66298	4	6.1	1:16,575
Kadarko	14149	9	13.6	1:5,572
Mallagum	18165	5	7.6	1:3,633
Kaura	21014	10	15.2	1:2,101
Manchok	31576	11	16.7	1:2,870
Bondong	29786	4	6.1	1:7,447
Zankan	10662	4	6.1	1:2,666
Total	**326137**	**66**	**100**	

Source: Field Survey, 2016

Looking at Table 4.8; Fada, Bondong, Kpak and Zankan political wards have only 4 medical wards each amounting to 6.1 percent respectively. Mallagum ward has 5 constituting 7.6 percent of the total medical wards in the study area with Agban ward having a higher value of 6 and contributing 9.1 percent. Kukum and Kadarko wards are tie with 9 medical wards which accounts for 13.6 percent, Kaura ward boast of 10 medical wards and contributing 15.2 percent while Manchok ward has the highest value of 11 wards across 4 healthcare centers which contribute 16.7 percent of the total percentage of medical wards in the area. In terms of the healthcare ward to population ratio in the study area; Kaura ward enjoys a better ratio of 1:2,101 and closely followed by Zankan and Manchok Wards with a ratio of 1:2,666 and 1:2,870 respectively. The result shows Kpak and Fada Wards to have a poor ratio of 1:16,575 and 1:14,076 respectively.

4.5.8 Hospital Beds

Hospital beds are essential components of the healthcare system as they provide rest and opportunity to admit, attend and monitor patients. Without hospital beds, patients cannot be admitted at the hospital and as such making the whole situation messy and complicated. Table 4.9 is the distribution of Hospital beds across the political wards in the study area.

Table 4.9: Distribution of Hospital Beds across Political Wards in Kaura LGA

Ward	Population	Beds	Percentage (%)	Ratio
Agban	34892	10	5.6	1:3,489
Kukum	43293	20	11.3	1:2,165
Fada	56302	10	5.6	1:6,630
Kpak	66298	8	4.5	1:8,287
Kadarko	14149	32	18.1	1:442
Mallagum	18165	15	8.5	1:1,211

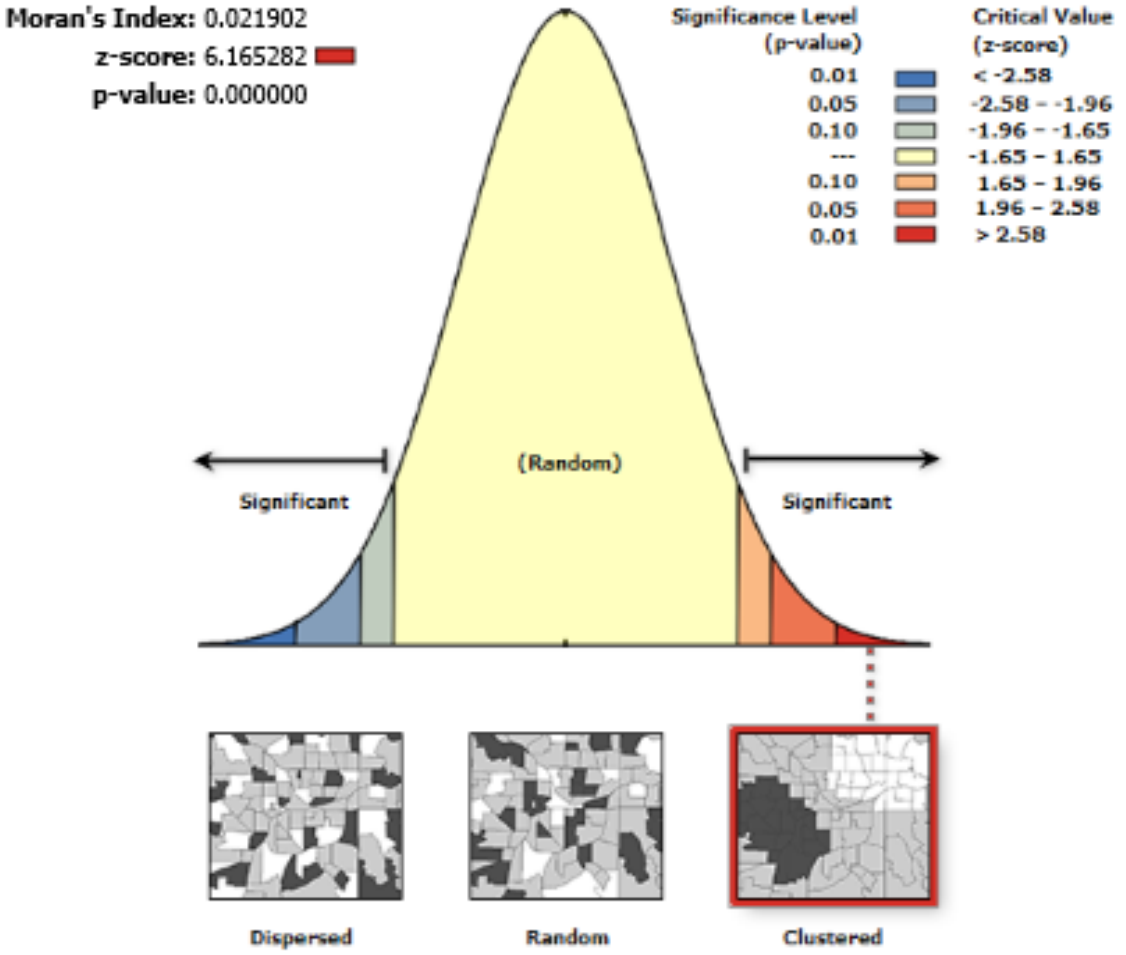
Kaura	21014	44	24.9	1:478
Manchok	31576	15	8.5	1:2,105
Bondong	29786	17	9.6	1:1,752
Zankan	10662	6	3.9	1:1,777
Total	**326137**	**177**	**100**	

Source: Field Survey, 2016

Results in Table 4.9 clearly shows that Kadarko ward with 32 hospital beds and 14,149 populations has a ratio of 1:478 which is the best in the study area. This is closely followed by Kaura with a facility to population ratio of 1:478. Zankan ward has the least number of beds with just 6 for its 10,662 population but has a ratio of 1:1,777 which is not the worst in the area. Fada ward has the lowest ranking in terms of the ratio as it has a ratio of 1:8,278.

4.4: SPATIAL PATTERN OF HEALTHCARE FACILITIES IN KAURA LGA

Figure 4.4 shows the spatial pattern of distribution of the healthcare facilities in the study.



Given the z-score of 6.17, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Global Moran's I Summary

Moran's Index:	0.021902
Expected Index:	-0.026316
Variance:	0.000061
z-score:	6.165282
p-value:	0.000000

Figure 4.4: Distribution Pattern of Healthcare Centres in Kaura LGA

Figure 4.4 shows the spatial pattern of distribution of the healthcare facilities in the study. From the result obtained, given the z-score at 6.17 means that there is a clustered pattern of distribution of the healthcare centres in Kaura Local Government Area of Kaduna State. This means that the facilities tend to cluster within a particular area in the settlement. This is true because their existence is determined by the presence of population. Also, since many of them are privately owned and market driven, they are located in business areas where population concentration is high.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents the summary of the major findings of this study. The conclusions drawn from the findings and the recommendations made were also presented in this chapter.

5.2 SUMMARY OF FINDINGS

Location 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. Over the years government has been criticized for failure to locate health institutions according to the population distribution of the urban area. Public healthcare institutions should be cited where they can easily be accessed by the population they serve. Inability to ensure this has caused most of the healthcare facilities to be either underutilized or over burdened because of their spatial location. Given the aim of this research; which is the analysis of healthcare facilities and human resources in Kaura Local Government Area of Kaduna state using Geographic information system. The study identified and located 38 healthcare centers in the study area, of which Rural Hospital Kaura is the only secondary health centre while the remaining 37 provides mostly primary healthcare services. The study also successfully mapped out all healthcare centers and displayed their spatial location over the entire study area. The findings in this research show that the healthcare facilities did not take cognizance of population as they are distributed without any special consideration.

From the analysis it shows that there is a clustered pattern of distribution of healthcare facilities in the study area, in terms of distribution there exist significant levels of disparity between the various wards. This was brought into cognizance by finding the ratio of available

healthcare centers in each ward to its entire population to be served. The results revealed a poor ratio of facility and resources to population thus suggesting high rate of inadequacy in of both human and physical resources in the study area. The research findings showed that the distribution of the healthcare centers and especially resources has placed many of the wards in disadvantaged based on the number of personnel services available to them. Therefore in terms of spatial distribution of the healthcare centers available in the entire study area, there exist inequalities among the wards in the study area.

5.3 CONCLUSIONS

Generally, the quality of healthcare delivery received bears direct relevance to the wealth and welfare of every society and also has a corresponding impact on the productivity of that population and its contribution to the development of its geographical territory. The study has conclusively shown that there is inequality in the distribution of the healthcare centers facilities in the wards that makes up the study area and most of the centers are characterize by poor man power. This research therefore concludes that the healthcare facilities in Kaura Local Government Area are not evenly distributed and population ratio was never considered in the build up to setting of these facilities. Also, the state of these healthcare facilities in terms of physical and human resources cannot address the current complex challenges and the population in the area.

5.4 RECOMMENDATIONS

The following recommendations were made based on the findings of this study:

i. There exist a high degree of inequality in the spatial distribution of healthcare centers; infrastructure and man power as observed in the 10 wards, this can be adequately addressed by providing additional healthcare centers taking into cognizance the

population structure of the wards to make up the shortfalls in the existing distribution pattern noted in the study area.

ii. The Kaduna state ministry of health as well as the Kaura Local Government Health Department should ensure a periodic visitation and inspection of existing healthcare centers both public and privately owned and there should be the enforcement of minimum standard and requirements.

iii. Many of the healthcare centers provide primary healthcare services but lack the basic facilities for primary healthcare delivery; there is a need for the government to upgrade its own healthcares to include basic facilities such as portable water supply, healthy toilet facilities among many others while the privately owned should operate on a government approved basic standard or shut down.

iv. This study should be replicated in other Local Government's Areas of the states so as to come up with a comprehensive GIS-database that will help give a clearer picture of the true quality of public healthcare in the state.

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Appendix I: CHECKLIST

Department of Geography
Faculty of Science
Ahmadu Bello University, Zaria.

Dear Respondent,

I am a student of the above named Institution carrying out a research work on the topic " Mapping and database creation of healthcare facilities in Kaura local government area of Kaduna state using GIS" as a fulfillment of the requirement for the award of Master Degree in Remote Sensing and GIS.

The outlined questions below are for you to accurately and sincerely answer them as required, as this will enable me to efficiently carry out this research as expected. All responses are strictly for this research work and remained highly confidential.

Thanks for your cooperation.

Yours sincerely,

Sylvester Nkut Bonet.

QUESTIONNAIRE

Only tick the relevant box [ ], and write information where necessary, fill in the space provided.

Date of interview: Day----------Month--------20------

Name of Village----------Ward----------

District----------Chiefdom----------

Name of healthcare center----------Location----------

SECTION: A

HEALTHCARE PERSONNEL AND FACILITIES SURVEY

Man power

1. Number of Doctors----------
2. Number of Consultants----------

3. Number of Nurses----------
4. Number of Midwifes----------
5. Number of Lab. Scientist----------
6. Number of Lab Technicians.----------
7. Number of Pharmacist----------
8. Number of Pharmacists Technician----------
9. Number of Radiologist----------
10. Number of Radiographers----------
11. Number of X-ray technicians----------
12. Number of Dental technologist----------
13. Number of Dental Technicians----------
14. Number of Ward Attendants----------
15. Number of Drivers----------
16. Others (Specify please)----------

Facilities

1. Number of Wards----------
2. Number of Beds----------
3. Number of Theatres----------
4. Water Supply—(a) Adequate[ ] (b) Inadequate [ ]
5. Number of Maternity beds----------
6. Number of Delivery rooms----------
7. Number of Ambulance(s) ----------

Appendix II: DATABASE OF HEALTHCARE FACILITIES IN KAURA LGA

Table

Healthcare Facilities

FID	Shape *	Facility	Town_Villa	ward	District	Chiefdom	Northing	Easting	doctors	No_of_Con	Nurses	Midwives	No_of_scty	No_lb_scie	No_lb_tch	No_phrm	No_
0	Point	HC Agban	Agban	Agban	Agban	Kagoro	9.536	8.531	0	0	0	0	2	0	1	0	
1	Point	PHC Garaje	Garaje	Agban	Agban	kagoro	9.543	8.489	0	0	1	1	2	1	1	0	
2	Point	PHC Tsonje	Tsonje	Agban	Agban	kagoro	9.522	8.518	0	0	1	0	0	0	0	0	
3	Point	PHC Bondong	Bondong	Bondong	Bondong	Maro'a	9.669	8.72	0	0	0	0	0	0	0	0	
4	Point	HC Biniki	Biniki	Bondong	Biniki	Maro'a	9.645	8.669	0	0	1	0	0	0	0	0	
5	Point	HC Ungwan Kaya	Ungwan Kaya	Bondong	Mantuak	Maro'a	9.693	8.694	0	0	0	0	1	0	0	0	
6	Point	HC Ungwan Gata	Ungwan Gata	Bondong	Bondong	Maro'a	9.649	8.734	0	0	0	0	0	0	0	0	
7	Point	MDG's Mantuak	Mantuak	Bondong	Mantuak	Maro'a	9.673	8.714	0	0	0	0	1	1	0	0	
8	Point	PHC Fada	Fada	Fada	Fada	Kagoro	9.579	8.539	0	0	1	2	4	0	1	0	
9	Point	HC Fada Daji	Fada Daji	Fada	Fada Daji	Kagoro	9.586	8.519	0	0	1	0	2	0	0	0	
10	Point	HC Dutse	Dutse	Fada	Fada	Kagoro	9.589	8.537	0	0	0	0	1	0	0	0	
11	Point	PHC Tachira	Tachira	kadarko	Fada Attakar	Takad	9.572	8.617	0	0	3	0	2	1	1	0	
12	Point	HC Dusai	Dusai	Kadarko	Kadarko	kagoro	9.575	8.563	0	0	3	1	1	1	1	0	
13	Point	MDG's Kadarko	Kadarko	Kadarko	Kadarko	kagoro	9.592	8.579	0	0	1	0	1	1	1	0	
14	Point	Laruth clinic	Kadarko	Kadarko	Kadarko	Kagoro	9.589	8.578	0	0	0	0	1	0	1	0	
15	Point	Rural Hospital Kaura	Kaura	Kaura	Kaura	Maro'a	9.619	8.591	2	0	10	7	9	3	4	2	
16	Point	Anturung HC	Anturung	Kaura	Aturung	Takad	9.601	8.642	0	0	2	0	0	0	0	0	
17	Point	Gidan First Aid Clinic	Anturung	Kaura	Anturung	Maro'a	9.602	8.643	0	0	0	0	0	0	0	0	
18	Point	Amarks HC	Kankwot	Kaura	Kaura	Maro'a	9.621	8.599	1	1	0	0	1	0	0	1	
19	Point	PHC Kaura	Kaura	kaura	Kaura	Maro'a	9.616	8.597	0	0	2	0	1	0	0	0	
20	Point	Turaki Buga Memorial Hospital	Kpak	Kpak	Kpak	Kagoro	9.581	8.529	1	0	7	7	3	0	5	1	
21	Point	HC Madamai	Madamai	Kpak	Kpak	Kagoro	9.588	8.537	0	0	0	0	1	0	0	0	
22	Point	PHC Kukum Dutse	Kukum Dutse	Kukum	Kukum	Kagoro	9.561	8.531	0	0	1	1	1	0	1	0	
23	Point	HC Kukum Daji	Kuku Daji	Kukum	Kukum	Kagoro	9.559	8.516	0	0	1	0	0	0	0	0	
24	Point	HC Kukum Gida	Kukum Gida	Kukum	Kukum	Kagoro	9.58	8.515	0	0	0	0	1	1	1	0	
25	Point	HC Zakwa	Zakwa	Kukum	Kukum	Kagoro	9.57	8.514	0	0	1	3	0	0	0	0	
26	Point	PHC Mallagum1	Malagum1	Malagum	Malagum1	Kagoro	9.632	8.568	0	0	0	0	2	0	0	0	
27	Point	PHC Malagum2	Malagum2	Malagum	Malagum2	kagoro	9.643	8.598	0	0	2	2	1	1	0	0	
28	Point	HC Tum	Tum	Malagum	Tum	Kagoro	9.633	8.534	0	0	0	0	2	1	1	0	
29	Point	Daki Medical & Diagnostic	Manchok	Manchok	Manchok	Maro'a	9.629	8.649	1	0	0	0	1	0	1	0	
30	Point	Manco clinic	Manchok	Manchok	Manchok	Maro'a	9.632	8.666	1	0	0	0	2	1	0	0	
31	Point	Bature HC	Manchok	Manchok	Manchok	Maro'a	9.621	8.668	0	1	0	0	0	0	0	0	
32	Point	PHC Manchok	Manchok	Manchok	Manchok	Maro'a	9.629	8.659	0	0	1	3	2	0	3	0	
33	Point	PHC Sabo Gari	Sabo Gari	Zankan	Zankan	Maro'a	9.595	8.694	0	0	1	0	1	1	0	0	
34	Point	HC Zankan	Zankan	Zankan	Zankan	Maro'a	9.592	8.696	0	0	0	1	1	1	1	0	
35	Point	HC Fada Attakar	Fada Attakar	Zankan	Fada Attakar	Takad	9.579	8.632	0	0	0	0	1	1	1	0	
36	Point	MDG's Zangang	Zankan	Zangang	Zankan	Takad	9.576	8.711	0	0	0	0	0	0	0	0	
37	Point	St.Louis clinic	Zankan	Zankan	Mifi	Takad	9.596	8.691	0	0	2	0	0	0	0	0	

1 (39 out of 39 Selected)

Healthcare Facilities | Export_Output_5.database | Healthcare Facilities with 2doc | Healthcare Facilities with no dr

Appendix III: HEALTHCARE CENTERS WITH DOCTORS

FID	Shape *	Facility	Town_Villa	ward	District	Chiefdom	Northing	Easting	doctors
15	Point	Rural Hospital Kaura	Kaura	Kaura	Kaura	Maro'a	9.619	8.591	2
18	Point	Amarks HC	Kankwot	Kaura	Kaura	Maro'a	9.621	8.599	1
20	Point	Turaki Buga Memorial Hospital	Kpak	Kpak	Kpak	Kagoro	9.581	8.529	1
29	Point	Daki Medical & Diagnostic	Manchok	Manchok	Manchok	Maro'a	9.629	8.649	1
30	Point	Manco clinic	Manchok	Manchok	Manchok	Maro'a	9.632	8.666	1

Source: Authors' Analysis, 2016

Appendix IV: HEALTHCARE FACILITIES WITH NO DOCTOR

FID	Shape *	Facility	Town_Villa	ward	District	Chiefdom	Northing	Easting	doctors
0	Point	HC Agban	Agban	Agban	Agban	Kagoro	9.536	8.531	0
1	Point	PHC Garaje	Garaje	Agban	Agban	kagoro	9.543	8.489	0
2	Point	PHC Tsonje	Tsonje	Agban	Agban	kagoro	9.522	8.518	0
3	Point	PHC Bondong	Bondong	Bondong	Bondong	Maro'a	9.669	8.72	0
4	Point	HC Biniki	Biniki	Bondong	Biniki	Maro'a	9.645	8.669	0
5	Point	HC Ungw an Kaya	Ungw an Kaya	Bondong	Mantuak	Maro'a	9.693	8.694	0
6	Point	HC Ungw an Gata	Ungw an Gata	Bondong	Bondong	Maro'a	9.649	8.734	0
7	Point	MDG's Mantuak	Mantuak	Bondong	Mantuak	Maro'a	9.673	8.714	0
8	Point	PHC Fada	Fada	Fada	Fada	Kagoro	9.579	8.539	0
9	Point	HC Fada Daji	Fada Daji	Fada	Fada Daji	Kagoro	9.586	8.519	0
10	Point	HC Dutse	Dutse	Fada	Fada	Kagoro	9.589	8.537	0
11	Point	PHC Tachira	Tachira	kadarko	Fada Attakar	Takad	9.572	8.617	0
12	Point	HC Dusai	Dusai	Kadarko	Kadarko	kagoro	9.575	8.563	0
13	Point	MDG's Kadarko	Kadarko	Kadarko	Kadarko	kagoro	9.592	8.579	0
14	Point	Laruth clinic	Kadarko	Kadarko	Kadarko	Kagoro	9.589	8.578	0
16	Point	Anturung HC	Anturung	Kaura	Aturung	Takad	9.601	8.642	0
17	Point	Gidan First Aid Clinic	Anturung	Kaura	Anturung	Maro'a	9.602	8.643	0
19	Point	PHC Kaura	Kaura	kaura	Kaura	Maro'a	9.616	8.597	0
21	Point	HC Madamai	Madamai	Kpak	Kpak	Kagoro	9.588	8.537	0
22	Point	PHC Kukum Dutse	Kukum Dutse	Kukum	Kukum	Kagoro	9.561	8.531	0
23	Point	HC Kukum Daji	Kuku Daji	Kukum	Kukum	Kagoro	9.559	8.516	0
24	Point	HC Kukum Gida	Kukum Gida	Kukum	Kukum	Kagoro	9.58	8.515	0
25	Point	HC Zakw a	Zakw a	Kukum	Kukum	Kagoro	9.57	8.514	0
26	Point	PHC Mallagum1	Malagum1	Malagum	Malagum1	Kagoro	9.632	8.568	0
27	Point	PHC Malagum2	Malagum2	Malagum	Malagum2	kagoro	9.643	8.598	0
28	Point	HC Tum	Tum	Malagum	Tum	Kagoro	9.633	8.534	0
31	Point	Bature HC	Manchok	Manchok	Manchok	Maro'a	9.621	8.668	0
32	Point	PHC Manchok	Manchok	Manchok	Manchok	Maro'a	9.629	8.659	0
33	Point	PHC Sabo Gari	Sabo Gari	Zankan	Zankan	Maro'a	9.595	8.694	0
34	Point	HC Zankan	Zankan	Zankan	Zankan	Maro'a	9.592	8.696	0
35	Point	HC Fada Attakar	Fada Attakar	Zankan	Fada Attakar	Takad	9.579	8.632	0
36	Point	MDG's Zangang	Zankan	Zangang	Zankan	Takad	9.576	8.711	0
37	Point	St.Louis clinic	Zankan	Zankan	Mifi	Takad	9.596	8.691	0

Source: Author Anlysis, 2016.

Appendix V: Healthcare Facilities with Nurses in Kaura LGA

FID	Shape *	Facility	Town_Villa	ward	District	Chiefdom	Northing	Easting	doctors	No_of_Con	Nurses
0	Point	HC Agban	Agban	Agban	Agban	Kagoro	9.536	8.531	0	0	0
1	Point	PHC Bondong	Bondong	Bondong	Bondong	Maro'a	9.669	8.72	0	0	0
2	Point	HC Ungwan Kaya	Ungwan Kaya	Bondong	Mantuak	Maro'a	9.693	8.694	0	0	0
3	Point	HC Ungwan Gata	Ungwan Gata	Bondong	Bondong	Maro'a	9.649	8.734	0	0	0
4	Point	MDG's Mantuak	Mantuak	Bondong	Mantuak	Maro'a	9.673	8.714	0	0	0
5	Point	HC Dutse	Dutse	Fada	Fada	Kagoro	9.589	8.537	0	0	0
6	Point	Laruth clinic	Kadarko	Kadarko	Kadarko	Kagoro	9.589	8.578	0	0	0
7	Point	Gidan First Aid Clinic	Anturung	Kaura	Anturung	Maro'a	9.602	8.643	0	0	0
8	Point	Amarks HC	Kankwot	Kaura	Kaura	Maro'a	9.621	8.599	1	1	0
9	Point	HC Madamai	Madamai	Kpak	Kpak	Kagoro	9.588	8.537	0	0	0
10	Point	HC Kukum Gida	Kukum Gida	Kukum	Kukum	Kagoro	9.58	8.515	0	0	0
11	Point	PHC Mallagum1	Malagum1	Malagum	Malagum1	Kagoro	9.632	8.568	0	0	0
12	Point	HC Tum	Tum	Malagum	Tum	Kagoro	9.633	8.534	0	0	0
13	Point	Daki Medical & Diagnostic	Manchok	Manchok	Manchok	Maro'a	9.629	8.649	1	0	0
14	Point	Manco clinic	Manchok	Manchok	Manchok	Maro'a	9.632	8.666	1	0	0
15	Point	Bature HC	Manchok	Manchok	Manchok	Maro'a	9.621	8.668	0	1	0
16	Point	HC Zankan	Zankan	Zankan	Zankan	Maro'a	9.592	8.696	0	0	0
17	Point	HC Fada Attakar	Fada Attakar	Zankan	Fada Attakar	Takad	9.579	8.632	0	0	0
18	Point	MDG's Zangang	Zankan	Zangang	Zankan	Takad	9.576	8.711	0	0	0

Source: Author Anlysis, 2016.

Appendix VI: Healthcare Facilities without Nurses in Kaura LGA

FID	Shape *	Facility	Town_Villa	ward	District	Chiefdom	Northing	Easting	doctors	No_of_Con	Nurses
0	Point	HC Agban	Agban	Agban	Agban	Kagoro	9.536	8.531	0	0	0
1	Point	PHC Bondong	Bondong	Bondong	Bondong	Maro'a	9.669	8.72	0	0	0
2	Point	HC Ungwan Kaya	Ungwan Kaya	Bondong	Mantuak	Maro'a	9.693	8.694	0	0	0
3	Point	HC Ungwan Gata	Ungwan Gata	Bondong	Bondong	Maro'a	9.649	8.734	0	0	0
4	Point	MDG's Mantuak	Mantuak	Bondong	Mantuak	Maro'a	9.673	8.714	0	0	0
5	Point	HC Dutse	Dutse	Fada	Fada	Kagoro	9.589	8.537	0	0	0
6	Point	Laruth clinic	Kadarko	Kadarko	Kadarko	Kagoro	9.589	8.578	0	0	0
7	Point	Gidan First Aid Clinic	Anturung	Kaura	Anturung	Maro'a	9.602	8.643	0	0	0
8	Point	Amarks HC	Kankwot	Kaura	Kaura	Maro'a	9.621	8.599	1	1	0
9	Point	HC Madamai	Madamai	Kpak	Kpak	Kagoro	9.588	8.537	0	0	0
10	Point	HC Kukum Gida	Kukum Gida	Kukum	Kukum	Kagoro	9.58	8.515	0	0	0
11	Point	PHC Mallagum1	Malagum1	Malagum	Malagum1	Kagoro	9.632	8.568	0	0	0
12	Point	HC Tum	Tum	Malagum	Tum	Kagoro	9.633	8.534	0	0	0
13	Point	Daki Medical & Diagnostic	Manchok	Manchok	Manchok	Maro'a	9.629	8.649	1	0	0
14	Point	Manco clinic	Manchok	Manchok	Manchok	Maro'a	9.632	8.666	1	0	0
15	Point	Bature HC	Manchok	Manchok	Manchok	Maro'a	9.621	8.668	0	1	0
16	Point	HC Zankan	Zankan	Zankan	Zankan	Maro'a	9.592	8.696	0	0	0
17	Point	HC Fada Attakar	Fada Attakar	Zankan	Fada Attakar	Takad	9.579	8.632	0	0	0
18	Point	MDG's Zangang	Zankan	Zangang	Zankan	Takad	9.576	8.711	0	0	0

Source: Author's Database, 2016.