LOCATIONAL ANALYSIS OF HEALTHCARE FACILITIES IN KEFFI LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA

BY

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (MSc) DEGREE IN REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS

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DECLARATION

I declare that this thesis entitled “Locational Analysis of Health Care Facilities in Keffi Local Government Area of Nasarawa State, Nigeria” was carried out by me in the department of geography. The information derived from literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for the award of another degree or diploma at this or any other institution.

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CERTIFICATION

This project has been read and approved as meeting the requirements for the award of Master of Science (MSc) Degree in Geographic Information Systems (GIS) and Remote Sensing in the Department of Geography, Ahmadu Bello University Zaria.

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DEDICATION

This project is dedicated to God and my loving family, whose effort and sacrifice has made my dream of having this degree a reality.

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To the most High God be the glory for the great things He has done. I acknowledge your great provisions, protections and support throughout the duration of this course. My appreciation also goes to my parents Mr. and Mrs. Thomas Inarigu for their Support and love towards my progress in life. I cannot but appreciate the constructive suggestions, criticisms and encouragement of my supervisors, Dr. B.A Sawa and Dr. D.N Jeb who took the pain to see to the success of this research work

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ABSTRACT

This work is on the locational analysis of health facilities in Keffi Local Government Area of Nasarawa State of Nigeria. The locations of 30 health care facilities which consist of hospitals, health centres and clinics were ascertained using Global Positioning System (GPS) and their addresses were collected from the Ministry of health and verified through field check. These were used to create a database. Parameters such as ownership and category were also included in the database. Arc GIS 10.0, was employed in analyzing these data. The database created was imported from Microsoft excel to Arc GIS environment where attribute data was linked to the spatial data. The linking of these two types of data made it possible to examine the spatial distribution of the facilities which in turn revealed that of the 30 Health Care Facilities, 23 or 66.7% are PHC, 6 or 20% are SCH and 1 HCF (i.e 3.33%) is a Tertiary HCF. A query further revealed that there are only six (6) public healthcare facilities representing (20%) and (80%) twenty four (24) private healthcare facilities in the study area. The result showed that there is gross inadequacy in the number of health professionals in the study area with respect to the standards for sitting PHC. The result also revealed that the ratio of patient to doctor and nurses to patient is high in Angwan Rimi ward (1:246 and 1:163) than any other wards. Again, the healthcare facilities were seen to be unevenly distributed. The spatial distribution of healthcare facilities in study area gave rise to a nucleated pattern; that is the facilities were concentrated in the core indigenous areas of the town. This implies that the health service providers were clustered at a point and people needing the healthcare service will have to travel through all forms of distances in other to utilize the health services in the study area. The research recommended that the Government should locate new healthcare facilities in Sabon Gari, Agwan Iya ii, and Goriya wards, also the Government should also provide the necessary facilities to attract private health managers to other locations within the study area so as to encourage equal spatial distribution of the healthcare facilities in Keffi Local Government Area.

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE STUDY

A common finding from these studies reveals that, distance plays an important role in utilization of healthcare facilities or services as it reveals that the longer the distance, the lower the utilization of such facilities. (Philippe, Mohammed, Mylene and Richard, 2008) noted that, two types of distance are typically used for calculating accessibility measures which include Euclidean distance and Network distance.

The study of regional variations in the distribution of social services like health centres has captured the interest of geographers, planners, and other scientists because of their general interest in the spatial variation of phenomena on the earth's surface. In particular, the question of distribution of resources to meet human needs or want stresses the importance of location and distance (Adeyemo, 2005).

The healthcare system in Nigeria is increasingly facing challenges of ensuring healthcare provision to the growing population that is disproportionately distributed over space. The challenges are due to a number of factors, such as, rapid population growth, uneven population distribution related to natural resource base, poor transportation networks which have made some areas remote, low human resource and the inadequate or lack of financial support for the provision and management of health services. Regardless of these influencing factors, an explicit consideration has not been given for equity in planning and distribution of health infrastructures over the years which is evident in most developing countries Nigeria inclusive (Savigny and Wijeyaratne, 1994; Onokerhoraye, 1999).

The fourth national development plan (1981-1985) outlined that mal-distribution of health institutions; inadequate coverage and limited accessibility to health care facilities are some

of the major problems facing health care delivery at the grass root level. Hence, there is yet no definite theory for the location and distribution of health facilities as in the case with other public facilities (Onokerhoraye, 1999).

In realization of a standard in the distribution of health facilities, the World Health Organization (WHO, 2007), recognizes the relevance of economic distance in the distribution of health infrastructure. This has led to WHO recommending the following standards of walking radius for different categories of health care facilities with 16 km for hospitals, 0-8 km for maternity and clinics, and 0-4 km for dispensaries. WHO also recommends that a hospital service area should not be more than 800 km^2. In terms of health personal to population ratio, the standard for doctor-patient ratio in developing countries is 1:10,000, nurse-population ratio is 1:1000, hospital population ratio is 1:10,000 and dispensary-population ratio is 1:5,000. This implies that all patients should have access to the health facilities at an efficient set of location which can save human effort and monetary resources that could be devoted to many other things (Ariyo, and Datong, 1996).

In terms of rapid increase in population, Keffi Local Government Area (LGA) has experienced a rapid population growth with a population figure of 53, 597 in 1991 and 92, 664 in 2006 (N.P.C, 2006). In considering the landmass of Keffi LGA which is (141.514Km^2) static and a dynamic population with an ever increasing demand for health care services; one would wonder how health facilities are spatially distributed across space to meet the demand of the growing population.

In addition, the density of the road network is an important factor in accessibility to health facilities (Law, 2007). It would be of interest to investigate the distribution of health facilities through the application of Geographic Information System (GIS) technique in the

management of urban and rural health infrastructure in achieving sustainable development in Keffi LGA.

The role of locational analysis in distance measurement for access to health facilities cannot be over emphasized; increase in distance to health care facilities has been reported to have resulted in low utilization of such facilities (Lovett & Gale, 2003) which has ultimately resulted in higher death rates from emergency cases such as asthma (Jones and Bentham, 1997).

A locational analysis study is done in a various ways. However, this study seek to analyses the location of healthcare facilities with the aid of geospatial techniques because it created new opportunities for public health administrators to enhance planning, analysis monitoring and management of healthcare systems in the study area and the world at large.

1.2 STATEMENT OF THE RESEARCH PROBLEM

Health infrastructural distribution is an imperative strategy in providing health for all and is widely acknowledged as a universal solution for improving population well-being in the world (W.H.O, 2004). The Nigeria National Health policy (1996) specified that it is desirable that every district in rural areas should have at least a dispensary, health clinic, maternity clinic, or a primary healthcare centre. Despite this provision, health care facilities are unequally distributed within Keffi Local Government area of Nasarawa State. Studies have shown that with increase in population and rapid urbanization health facilities are increasingly becoming inadequate and worst still not equitably distributed. This has been attributed to haphazard location of the existing health facilities where a large percentage of the population in the city has no access to the available health facilities (Alabi, 2011).

The proximity of Keffi to the Federal Capital Territory, coupled with the relative cost of accommodation and ease at which people can acquire land in the area compared to Abuja, has

attracted the influx of low and middle income workers who cannot afford accommodation in the Federal Capital Territory, Abuja to this area (Yari, Madziga and Sani, 20 02). The idea that place and location can influence health is a very familiar concept in Medicine, as far back as (460-370 BC) Hippocrates, the father of Modern Medicine, observed that certain diseases seem to occur in some places and not in others (Gatrell and Bailey, 1995).

Since the 1990s, Geographic Information System (GIS) has been increasingly used in public health settings. The WHO and UNICEF created the Public Health Mapping Program in 1993, to establish a GIS to support the management and monitoring of Guinea worm Eradication program. This has been expanded to a much wider range of public health applications and now includes the promotion and use of GIS for other disease control program and in public health departments of a number of countries (Richardson, Mitchell, Shortt, Pearce, & Dawson, 2009).

The use of GIS within health services research offers exciting potentials (Albert, Gesler, and Levergood, 2005). GIS technology increases the quality of information produced by the environmental hazards and epidemiologic investigations by adding the dimension of context (Tim, 1995). An example of the application of GIS in health research was carried out by Love and Lindquist (1995). They used GIS to measure the distance of aged population to hospitals in Illinois in United States of America. They generated isorithmic maps showing four distance contours (0 to 5, >5 to 10, >10 to 15, >15 to 20, >20 miles) from the closest hospital and the closest geriatric hospital. Eighty percent of the Illinois aged population was within 4.8 (km) of one hospital, and 11.6 (km) of two. There were substantial differences in distances to first, second, third, fourth, and fifth closest hospitals for the aged population living within and outside metropolitan statistical areas. However, the authors found no evidence that access or distance is

different for the aged than for the general population. They failed to take into consideration other age bracket in the population, leaving a gap to be filed by this study.

Lee (1996) assessed the relative distance of San Francisco's homeless population to clinics and hospitals in the United States of America using MapInfo. Map showing clinic locations relative to the distribution of the homeless population using a one-mile buffer around hospital with emergency room was created; it was found that most homeless shelters and free food were within these zones in the study area. The author suggested that the homeless were geographically accessible to healthcare.

Iwasa (2005) used GIS to analyze access to health facilities in Uganda by relating location and population data in an innovative way using grids location based service, Global Positioning System was used to carry out a health infrastructure survey. The population of the country was gridded at a resolution of 5 km^2 which spread the national population on areas excluding water bodies, data on health facility, grades, and type of ownership were collected during the survey and geo-statistical tools analysis were also utilized to analyze the randomness' of health infrastructure location within grids. He came to the conclusion that 6.6 million people which is 27.3% of the total population is within the 5 km radius to health facilities, the result was based on a tight spatial analysis for all grids which are completely contained in the 5 km zone.

Also Alabi (2011), employed GIS technique in assessing the distribution of health centers in Lokoja area of Kogi State. GPS was used pinpoint the location of existing heath centers within 5 neighborhoods in Lokoja. Nearest neighborhood analysis (NNA) method was used to analyze the data in the research by establishing the distribution pattern of public and private health centers in the study area. the research found that 0.99228 indication of weak randomness

because it exceeds the Z-score table value of -0.723417 which is indicative of insignificant accessibility to healthcare facilities in the area.

Adamu (2012) measured geographic accessibility to hospital facilities in Sheffield, using two distance measures; Euclidean and Network distance. Geographic Information System (GIS) was used as a tool to analyze the population distribution and to determine the distance and availability of hospital facilities in Sheffield. Distances between population centroids (origin) and hospital postcodes (destination) were calculated using Euclidean and Network distance measures. A threshold distance of 7km was used as a bench mark to determine level of accessibility (High or Poor Access) in the study area. Results from the study reveals that the population in the city Centre had better access to hospital facilities due to proximity, as most hospitals are located within the city Centre. Secondly, the comparison of the distance types based on the different age groups shows that Euclidean distance was highly correlated with Network distance, with values greater than 0.90. However, the young and middle aged category appeared to have better access to hospital facilities in Sheffield area than the old age category.

The researches mentioned above looked at accessibility to health facilities and how health facilities are distributed across space, none has come up with the locational pattern of healthcare facilities, their distribution and distances. This brings up the quest in research to assess the distribution of healthcare facilities and the factors that play a dominant role in influencing the pattern of distribution of healthcare facilities in the study area. This research is premised to answer the following questions:

1. What is the spatial distribution of both private and public Healthcare facilities in the area?
2. Where are the private and public Healthcare facilities by areas with respect to area of specialization in the hospital?
3. What are Doctor Patient and Nurses patient ratios in the study area?

4. What are the distance and time taken at certain speed from the wards to the Tertiary HCF (FMC) in the area?
5. What was the Healthcare facility in the study area?
6. Where was the Propose location for healthcare centres in the area?

1.3 AIM AND OBJECTIVES

The aim of this study is to analyse the spatial distribution of healthcare infrastructure in Keffi Local government area of Nasarawa state using GIS techniques.

This was achieved through the following objectives which are to:

i. identify and map both private and public Healthcare facilities in the area.
ii. identify and map private and public Healthcare facilities with respect to area of specialization.
iii. examine the Doctor-patient and Nurses-patient ratios.
iv. estimate the travel distance and time from settlements and wards to the only Tertiary HCF (FMC) in the area.
v. create a geo-database for Healthcare facilities in the area.
vi. propose new sites for health centres in the area.

1.4 SCOPE OF THE STUDY

The study area consists of ten wards. This study covered all the health care facilities in Keffi L.G.A of Nasarawa State Spetially, it covered all the ten wards namely: Iya I, Iya II, Goriya, Tudun Kofa, Gangare, Liman Abaji, Jigwada, Sanbon Gari,Yara, and Angwa Rimi ward. Private and Public Primary, Secondary and Tertiary health care facilities were all covered by this study. The researche contained attributes of the healthcare facilities such as, areas of

specialization, occupation, age, sex, date, types of diseases. On the basis on the temporal scope, the researched was collected from 2004 to 2014.

1.5 JUSTIFICATION OF THE STUDY

Requirement for appropriate and accurate information on the availability and distribution of health facilities, to meet the growing health challenges, policy and decision makers need to know spatial distribution of Health facilities vis-à-vis population distribution or density especially on the need for the establishment of new healthcare centres.

Thus, a geospatial database on location and capacity of health centres is an invaluable resource that is needed to boost healthcare delivery in Keffi L.G.A. It will also form the baseline data, for future Healthcare delivery plans in the study area. The study will extend the frontier of knowledge in the area of analyzing location to healthcare using the robust GIS technique in a third world country like Nigeria, it can also be useful to donor agencies like WHO, CSDA, USAID etc., in planning of intervention programs. This work will provide healthcare planners and managers particularly government in taking the right decisions on where to site or locate healthcare.

CHAPTER: TWO

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 CONCEPTUAL FRAMEWORK

In order to remove any ambiguity in this study, the researcher will address the categories of healthcare and location to their services.

2.1.1 Categories of Health Care Facilities

In most countries, the system of health care delivery comprises a range of institutions which are classified on the basis of their specialization, sophistication and the level of care they can provide. Basically, there are three main levels identified, viz: primary, secondary and tertiary health care delivery systems (Pavignani, 2007).

The primary health care delivery system comprise of those small health care facilities which are based in the community and are more accessible to patients and their families. They include dispensaries, clinics and primary health care centers (PHCs).Primary health care services generally provide simple diagnosis and treatment and are mainly outpatient basic health care staffed by a medical officer or community health workers (CHWs).But some facilities under the primary health care category may be devoted only to special-program activities, such as safe motherhood, tuberculosis control, kick malaria or immunizations. (Ordinoha, 2013).

Next is the secondary healthcare, more commonly called general hospitals to which patients from a wide surrounding area or district are referred when necessary by the primary health care units for more serious diagnosis or treatment. Hospitals, usually located in urban and some rural areas, are a very important part of health care provisioning because there will always be a proportion of patients who need the particular skills and equipment that can be concentrated in them. Apart from out-patients services, they offer surgical and emergency services. In many cases, the out-patient component (mainly provide first contact care) is quite large. It is however,

note worthy that hospitals are very expensive element in any health service delivery system as they are costly to build and equip and the money necessary to staff and run them can be enormous. (Kaplan, 1990)

Finally the large specialized teaching hospitals, usually located in the main towns and often only in the capital city, form the tertiary level of care. They are equipped with higher technology and mainly devoted to in-patient care. This is usually larger than general hospital and has a greater emphasis on teaching, particularly of doctors. In most cases, there is a close relationship with a medical school and with medical research (Gofin, 2005).

2.1.2 The Concept of Location

From the foregoing, we have seen that health care facilities are of different grades, based on the level of service they offer and these facilities are located in various areas based on a number of factors. It is therefore pertinent to review some of the theoretical basis behind the location .of phenomena on the surface of the earth. Whynne-Hammond (1979) was of the view that in spatial analysis three elements are very important in any study. These include location, interactions and regions.

Ikporupko (1986) sees accessibility of a given location in terms of how easy getting to place. The author however, opined that accessibility has a role to play in locational activities (medical facilities inclusive). The researcher looked at accessibility in terms of ability to get to a given place which entails the availability of means of transport and appropriate infrastructure and the cost component (that of getting cheaply) that entails the monetary, time and cost incurred in getting at the location in question. Therefore, location does affect utilization of facilities it is an important factor for the spatial demand for goods and services.

2.1.3 The Location theory

In Location theory, the spatial pattern of economic activities is explained mainly in terms of transport cost. Therefore, Hoover (1984) remarked that the expenses and inconveniences of moving finished goods to distant customers and procuring raw material from distant sources induce producers to locate near their market or their source of raw materials. That is, industrialist tends to locate where aggregate transfer cost are minimum.

However, it has been note by Mike (2010) that because of the nature of their activities, public services like. Hospitals, generally locate primarily with population distribution in mind, and are therefore oriented towards the consumer (market) depending on the transport situation. The locations that are more likely to minimize travel costs for the user population are those at strategic points in the transport network. In other words, the cost of transport (for people, or consumers) rather than the transfer cost (of materials by the supplier) is more important in public facilities, which involves mainly the movement of people to points where services are located. Neuman (1990).

On location of medical facilities, numerous factors of public facilities have been given. Reid (1984) displays that in recent times, the issues of access, equity and efficiency criteria that consider the distributional aspect of public facilities have been receiving attention. Filani (1992) shares the same idea when he asserted that accessibility questions assumed greater importance among researchers and policy makers in recent years because, it is now recognized that the actual is to them, who get what depends on where one lives implying that, location on a transport network is an important determinant of the availability of public facilities (medical services inclusive).

Maro (1987) in his study of the location of health facilities in Tanzania used the distance of within 5 kilometers, within 10 kilometers and beyond when 10km as reasonable measures of proximity to health facilities. Kirby (1980) however, suggests that the cure of the problem of allocation is that which practices access to health is highly influenced by proximity to supply, the provision of services were equal. Minimal provision of free hospital at widely separate location has the effect of transferring the real cost of health care to patients through additional transport cost. Olajuyin et al (1997) investigated the effect of location on the utilization of healthcare facilities in Irewole Local Government Area of Osun State, Nigeria. The researcher found that healthcare facilities were unevenly distributed among the settlements and that the distance was a paramount factor.

Ajala, Sanni and Adeyinka (2005) studied accessibility to healthcare facilities as 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. The researches mentioned looked at accessibility to healthcare, and the factors that affects the utilization of healthcare facilities, none of the research came up with a reason for the present location of health facilities. Hence, the study also seeks to contribute to the existing literature by using more variables (representing the totality of healthcare delivery by wards in the Local Governments area and level of being ‘marginally advantaged or marginally disadvantaged in terms of distribution of healthcare facilities and personnel. This, we believe, will help policymakers to adequately address the challenges in spatial variations in access to healthcare facilities and personal in Osun state.

2.1.4 The Location-allocation theory

The key issue about centers is to try to minimize travel time or cost of transportation by consumers. That is to locate facilities and at the same time allocate consumers to them, in a way that movement costs or time is minimized. This is the main concern of the location - allocation theory. According to Scott (1977), the location - allocation problem can be stated thus: "given a set of *n* points distributed on a plane, a numerical weight to be attached to each point, and a set of *m* indivisible centroids without predetermined locations, the location - allocation problem is to find locations for the *m* centroids and the allocation of each point or part thereof to some centroid so as to optimize an objective function".

What that means is that the *n* points could be settlements (example - electoral wards, villages, towns, or some points within them) while the numerical weight could be the population of the settlements. Then the *m* indivisible centroids could be the facility in question i.e. a school, clinic, dispensary etc. example a location could aim to minimize travel costs or maximize utility.

Since hospitals are established to provide medical services, efficiently located hospitals can save human lives in medical emergencies by maximizing the accessibility of hospitals to hospitals users (Okafor, 1981).

2.1.5 Definitions and Concepts of Access to Primary Health Care

Access to Primary healthcare can be seen from a broad perspective. Efforts to conceptualize and measure access have varied depending on different circumstances and context of study. The most basic problem in definition of access 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 (Guaoliardo 2004). This might create confusions due to overlapping of understanding between physical presence of (Primary Health Care) facility and ability and willingness of people in obtaining care.

Access to healthcare is a complex and multidimensional concept. Penchansky & Thomas (1981) have defined access as a concept representing the degree of 'fit' between the clients and the system. Alternative definitions include spatial components, describing access as pertaining to the relative ease by which healthcare can be reached from residential locations (Allen, Liu and Singer 1993; BTS, 1997; Luo and Wang 2003) There is also a general consensus that access to healthcare refers to the ability of an individual to receive care when they need it, regardless of ability to pay (Hanratty, Zhang & Whitehead, 2007).

A more specific definition refers to ability to secure a specified set of health care services with certain level of quality, subjected to a specified maximum level of personal inconvenience and cost while in possession of a specified amount of information (Oliver & Mossialos, 2004). The term 'specified' in this definition makes it easier for policy makers to define access depending on specific circumstances for different places depending on the availability of resources to finance healthcare. Mosely (in Ariyo and Datong, 1996) conceived accessibility as the ease with which people in an area can obtain necessary services. It can be summarized that general definition of access can guide the Planner and Policy maker towards important factors such as relevant range and quality of service, inconvenience, disutility, cost, information decimation etc, to be considered. If adopted and implemented properly, this can serve as a standard against which existing access can be compared. Therefore, this helps policy makes to check if they are improving access over different areas and population (Shrestha, 2010).

2.1.6 Dimension of access to healthcare services

Penchansky & Thomas (1981) have grouped those issues as barriers into five dimensions: availability, accessibility, affordability, accommodation and acceptability. The first two dimensions are spatial in nature. Availability refers to the total number of services from which user can make their choice. It refers to the extent to which Acceptability deals with the

cultural and religious factors of people. Factors like age, gender education level, race or ethnicity determines the level of acceptability of service provision to a large extent. This also depends upon the personal perception of people that might vary within same religion group or gender.

Adequacy is seen from two ways: quality of service and personal treatment by the service providers. Opinion about the medical treatment whether people trust the medical ability provided by the facility or not, if they are satisfied with the quality of service or personal behavior of all facility personnel right from the point of entry to facility for example, the person at reception till the end of medical treatment by doctors. The last three dimensions are non spatial, related to cost, service quality and cultural factors.

Obrist, *et al* (2007) also adopted the above mentioned five dimensions in clarifying the concept of access to health care but the term 'accommodate' is replaced by adequacy' while explaining if patient's expectation towards the quality of service and personal treatment is met by the facility. However, in this study, the dimension of accessibility related to distance were used in assessing the existing situation of access to PHC. Accessibility was related with the geographic location of the patient to the location of facilities.

2.2 LITERATURE REVIEW

2.2.1 Health Care in Nigeria

The Nigerian government is committed to quality and accessible public health services through provision of primary health care (PHC) in rural areas as well as provision of preventive and curative services (Nigeria Constitution, 1999). PHC is provided by local government authority through health centers and health posts and they are staffed by nurses, midwives, community health officers, health technicians, community health extension workers and by physicians (doctors) especially in the southern part of the country.

Gupta *et al.,* (2004) stated that the goal of primary health care (PHC) was to provide accessible health for all by the year 2000 and beyond. Unfortunately, this is yet to be achieved in Nigeria and seems to be unrealistic in the next decade. The PHC aims at providing people of the world with the basic health services. Though PHC centers were established in both rural and urban areas in Nigeria with the intention of equity and easy access, regrettably, the rural populations in Nigeria are seriously underserved when compared with their urban counterparts. About two-thirds of Nigerians reside in rural areas therefore they deserve to be served with all the components of PHC.

According to Adeyemo, (2005) and Federal Ministry of Health, (2004) the health care delivery at the LGA is headed politically by a supervisory councilor and technically and administratively by a PHC coordinator and assisted by a deputy coordinator. The PHC co-coordinator reports to the supervisory councilor who in turn reports to the LGA chairman the different components of the LGA PHC are manned by personnel of diverse specialty. The LGA is running her primary health care services delivery in compliance with the principles framework of the National Health Policy (Nigerian National Health Bill, 1987).

The Third Development Plan (1975 to 1980) for Nigeria focused on the inequity in the distribution of medical facilities and manpower personnel. Despite the desire by the government to ensure a more equitable distribution of resources, glaring disparities are still evident. The deterioration in government facilities, low salaries and poor working conditions had resulted in a mass exodus of health professionals (Iyun, 1988).

To further shade light on the issues with healthcare in Nigeria, (Wunsch and Olowu, 1996) stated that there has been too much concentration of medical personnel at the urban to the neglect of the rural areas. Another significant problem in the management of PHC is transportation. It has been reported in LGA PHCs that there are not enough vehicles for workers

to perform their task especially to the rural areas. Immunization outreach services are inadequately conducted. The maintenance culture of the existing vehicles is poor while PHC vehicles were used for other purposes other than health related activities. To put succinctly, many of the PHC vehicles donated by UNICEF in the 1980s are totally non-functional.

2.2.2. Health needs and Problems of Rural Populations

There are three health care delivery systems in Nigeria (primary, secondary and tertiary).There are innumerable problems within primary health care delivery system which affect the whole population. An assessment of these problems and needs is important to assure easy accessibility to health care services by rural people. Apparently, people living in remote areas show an adaptability that allows them to adjust to the adverse conditions. Critical observation of some groups of nomads, for example the Fulanis and fishermen from the core northern states, the migrant Tiv farmers from Benue State, reveals satisfactory physical health and increasing resistance to disease or illness, but they are not without health problems. AHWO, (2008).

The health and health-related problems of nomads, migrant farmers and rural people include the following:

i. Poverty associated with poor housing, unsatisfactory environmental sanitation, polluted water and food which predispose to malnutrition and infectious diseases.

ii. Uneven distribution of health services, and shortage of physicians, nurses and trained health personnel in rural areas.

iii. High mortality and low average life expectancy, due to lack of access to health services. It is unfortunate that systematically collected data are lacking about levels of morbidity and mortality in rural communities. Despite the availability of PHC services, some rural dwellers in Nigeria

tend to underuse the services due to perceptions of poor quality and inadequacy of available services (Sule *et al.,* 2008).

Various reasons can be adduced for the underuse of the services provided:

a) Difficulties associated with transportation and communications;

b) High rates of illiteracy among rural peoples;

c) Traditional conservatism and resistance to ideas from outside; deep rooted traditions and customs, including health beliefs and practices, which increase the patronage of the services of traditional healers; and

d) Lack of understanding of PHC among health professionals and decision-makers resulting in poor quality services; and

e) Heath worker attitude to work (frequent abstinence from the work place) (Adeyemo, 2005).

iv. A tendency to press older children into adult responsibilities early, resulting in psychological problems due to role conflicts.

v. Endemic diseases prevalence, such as malaria and trachoma.

vi. Zoonotic diseases as a result of their close contact with animals as part of their way of life.

Clearly most of the problems and needs of rural areas are multi-factorial in origin and require multidisciplinary interventions (Abiodun *et al.,* 2010).

2.2.3. Current Status and Gaps in PHC Services In Rural Communities

PHC centers are filtering units for those who require specialized services at the higher levels of care. Specialized medical services such as radiotherapy, orthopedic procedures and surgeries are completely absent. There are many variations in the ways that medical care is given to rural people. The psychosocial health of rural dwellers is a neglected aspect of services

provided. Gap remains in the knowledge of rural health workers to respond satisfactorily to identify problems.

This gap needs to be addressed because patients satisfaction with health care is an important health outcome which has implications for capacity utilization. And, in health systems that emphasizes the cooperation and involvement of the community, both in terms of resources contribution and management, satisfaction with health care assumes an important dimension in terms of its implication for success of public health programme (Hegazy *et al.*, 1992).

Some of the health workers are untrained and the trained ones lack the modern concept of PHC practice. Although, in principle, PHC requires intrasectoral and intersectional coordination and community participation, they are often lacking when put into real practice. Most of the services rendered lack community linkage and because of this, most community members are unaware of some available services. In general, nomadic women and children especially in the northern part of the country are the most underprivileged and chronically neglected segment in rural areas. Study has shown that rural women especially nomads, when compared with the urban population, significantly underuse maternal and child health services (Abiodun et al., 2010).

2.2.4 Community Participation and Involvement

It is almost universally acknowledged by national and international health planners that community participation is the key to the successful implementation of primary health care (PHC). The 1978 Declaration of Alma-Ata identified community participation as 'the process by which individuals and families assume responsibility for their own health and welfare and for those of the community, and develop the capacity to contribute to their community's development (World Health Organi-zation, 1978). Nigeria is one of the few countries in the developing world that has systematically decentralized the delivery of basic services in health to

locally elected governments and community based organizations. Com-munity participation has been institutionalized through the creation of village development committees and district development committees that are grass-roots organiza-tions expected to work closely with local governments in monitoring and supporting primary health care services. Recently, there have been several governmental initiatives to strengthen these institutions of community participation to improve health services (World Bank, 2003).

The National Health Policy in Nigeria emphasizes active community engagement in the provision of PHC services in the spirit of the Bamako Initiative of 1987, when Health Ministers from various African nations adopted resolutions for promoting sustainable primary health care through community participation in financing, maintenance, and monitoring of services. Community participation was institutionalized in Nigeria through the creation of District Development Committee (DDC) and the Village Development Committee (VDC) (World Bank, 2003).

There is a large and growing body of evidence (Mike, 2010) that certain types of service delivery are enhanced with the active participation of the communities they serve. As end-users of the services, communities have a stake in ensuring that services are well-provided, and are also well-positioned to monitor the quality of services. With the benefit of local information, they can assess the specific obstacles facing facilities in providing services and they can seek to ensure that facilities have the necessary infrastructure, supplies and staff motivation to provide the services they are supposed to provide.

2.2.3 Application of GIS in Healthcare Management

Increasing advancement in GIS in health organizations, together with the availability of data, has supported studies related with developing measures of access to health care services.

On 17 October 1989, the California Bay Area was hit with a serious earthquake registering 7.1 on the Richter scale. Alameda County had a GIS in operation and dedicated it to their emergency response activities that included the identification of damaged vehicles and downed power lines. The GIS facilitated the management of incoming reports from rescue crews and provided a rapid and concerted emergency response. At the same time, the California Highway Patrol set up a make shift command center beside the rubble of a collapsed section of the Nimitz Freeway. Using Alameda's GIS software and a portable computer, officers were able to systematically monitor the search-and-rescue operation. Reports were issued periodically on each 80-foot section to show the location of trapped vehicles (Tyler, 1990).

Zwarenstein *et al.* (1991) found ARC/INFO GIS useful in analyzing the affect of removing race restrictions on hospitals in Natal/KwaZulu, South Africa, in 1985.Again, Thiessen polygons via ARC/INFO software were used to represent catchment areas. Three maps were produced using Thiessen polygons to define catchment areas. These included: (1) white referral and general hospitals, (2) black referral and general hospitals, and (3) all referral and general hospitals (race restriction removed). The results indicated that even with the removal of race restrictions on hospitals the population/bed ratio did not significantly improve for blacks.

In 1987 California passed an air toxics "hot spots" act which called for the identification of carcinogenic and no carcinogenic health risks of facility-specific air toxics emissions. Two initial objectives of the programs were to determine the degree of public exposure and to assess the potential health risk from air toxics emissions from a facility. These objectives were accomplished using PC ARC/INFO. In one part of the research, isopleths were drawn around a facility to indicate the worst possible excess cancer risk due to operational emissions from a facility (Moore, 1991).

In another study, Guthe *et al*. (1992) conducted a pilot project to compare the expected versus actual spatial pattern of high blood lead among children of Newark, East Orange, and Irving, New Jersey, using a GIS. The following data bases were brought together for the purpose of predicting spatial patterns of lead exposure from known risk factors:

(1) U.S. Census TIGER Line files; (2) blood screening records from the New Jersey Department of Health; (3) local sources of industrial and hazardous waste from the New Jersey Department of Environment Protection and Energy; and (4) traffic counts from the New Jersey Department of Transportation. Noticeable differences existed between the observed and expected spatial patterns of lead exposure. These differences suggested that additional variables should be incorporated into the model for more accurate lead-exposure prediction.

Solarsh and Dammann (1992) brought together III PLUS, Epi Info, (an epidemiological data analysis program from the Centers for Disease Control) and Harvard Graphics to produce a community pediatric information system (CPIS) to monitor longitudinal child health trends (e.g., measles surveillance) in the Edendal Health Ward in southern Natal, South Africa. Given hospital inpatient data (e.g., date of admission, sex, age, vaccination status, etc.), the community pediatric information system can "pinpoint" areas experiencing a rapid increase in measles incidence. This customized system offered public health officials the appropriate spatial information to focus efforts during periods of measles outbreaks.

Openshaw *et al*. (1987; 1988) developed a geographical analysis machine (GAM) that was used to test the significance of childhood leukemia cancer clusters. Within the GIS component of GAM, a grid of points was superimposed over the study area. Each point of the grid was used as a center for a set of concentric circles. The age-sex adjusted incidence rate of childhood leukemia was calculated for each circle and tested for significance based on Poisson probabilities. The advantages of this procedure were the use of disaggregate cancer incidence

data and the fact that potential cancer clusters were tested from multiple adjacent locations on the grid the researcher discovered incidence of leukemia in male children who are exposed to poison radiation (Thomas, 1992).

Awoyemi *et al* (2011) found unequal access to health facilities in the examination of factors influencing access to and the use of health facilities in Kogi state, Nigeria. They found that long distance to health facilities caused by the poor location pattern of health care facilities is a major barrier to their use.

In a similar way Agaja (2012) also carried out extensive GIS mapping and documentation of primary maternal health care centers in Ugheli South and Warri South Local Government Areas of Delta state, Nigeria. This was done to provide geospatial information about the distribution and accessibility of primary health care centers. The distribution was found to be clustered in some areas leaving others areas underserved.

Tanser (2005) studied the methodology for optimizing the location of new PHC facilities in rural communities: a case study of Kwazulu- Natal. South Africa The study found out that poorer populations are more likely to exclusively use the nearest healthcare facility irrespective of discrepancies in standard of delivery. This makes the placement of health care facilities in deprived settings particularly important and it is therefore vital that facilities are sited in such a way that as many people as possible have access to the services they offer.

The researches cited fail to mention or inadequately address possible applications of GIS on travel distance to healthcare facility, however, this gap will be covered in this research by calculating the travel distance from ward to Federal Medical Centre Keffi, (FMC) and from settlement to the FMC.

CHAPTER THREE: STUDY AREA AND METHODOLOGY

3.1 THE STUDY AREA

3.1.1 Location

Keffi Local Government area of Nasarawa state is located between Latitudes 8^0 18‘N and 8^0 51‘N and Longitudes 7^0 18‘E and 7^0 40‘E, it has an area of 138km^2. It is bounded by Karu to the North and Nasarawa to the South and Garaku to West, Ministry of land and survey(2014).

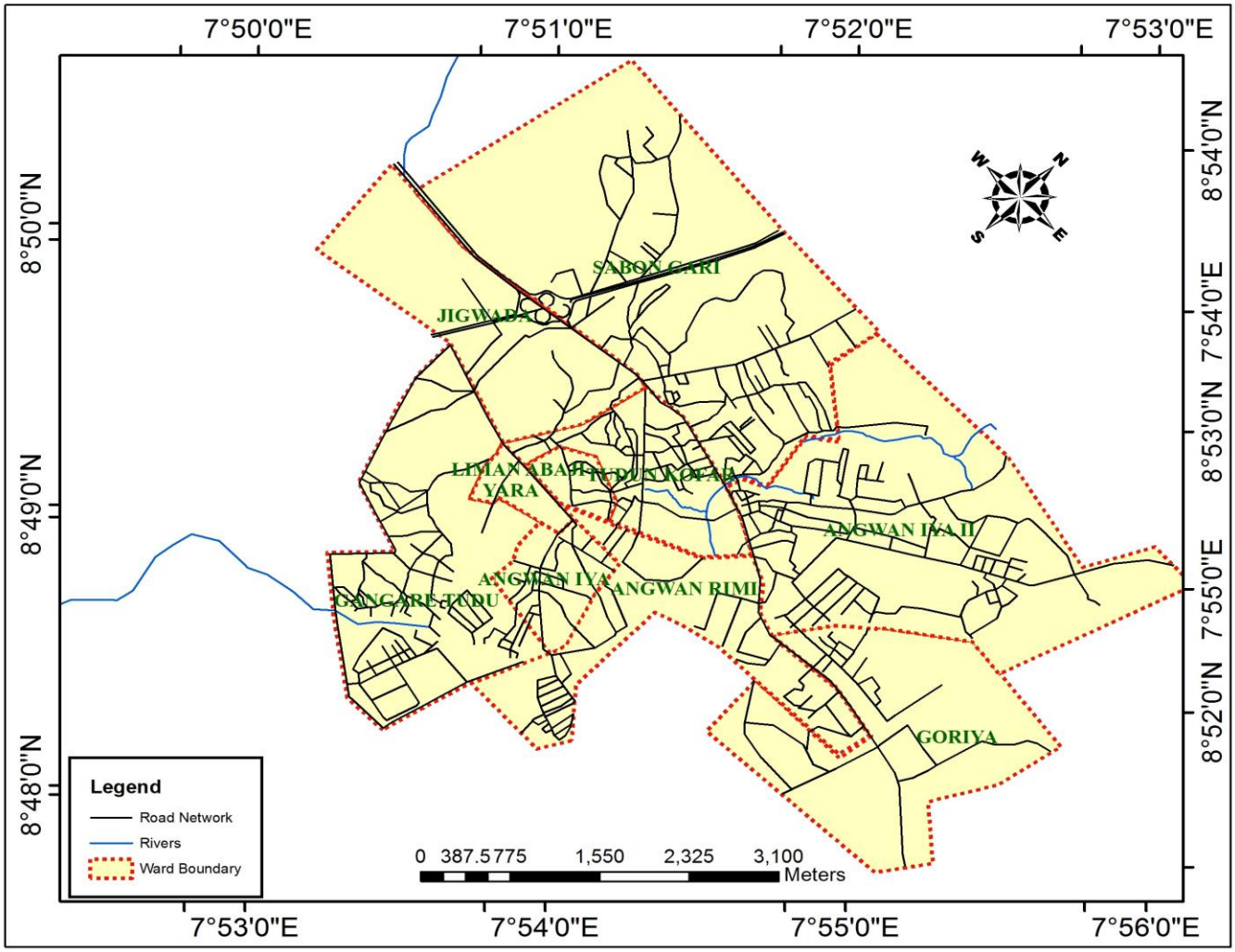


Figure 3.1: Keffi Local Government Area the study area
Source: Modified from the administrative map of Nasarawa state

It was founded by a Fulani cattle rearer from Yan-Tumaki in Katsina state, called Abdul Zanga in 1802, A.D. Keffi Local Government area is made up of people of diverse ethnic and cultural background living in peace and harmony with one another. Some major tribes of Keffi local government are Fulani, Hausa, Mada, Eggon, Yeskwa, Gwandara and other minority. Keffi Town is the administrative Headquarter of Keffi LGA, the LGA was created in 1996 when Nasarawa State Was created

3.1.2 Climate

Keffi has two distinct seasons, namely the rainy season that begins around March and runs through October and the dry season which begins from October and ends in March. The temperature value ranges between (23^0C-33^0 C) while the humidity value ranges between (64%-96%) However, within these seasons is a brief harmattan season that is occasioned by the north east trade wind and the attendant dust haze, increased cold and dryness (NIMET, 2011)..

Weather conditions in Keffi are influenced by its location within the Niger ¬Benue trough on the windward side of the Jos Plateau and at the climate transition zone between the essentially 'humid' south and the 'sub-humid' north of the country.

The high temperatures and the relative humidity in the Niger ¬Benue trough give Keffi a heating effect Rainfall, the annual rainfall is 602mm Keffi reflects its location on the windward side of the Jos Plateau while the monthly rainfall distribution intensifies during the months of July, August and September (NIMET, 2011).

3.1.3 Relief and Soil

Topographically, the study area is characterized by undulating terrain which is composed of low-lying lands towards the southern part of the area and a network of hills in the north. Thus,

allowing the area to be drained by the Anto River and meanders through the interlocking dissection of terrain. (Binbol, 2007)

Many parts of Keffi LGA are ravaged by gully erosion, since most of the inhabitants of the state are farmers extensive areas in Keffi are cleared for farming thus exposing wide areas to sheet erosion. The major soil units of the area as observed by (Obaje et al., 2007), to be underlain by the Precambrian Basement Complex rocks and consists mainly of gneisses and schist with migmattite, granites and small occurrences of quartzite, pegmatite, amphiboles, granitic gneisses and diorites. The rocks date back to the Paleozoic era and boundaries between them are gradational. The study area by virtue of its location has the advantage of double passage of the sun overhead. This means that insolation is relatively constant and sunshine hours high. Generally, sunshine hours are high in the area averaging about nine hours in the dry season but little lower for the wet season because of the effect of cloud cover (Binbol, 2007)

The soils are derived mainly from the basement complex formation and older sedimentary rocks. Lateritic crust occurs in extensive areas on soils on the basement complex while hydromorphic soils are common along the Anto River and floodplains of major rivers. Soils in the area are generally deep and well drained with high fertility rating and variable run-off potential.

3.1.4 Population and Socio-Economic Activities

Keffi LGA has a population figure of 92,664 people as at 2006 population, comprising of 47,527 males and 45,023 females (NPC, 2006). Most of the tribes or ethnic groups Aho, Hausa, Gwandara, Yeskwa, Fulani, eggons, Yorubas, Igbos, and Madas. However the Hausas are concentrated within the center of town, while the surrounding area is populated with other ethnic group, however Keffi is the major settlement in the Local Government Area with few other

settlements. Most of the inhabitants of Keffi are mostly farmers and civil servant Human activities, climate change coupled with rural poverty have led to increased deforestation in the rural areas of Nigeria. Most farmers in keffi are, poor and rely on subsistence agriculture for a living, this has a direct relationship with their nutritional intake and invariably their state of health Oguntala, (2000).

Agriculture is the mainstay of the people of Keffi Local Government area. The fertile nature of the land allows the production of varieties of both grains and root crops such as maize, beans, yams, cassava among others. In addition to varieties of fruits trees and herbs, thus, about 70% of the land area in Keffi LGA is farmland as can be seen in Figure 3.2.

There are local industries like wood carving, pottery, dyeing, cloth weaving and blacksmithing that also thrive in the area. Keffi Town is also one of the commercial centres in Nasarawa State. Its close proximity to the FCT has led to development of hotels, business centres, shopping centres while, and the State University is located within Keffi town in addition to school of Health and Federal Medical Centre.

3.2 METHODOLOGY

3.2.1 Reconnaissance Survey

Reconnaissance survey had been carried to get acquainted with the study area. During the reconnaissance survey, locations of the Healthcare facilities were captured with the aid of GPS. Also, documents contained attributes information of the Healthcare facilities were collected and open forum discussion were made with the heads of Healthcare officicials and also with the people living in the study area. Again, detailed fieldwork was carried out for this study.

3.2.2 Data Required and Sources

Two types of data were required for this study, Primary data and Secondary data.

3.2.2.1 Primary data:

True colour composite of Spot 5 satellite images of 2005 with a resolution of 5m was sourced from National Centre for remote Sensing (NCRS) Jos and it was used for the delineation of Roads, Drainages, and Settlements. According to the Federal Ministry of Health (F.M. H, 2000), Keffi L.G.A has a total of 30 healthcare facilities, the Updated list of registered health facilities was sourced from Keffi Local Government Health Department, other facilities operating and functioning at the time of visit were included in the list. Questionnaire was administered to healthcare managers at each facility visited who were in position to give vital information about the healthcare facilities. The questionnaire was designed to capture information about the various categories of healthcare facilities (Primary, Secondary, and Tertiary).

3.*2.2.2. Secondary data:*

Map of Keffi L.G.A was extracted from topographic map of Nasarawa State, at a Scale of 1:250,000 traced and scanned. Documents contains attributes information for populating the geodatabase such as: the address, location, Ward, name and types of healthcare facilities, occupations of the patients, sex of the patients, diseases types and date of diagnosis was collected from the Ministry of Health (Nasarawa State). The Population data of the study area was obtained from the National Population Commission (NPC). Literatures materials were gotten from text books, journals, conference papers, internet, etc.

3.2.3 Source of Data

i. Satellite Image: The spot 5 image was sourced from the N.C.R.S Jos.

ii. Land Use Map: This was extracted from the spot-5 image of the study area. Thereafter, other thematic layers like drainage, road network were derived from the image.

iii. Population Data: Was acquired from the N.P.C. the population data was for 2006 and was projected to 2013 using the population growth for Keffi L.G.A at 2.4%

iv. Primary data on healthcare facilities: Administration of questionnaires and interview

The table 3.1 show the population of the study area at wards level was gotten from 1991 national population and projected to 2006.

Table 3.1 Population of the study area as of 2006.

S/NO	**WARDS**	**POPULATIONS**
1	ANGWAN RIMI	16,420
2	GANGARE	8,100
3	T-KOFAR	14,000
4	L-ABAJI	14,840
5	SABON GARI	4,320
6	GORIYA	5,420
7	ANGWAN IYA I	8,860
8	YARA	12,000
9	ANGWAN IYA II	2,550
10	JIGWADA	6,000
TOTAL		92,510

Source: Modified from N.P.C (2006).

3.2.4 Hardware & Software

3.2.4.1 Hardware

i. HP Compaq laptop with 120 GB of HDD, 2 GB of RAM, 1.87 GH3 clock-speed, 32-bit operating sys-tem.
ii. Hand held G.P.S
iii. HP DeskJet Printer (D1500 model).

3.2.4.2 Software

i. Arcgis 10 for GIS Analysis
ii. Excell for simple statistical Data Analysis
iii. Microsoft word 2007.

3.2.5 Data processing

This research project employs quantitative methodology based on GIS techniques to address its research objectives. A GIS analysis was chosen for this study because it is optimal to address the research question of whether healthcare facilities are evenly distributed in the study area, by allowing for large scale analysis of physician, population facility data. There were four major processes in this project: data collection, geo-database design, mapping of spatial distribution of all Healthcare facilities, mapping of the distribution of healthcare professional and proposing of suitable locations for new healthcare centres. The first step was the collection of both the spatial data and attribute information. The second is the design and construction of geo-database for importing the spatial data and organizing the resource information into tables, third, is to utilize the geo-coding functionality to match the resource information with their address into

spatial coordinates. Next is the creation and presentation of maps with different categories of resource information.

3.2.6 Questionnaire Administration

The content of questionnaire was divided in to three groups namely: healthcare service input and outputs, manpower and facilities and each of these groups was further divided in to many subgroups. Healthcare service input and outputs: name of village, ward, district, LGA, health facility type and health facility location, health facility grade. Manpower: number of doctors, number of nurses, midwives, pharmacists, dentists, anesthetists, laboratory technicians, radiographers, theatre attendants, ward attendants, dressers, out-patient attendants, cleaners, opticians/optometrists, pediatrician, cardiologist, x-technician, pathologist, anesthetist, psychiatrist, obstetrician, gynecologist. facilities: number of wards, beds, drugs, laboratory, available laboratory, number of ambulances, surgical theatres, source of water supply, electrical supply, surgical, equipment, radiologist, dental ward, children's cots, maternity beds, pharmacy dept, administrative blocks, dressing rooms, delivery room HIV screening centre, intensive care unit, emergency unit, mosquito treated net, orthopedic unit, blood bank, immunization unit, family planning unit, the problems encountered by dispensary/clinics/hospital. A total of 30 copies of questionnaire were distributed to Healthcare Facilities and all were successfully retrieved. All the Healthcare Facilities were covered in this study.

3.2.7 Data Preparation for Analysis

The three major features classes were mainly point, polygon and lines. The point is the healthcare facilities; their attribute data were initially typed in Microsoft Excel format and transformed into text (ms Dos). The database included HCFs name, location address, and type of

healthcare facilities, distributions of healthcare facilities, distribution of healthcare personals the type of services rendered by each facility, and the (Longitude and latitude) of each healthcare facility in the area. Spatial datasets were build and it was done by manual on-screen digitization in ArcGis, ArcMap for all the features required for this projects and these included mainly the roads and wards. A spatial attribute table for the Healthcare Facilities was created. This was done by importing the field data from Questionnaires on the location and capacities of healthcare facilities stored in Excell format into ArcGis, ArcMap format. Base map Preparation: The map was scanned and imported in to ARCGIS 10.GIS software. The map was then geo-referenced to enable it conform to GIS Analysis.

3.2.8 Creation Spatial Geo-Database

The first aspect of the geo-database design for this project entailed the creation of feature classes for the various geographic features such as roads, rivers, settlements and other geographic features identified on the base map. The second aspect was the creation of the Geo-data base for all the healthcare facilities for the study area based on the GPS point data collected during fieldwork by the process of the feature classes were then created manual on-screen.

3.2.9 Spatial Distribution Analysis

In order to achieve this, the study area was extracted from the Topographic map of Keffi, the coordinates of the study area were extracted. These coordinates were then used for the sub setting of the sport 5 satellite image of 2005 to cover the study area. Then, the coordinate of each health facility was obtained using a hand –held GPS. Point map was then produced using the coordinates generated from the use of GPS for the location of the healthcare facilities as

discussed under data processing stage. This showed the spatial distribution of the health care facilities in the study area.

3.2.10 Travel Time Analysis to nearby Healthcare Facility

To analyze the travel time from settlements to any nearby healthcare facility, the road network map, spatial distribution of healthcare facilities and the settlement map integrated. An attribute table was created with a field for speed limits and a speed limit of 500metres per minute was adopted for the roads in keffi, these was done in order to know the time taking to reached the main FMC at a giving speed limits. This decision was arrived at due to the congestion on all the roads in keffi. The presence of speed bumps, traffic jam, and motor cycles slows down vehicular movement making the speed limit adopted for this study necessary.

3.2.11 Interviews with Managers of Private and Public Healthcare Facilities

Interviews with all managers of private and public healthcare facilities were done in order to understand the reasons or motivating factors behind the reason for the establishment of healthcare facilities and the constrains they face in the choice for locating healthcare facilities on the basis of rental houses or land acquisition for the facilities.

3.2.12 Statistical Analysis

GIS analysis was used to show the distribution of Healthcare professional, while Bar chart, Pie chart was also used to show the numbers and percentage of general medical practitioner (Doctors) in all the facilities.

The results from the ArcGIS queries and questionnaires was further in form of descriptive statistical and it was basically done to determine the percentages, numbers, of healthcare

professionals and healthcare facilities in the study area. The results were presented inform of tables, figures, and percentages

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 INTRODUCTION

The results of the analyzed data are presented in this chapter, based on the seven objectives. The first parts is the identification and mapping of private and public Healthcare facilities in the area, the second was to the identify and map private and public Healthcare facilities by areas of specialization, thirdly was to determine the Doctor patient and Nurses patient ratios, fourth was to evaluate the travel distance and time from settlements and wards to the only Tertiary HCF (FMC) in the area, the fifthly was to Create a geo-database for Healthcare facilities in the area and lastly to proposed new location for health centres facilities in the area.

4.2 DISTRIBUTION OF HEALTH CARE FACILITIES IN THE AREA

The results of the spatial distribution of HCF in the study area are presented in Figure 4.1, and Table 4.1, show the spatial distribution of Primary, Secondary, and Tertiary health care facilities.

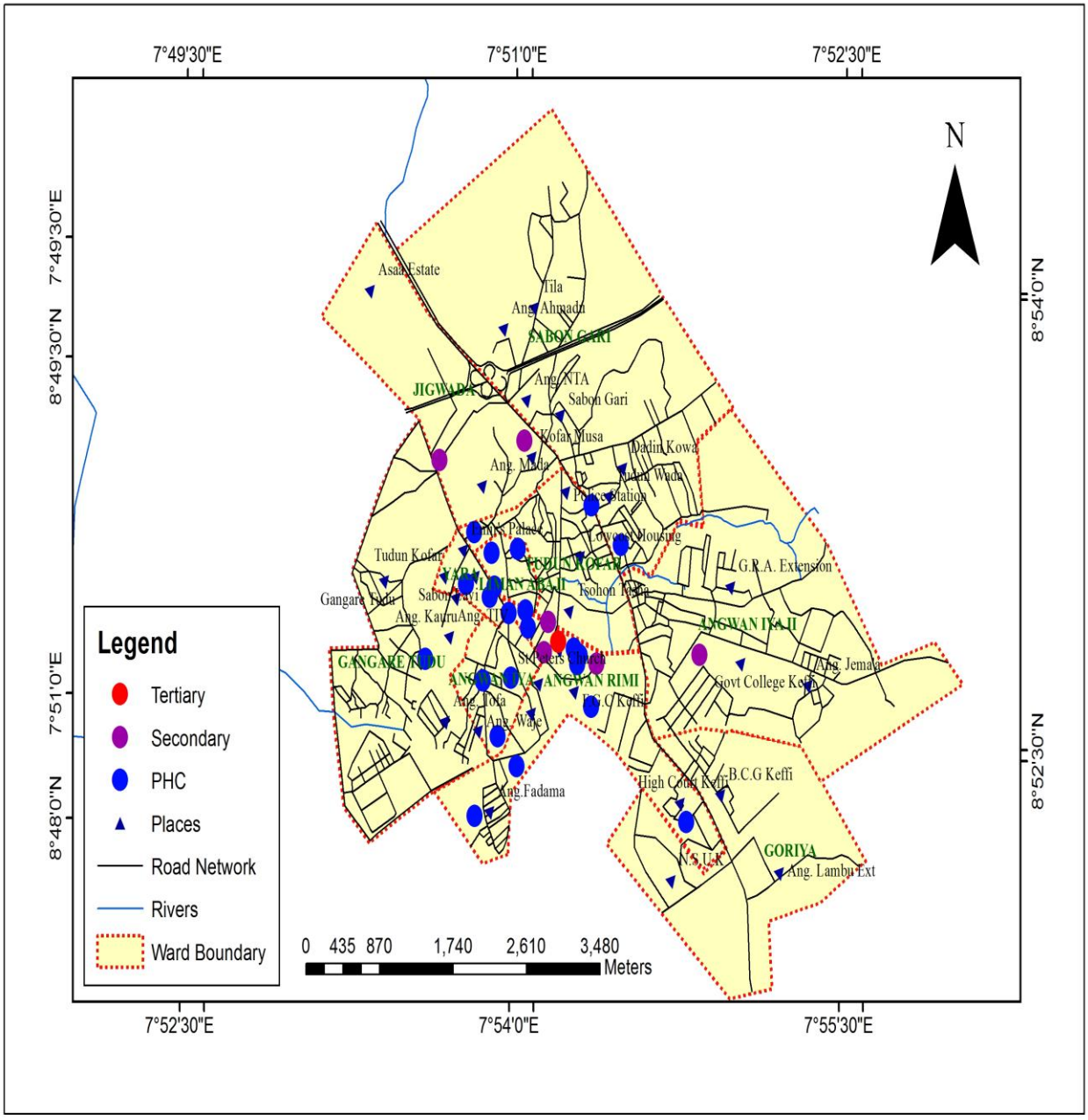


Figure 4.1: The Spatial distribution of healthcare facilities in the study area
Source: Authors Analysis

The result showed that there are 30 Health Care Facilities in Keffi L.G.A of this number, 23 or 66.7% are Primary Health Care, 6 (20%) area Secondary Health Care and 1 Health Care Facility (i.e 3.33%) is a Health Care Facility.

Table 4.1: Distribution of HCF

TYPE	NUMBER	PECENTAGE (%)
PRIMARY	23	66.7%
SECONDARY	6	20
TERTIARY	1	3.33%
TOTAL	30	100

Source: Author's Analysis

The distribution of healthcare facility in the Keffi LGA showed that there are 23 primary healthcare facilities, 6 secondary healthcare facilities, and 1 tertiary healthcare centre. The total number of healthcare facilities in the LGA is therefore 30. From the comparison in Figure 4.1 above, it appears that location of healthcare facilities does not take into account the size of population in the study area and Specific examples include Agwan iyaI ward with 4,150 inhabitants has only 1 private secondary healthcare facility while Angwan iya II-Ward has 4,097 inhabitants but is served by six P.H.C Similarly, location of healthcare facilities is not based on the administrative units which are in contrast with National Health Policy (2004); for instance, there is no healthcare facility in Sabon Gari Ward and Goriya ward despite the large number of inhabitants in the area.

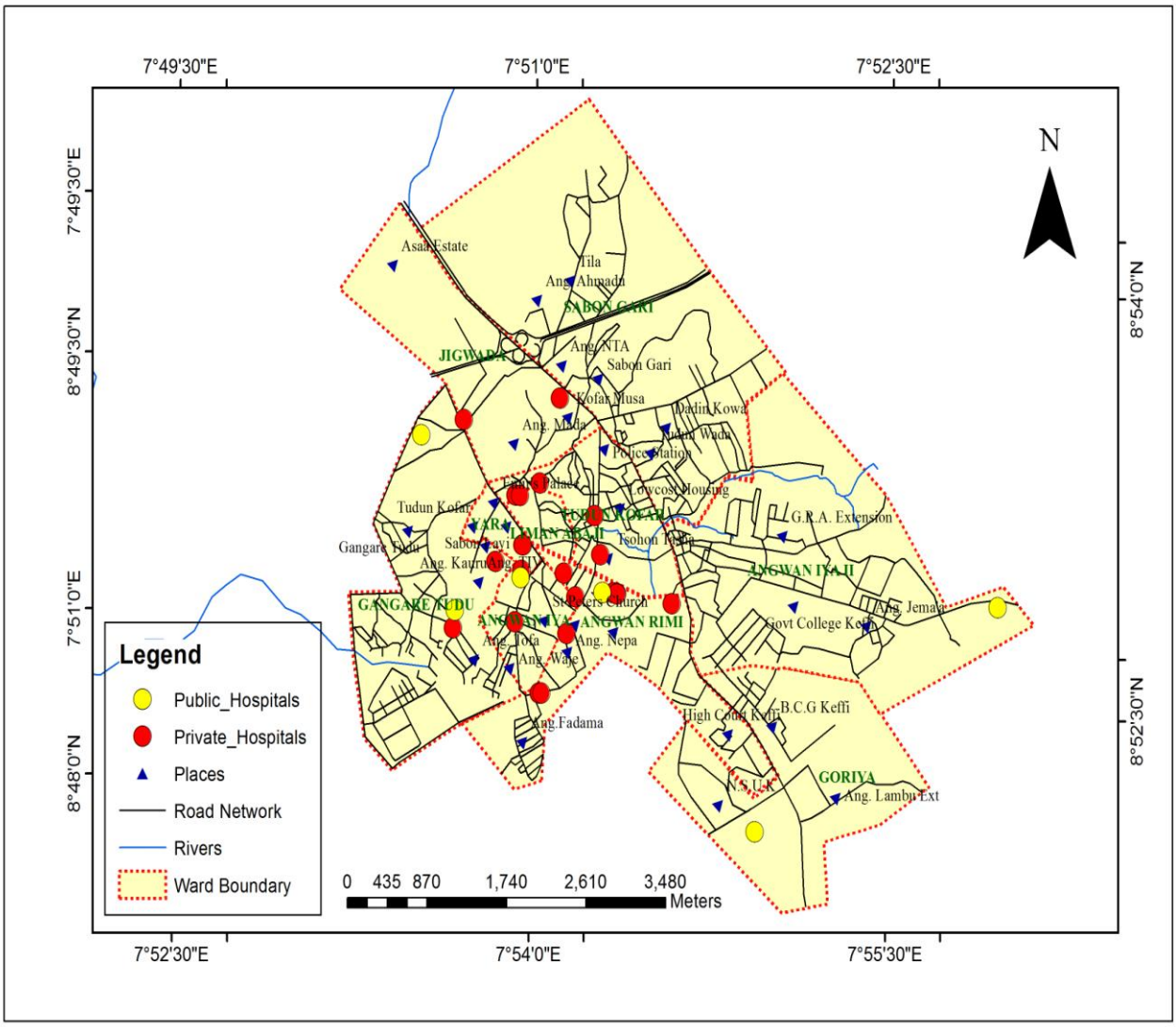


Figure 4.2.: Spatial Distribution of Public and Private Health Care Facilities in the Area
Source: Authors Analysis

The results of the spatial distribution of public and private HCF in the study area are presented in Figure 4.2., and Table 4.2.

Based on the results, it was found that, the privates healthcare facilities was mainly concentrated in the highly populated wards in the study area and also closed to places that had highly human activities such as market places, close to schools and high residential areas.

The distribution is concentrated in the core of the town justifying the result of the interview with private health care managers that population and the presence of social amenities such as

electricity, pipe borne water and tarred road as a major determining factor in the siting of their healthcare facilities.

Table 4.2 Public and Private Health Care Facilities

HCF TYPE	NUMBER	PERCENTAGE (%)
PUBLIC	6	20
PRIVATE	24	80
TOTAL	30	100

Source: Author's Analysis

Figure 4.2 and figure 4.2 shows that there are only six (6) public healthcare facilities representing (20%) and twenty four private (24) HCF in the study area, representing (80%). It was found that private hospital constitutes highest numbers of healthcare facilities in the study area than the public once which may be as the results of high demands of medical attentions that lead to the high numbers of the private healthcare. It was also found that, most of the private healthcare facilities were owned by the medical personals from the public hospitals

4.3 SPATIAL DISTRIBUTION OF HEALTHCARE WITH PROFESSIONALS IN THE STUDY AREA

The geographic distribution of human resource is a key determinant of measuring accessibility to healthcare facilities hence, the reason for the analysis on the figures and tables.

4.3.1 Availabilities of Medical Doctors in both Public and Private HCF

The figure 4.3 and table 4.3 show the spatial distribution of medical doctor in both the public and private HCF.

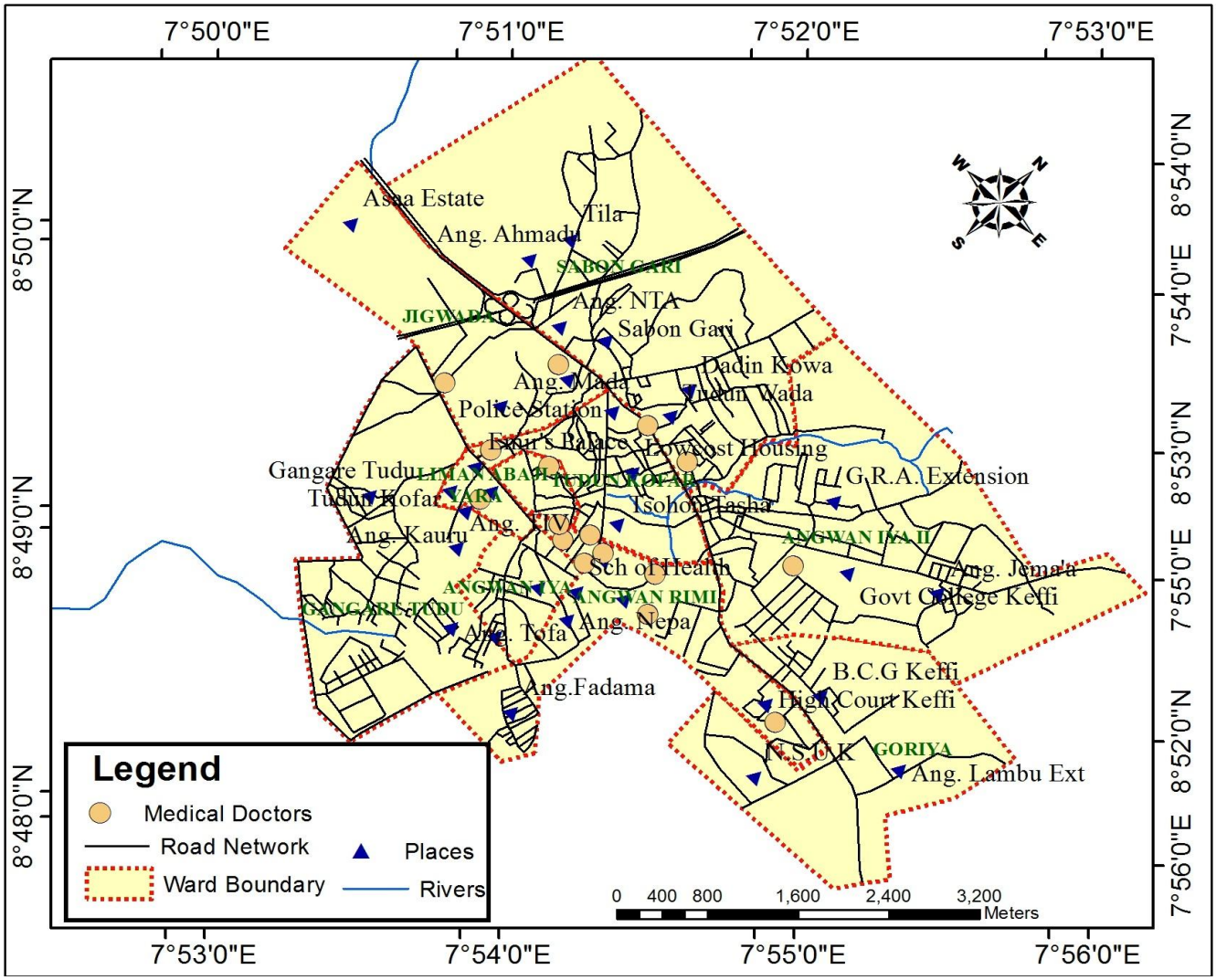


Figure 4.3: Spatial Distribution of Healthcare Facilities with medical Doctors in the Study Area
Source: Authors Analysis

Table 4.3: Distribution of Doctors in both Public and Private Healthcare Facilities

HFS	No Of Doctors	Percentage (%)
PRIVATE	27	29.7
PUBLIC	64	70.3
TOTAL	91	100

Source: Author's Analysis

Figure 4.3 and table 4.3 shows the distribution of medical doctors and nurses, in both public and private health facilities in the ten wards, ninety percent (70.3%) of medical doctors are in the public facilities and 29.7% in the private sector. The availabilities of human resources are unbalanced in respect to medical doctor in the surveyed wards. Certain wards e.g Yara ward have to few doctors while some wards have a concentration of doctors, for instance, Rimi wards has a total number of 64 Doctors, whereas , Goriya, Jigwada and Gangere wards have a complete absence of Doctors. This ultimately affects the level of accessibility to health care in the area. The public hospitals are owned by the government and the jobs are pensionable which explains why there are more healthcare professionals in public than private hospitals. In particular, the concentration of doctors is more in the single Tertiary healthcare facility that is the Federal Medical Centre which serves as a referral hospital.

4.3.2 Distribution of Nurses in both Public and Private HCF

The figure 4.4 and table 4.4 show the availabilities of nurses in both the public and private HCF. These was done using query from the geodatabase of the study area.

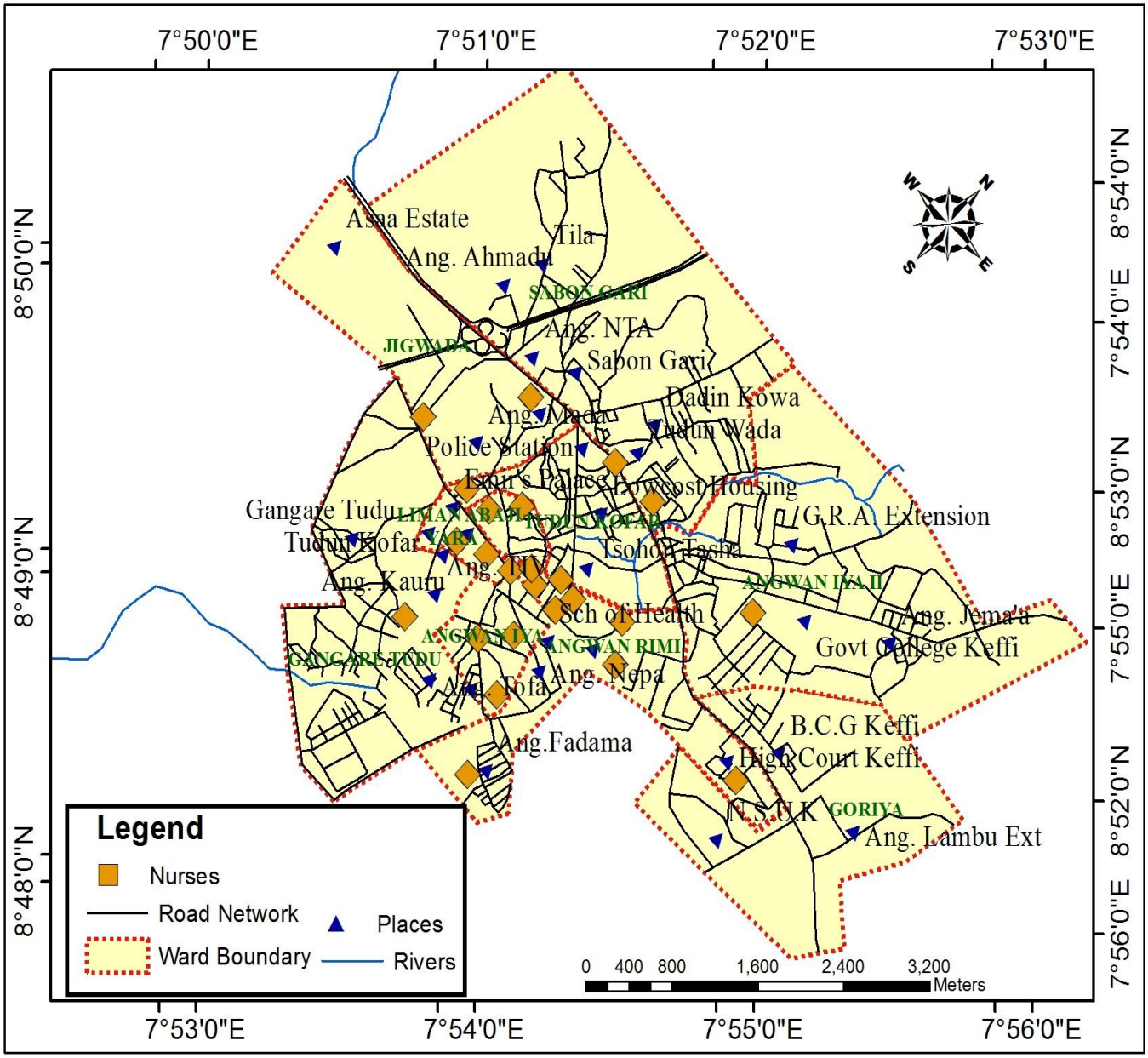


Figure 4.4: Spatial Distribution of Healthcare Facilities with Nurses in the Study Area
Source: Authors Analysis

Table 4.4: Number of Nurses in both Public and Private Health Facilities

HFS	No of nurses	Percentage (%)
PRIVATE	79	43.9
PUBLIC	101	56.1
TOTAL	180	100

Source: Author's Analysis

As presented in figure 4.4, table 4.4 t shows that there are total of 101 nurses in the public facilities which represent (56.1 %) and only 79 of the private which represent (43.9 %). The availabilities of nurses are unbalanced in the surveyed wards. Certain wards have too few nurses, areas like Agwan iyall has two nurses (2) and some wards like Jigwada and Goriya have no nurses at all, whereas, Aagwan Rimi has a total of 101 nurses. This reduces the chances of other people from nearby settlement to access such a vital service.

4.3.3 Distribution of HCF with Midwives

The figure 4.5 and table 4.5 show the spatial distribution of HCF with midwives.

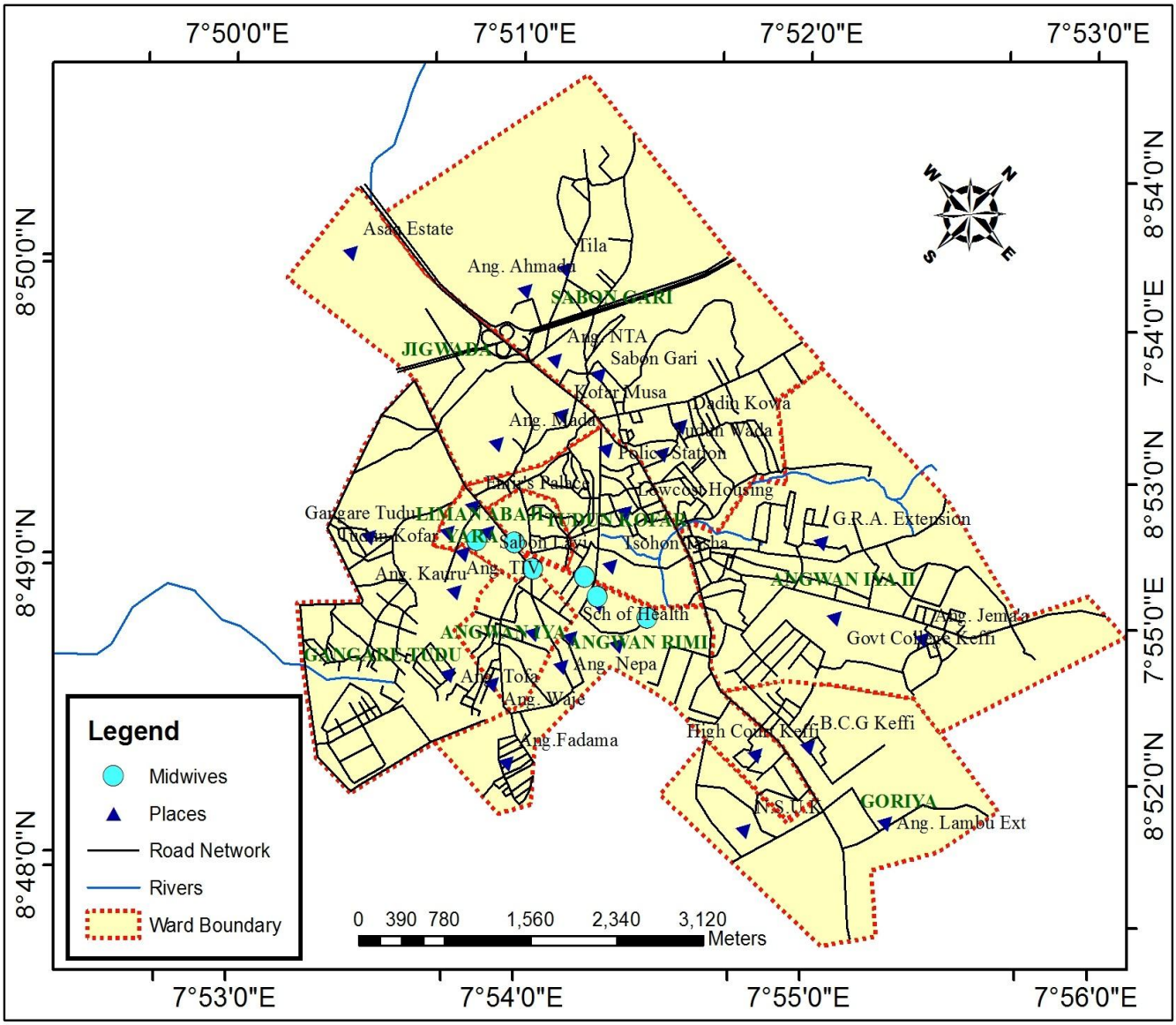


Figure 4.5: Spatial Distribution of Healthcare Facilities with Midwives in the Study Area
Source: Authors Analysis

Table 4.5: Availability of Midwives in both Public and Private Facilities

HCF	NO OF MIDWIVES	PERCENTAGE (%)
PRIVATE	10	8.8
PUBLIC	103	91.1
TOTAL	113	100

Source: Author's Analysis

The result of the spatial distribution of healthcare centres with midwives, are presented in Figure 4.5 and Table 4.5 the numbers of midwives in the study area. There are a total of 113 midwives in the entire health facilities, with the public health facility having a total of 103 midwives which is (91.1 %) this could be attributed to the presence of the Federal Medical Centres which account for a total of 100 midwives. Whereas the private healthcare facilities could only account for 10 midwives representing (8.8 %) Despite the high numbers of midwives in the study area, a great disparity still exists in terms of their distribution. Out of 30 healthcare facilities, only six have midwives while 24 are without midwives. Findings also shows that the facilities having midwives services are mainly concentrated in Agwan Rimi and Liman Abaji leaving other wards with complete absence of midwives despite the large number of population living in that area.

4.3.4 Distribution of HCF with Pathologist

The figure 4.6 and table 4.6 shows the spatial distribution of HCF with pathologist.

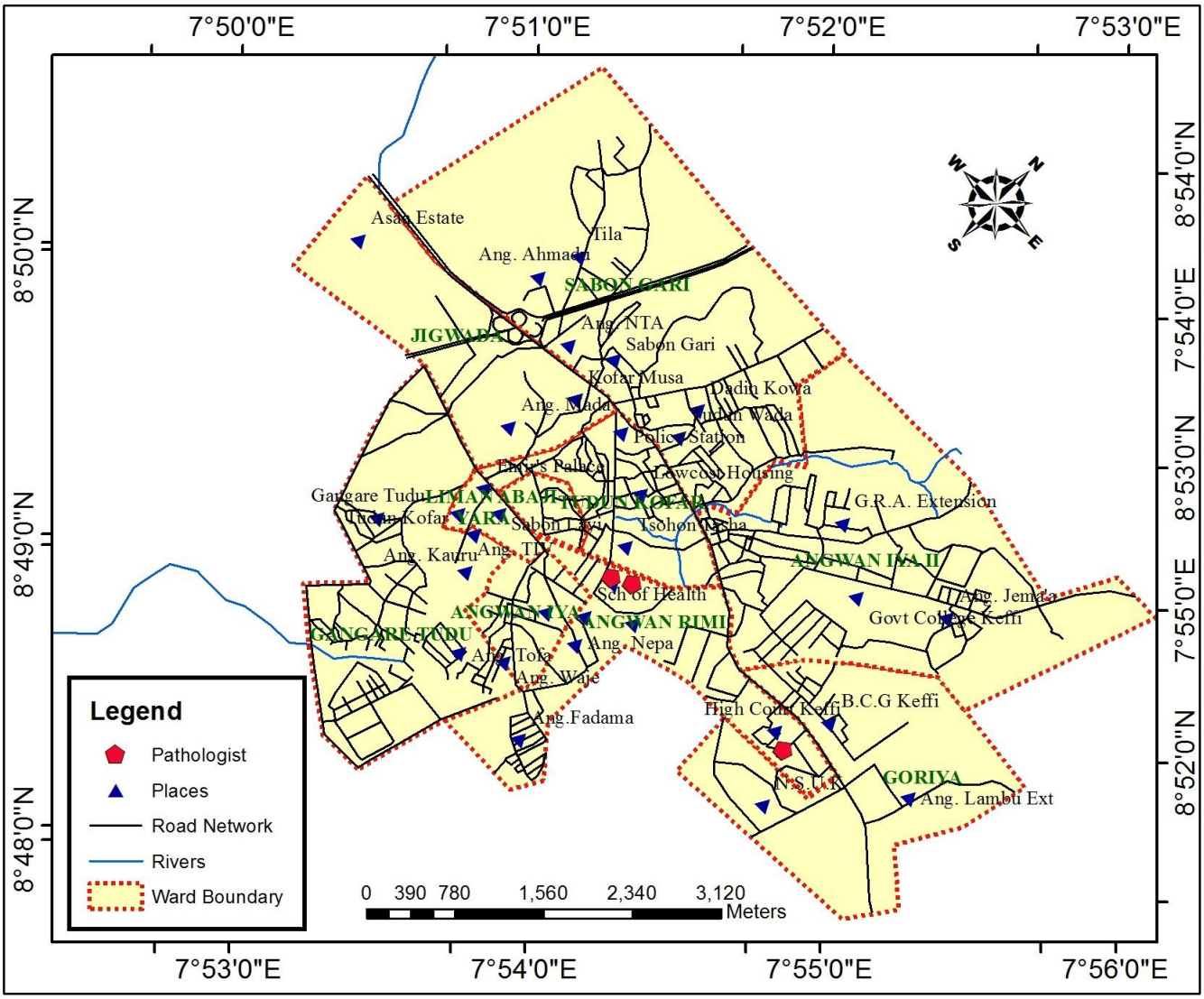


Figure 4.6: Spatial Distribution of Healthcare Facilities with Pathologist in the Study Area
Source: Authors Analysis

The result of the distribution of pathologist (medical practitioners that interpret abnormalities in diseases tissue) in the study reveals how inadequate the numbers of pathologists are in the study area. Out of the 30 healthcare facilities only 3 have pathologist, and the health facilities are not evenly distributed, two are located at Agwan Rimi, ward while, one is located at Goriya ward leaving other wards without such services.

Table 4.6: Availability of Pathologist Services in Public and Private Healthcare Facilities

HCF	NO OF PATHOLOGIST	PERCENTAGES (%)
PRIVATE	19	25.6
PUBLIC	55	74.3
TOTAL	74	100

Source: Authors Analysis

Table 4.6, shows the percentages of pathologist in but public and private healthcare facilities, the survey revealed that 19 pathologists are found in the private healthcare facilities which is (25.6%) while 55 are found in the public healthcare facilities, which is (74.3%). The situation shows the insufficient access to pathologist services in the study area.

4.3.5 Distribution of HCF with Pediatricians

The figure 4.7 and table 4.7 shows the spatial distribution of HCF with Pediatricians.

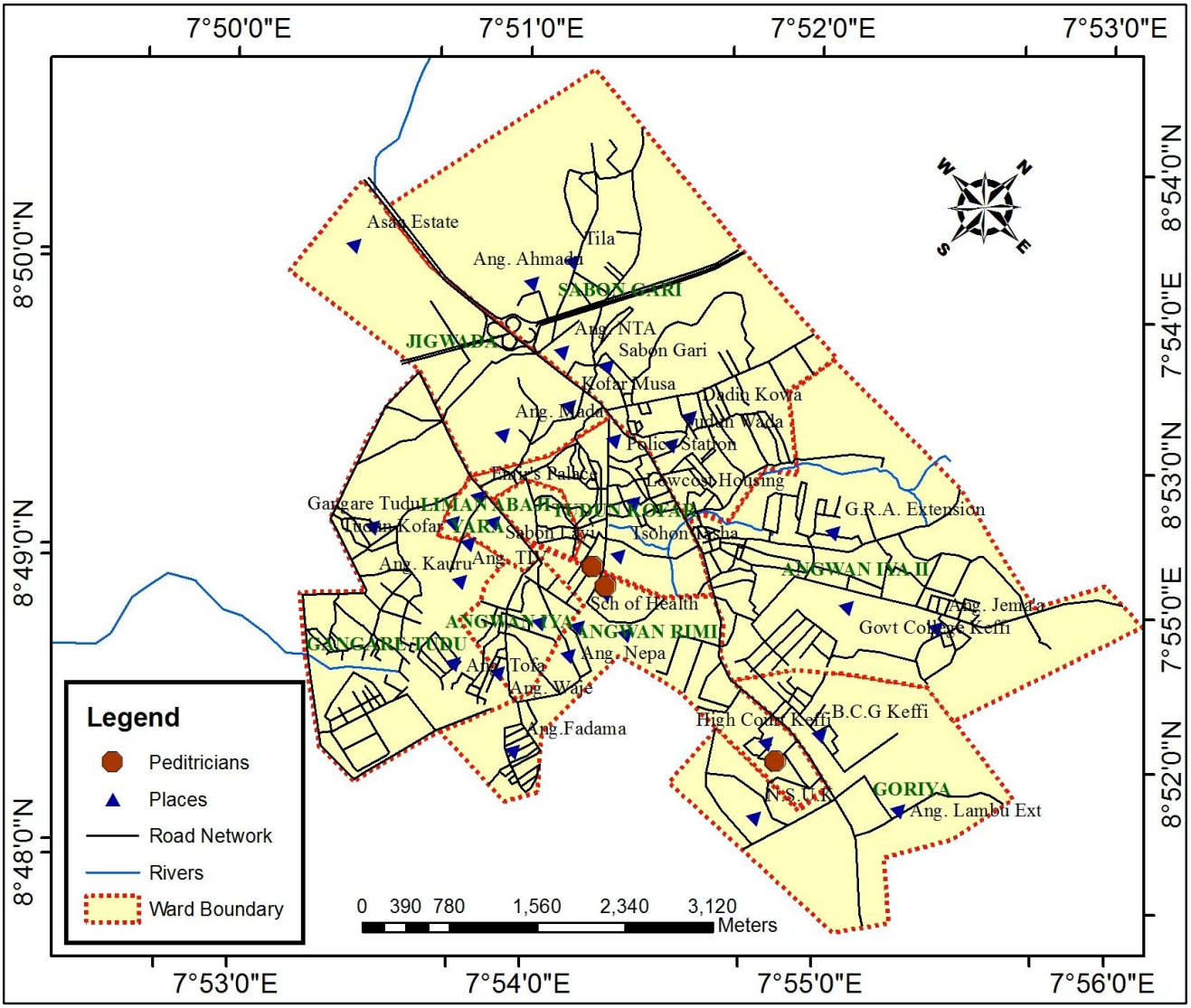


Figure 4.7: Spatial Distribution of Healthcare Facilities with Pediatricians in the Study Area
Source: Authors Analysis

Figure 4.7 show the distribution of pediatrician in the study area, out of 30 health facilities surveyed only a 3 health facilities have pediatricians in their facilities, this implies that, people leaving outside these facilities will have difficulty assessing such services. This is a

branch of medicine that deals with the medical attention of adolescents, children and infants there by very imperative to the survival of the future generation. But the number of pediatrician in keffi was found to be grossly inadequate in view of the population in Keffi L.G.A.

Table 4.7: Availability of Pediatrician in both Public and Private Health Facilities

HCF	NO OF PEDIATRICIAN	PERCENTAGES (%)
PRIVATE	1	20
PUBLIC	4	80
TOTAL	5	100

Source: Author's Analysis

Table 4.7, show the percentages and number of pediatricians in both public and private healthcare facilities, only one pediatrician is found in the private healthcare facility representing (20%) while 4 pediatricians were found in the public healthcare facilities representing (80%). This situation shows a gross shortage in the numbers and the distribution of pediatrician in the study area.

4.3.6 Distribution of HCF with Gynecologists

The figure 4.8 and table 4.8 show the spatial distribution of HCF with Gynecologist.

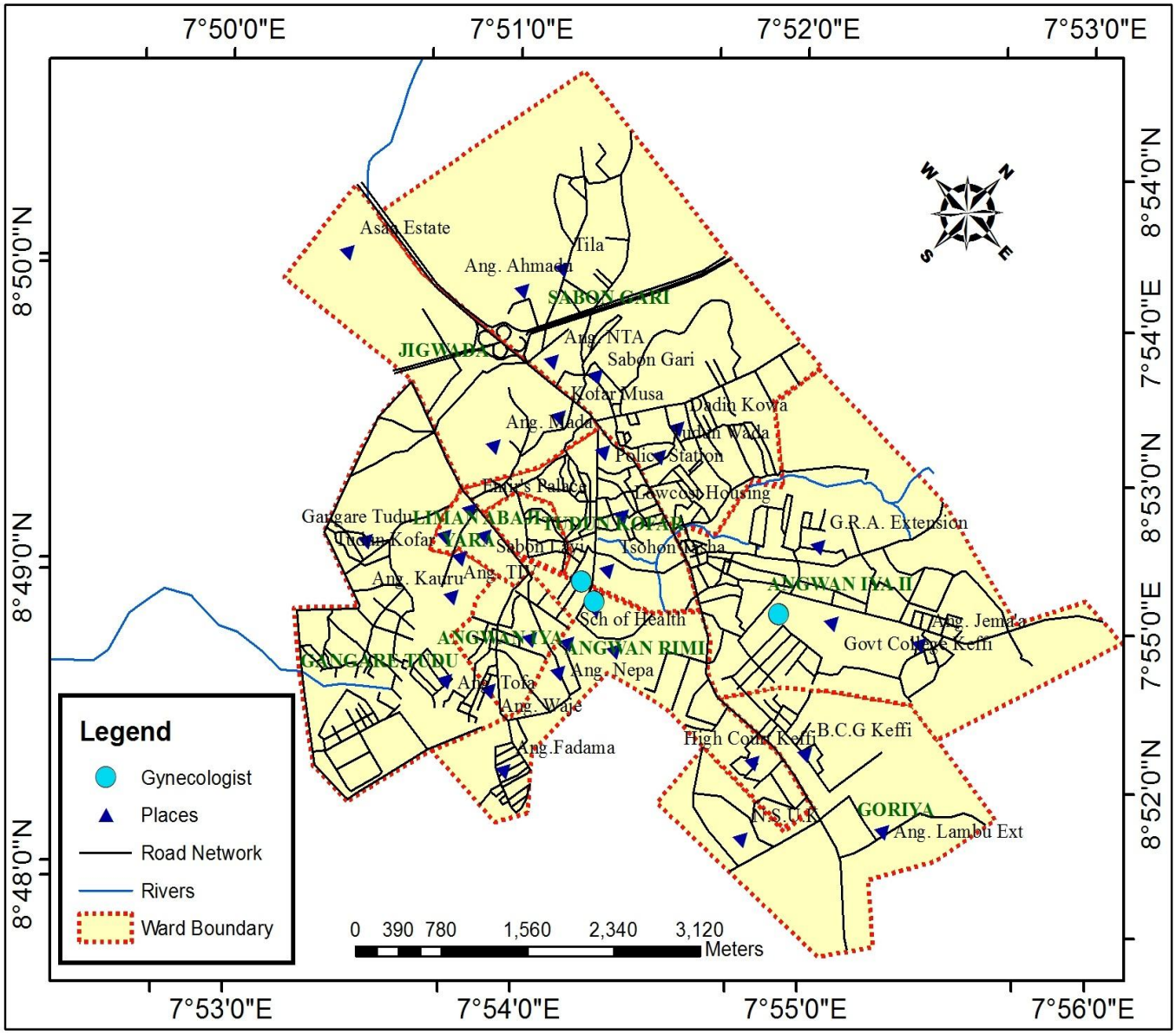


Figure 4.8: Spatial Distribution of Healthcare Facilities with Gynecologist in the Study Area
Source: Authors Analysis

The result of the availability of Gynecologist is presented in figure 4.8 and table 4.8 respectively. The figure show the numbers available in both public and private healthcare facilities the survey revealed that there are 5 Gynecologist in the public healthcare facilities,

representing (50%) and 5 in the private healthcare facilities, representing (50%) the availability of such services is grossly inadequate, and poorly distributed as shown on figure 4.9.

Table 4.8: Availability of Gynecologist in both Public and Private Health Facilities

HCF	NO OF GYNECOLOGIST	PERCENTAGES (%)
PRIVATE	5	50
PUBLIC	5	50
TOTAL	10	100

Source: Author's Analysis

4.3.7 Distribution of HCF with Dentist

The figure 4.9 and table 4.9 show the spatial distribution of HCF with dentist.

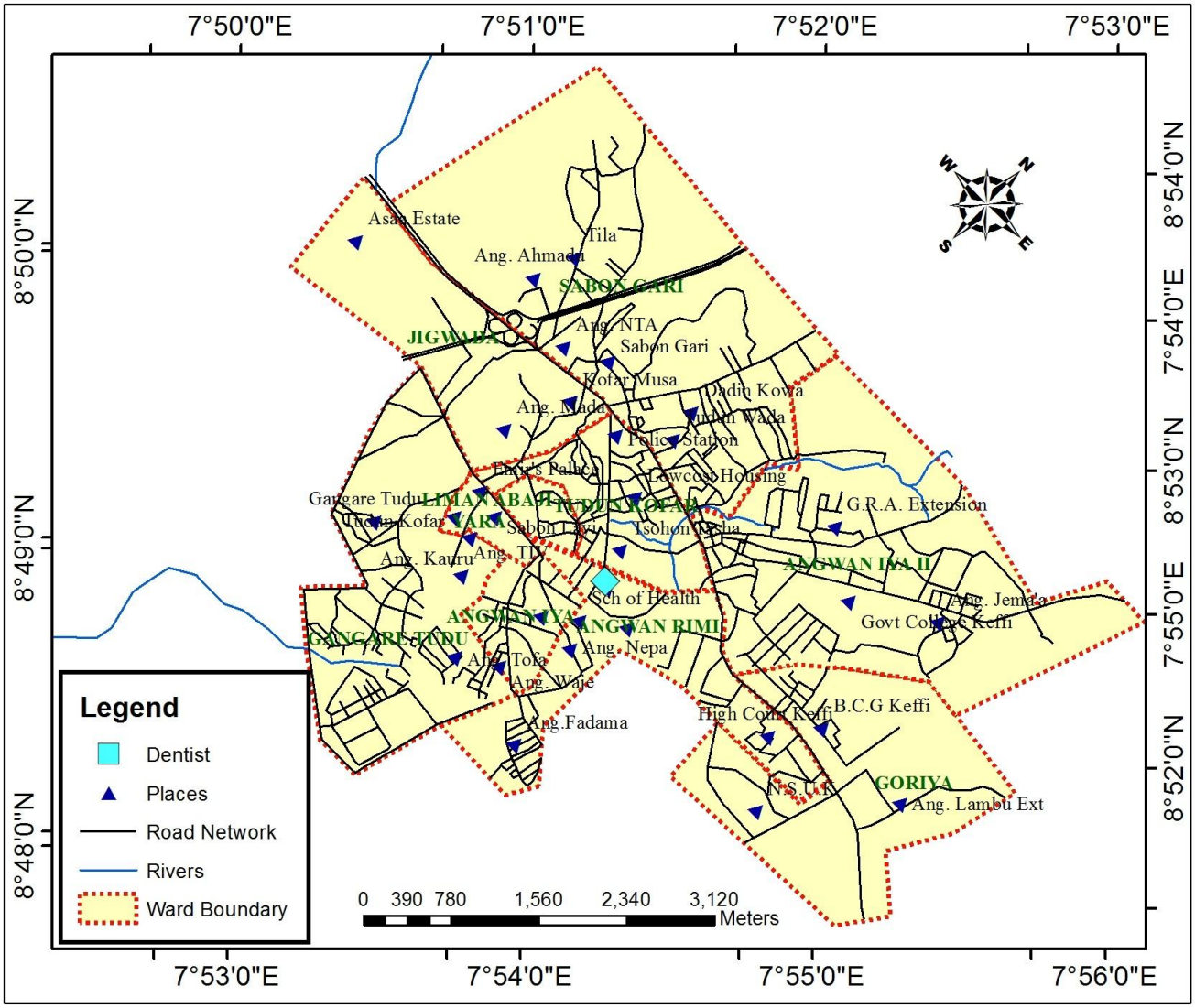


Figure 4.9: Spatial Distribution of Healthcare Facilities with Dentist in the Study Area
Source: Authors Analysis

Table 4.9: The Availability of Dentist in both Public and Private Health Facilities

HCF	NO OF DENTIST	PERCENTAGE (%)
PRIVATE	0	0
PUBLIC	1	100
TOTAL	1	100

Source: Author's Analysis

The result of the distribution of Dentist is represented in figure 4.9 and Table 4.9 respectively. The result revealed that private healthcare facility had 0 while the public healthcare facility had 1 which was at the Federal Medical Centre (FMC) representing (100%).

4.3.8 Distribution of HCF with Optometrist

Figure 4.10 and table 4.10 show the spatial distribution of HCF with Optometrists

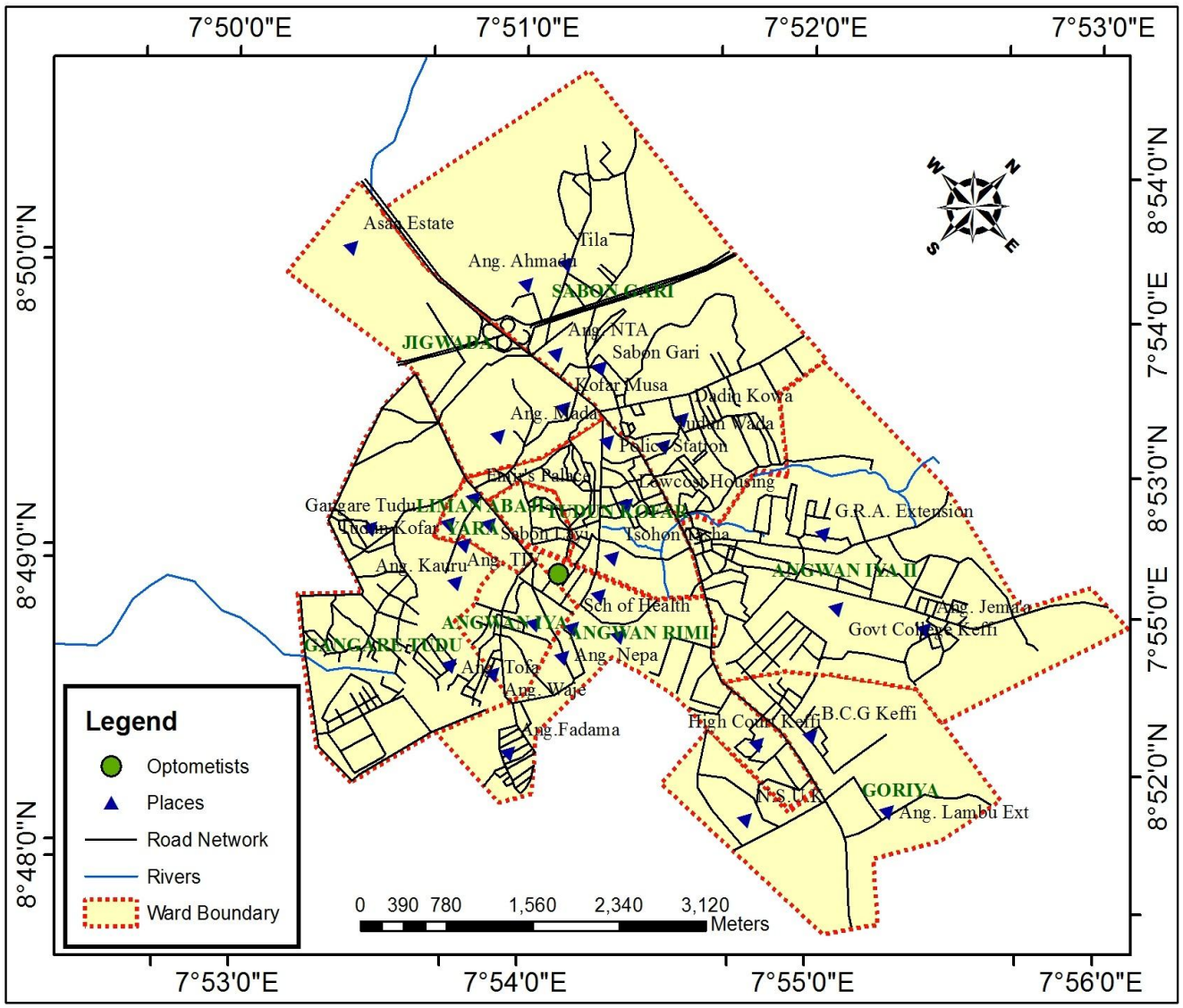


Figure 4.10: Spatial Distribution of Healthcare Facilities with Optometrist in the Study Area
Source: Authors Analysis

Table 4.10: Availability of Optometrist in both Public and Private Facilities

HCF	NO OF OPTOMETRIST	PERCENTAGE (%)
PRIVATE	2	28.5
PUBLIC	5	71.4
TOTAL	7	100

Source: Author's Analysis

The result of the availability of Optometrist is presented on figure 4.10 and table 4.10 respectively. The availability of optometrist in the surveyed wards revealed that 7 optometrist where available in all, 2 where available in the private healthcare facilities which represent (28.5 %) and 5 where available in the state run facility which represent (71.4 %).

4.3.9 Distribution of HCF with Cardiologist

The result shows the spatial distribution of HCF with cardiologist. From the results, none of the Healthcare in the study area had Cardiologist at all and as such there is an urgent needs of such personals in the study area so as to a certain the criteria's assigned for the establishment of healthcare facilities. It was also shows the availability of cardiologist, in the surveyed wards, the result revealed that there are no such services available in both the public and the private healthcare facility. This is a serious gap in terms of a professional service that required in the study area. In view of the rise in hypertension and heart attack, there is a serious need for a cardiologist to meet the growing need of such services.

4.3.10 Distribution of HCF with Psychiatrist

Figure 4.11 and table 4.11 show the spatial distribution of HCF with psychiatrists.

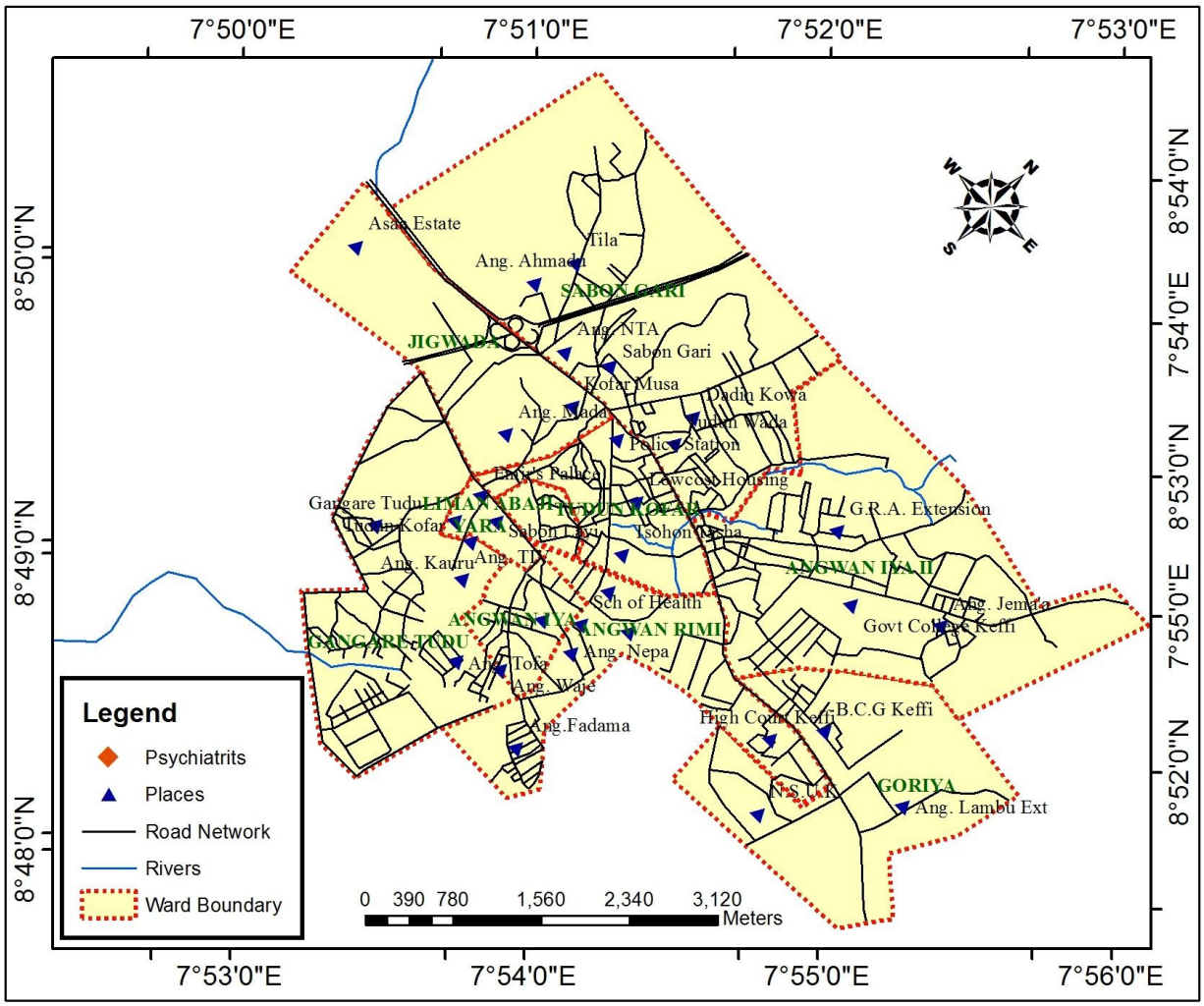


Figure 4.11: Spatial Distribution of Healthcare Facilities with Psychiatrist in the Study Area
Source: Authors Analysis

Table 4.11: Availability of Psychiatrist in both Public and Private Facilities

HCF	NO OF PSYCHIATRIST	PERCENTAGE (%)
PRIVATE	0	0
PUBLIC	5	100
TOTAL	5	100

Source: Author's Analysis

From the query analysis made in figure 4.11 show the availability of psychiatrist in the surveyed wards, the survey reveals the presence of only five psychiatrist in the public healthcare

facilities, representing (100%) such services is not available at the private healthcare facilities, which means that people living outside the public healthcare facility will find it difficult accessing such services.

4.3.11 Distribution of HCF with Immunization

The figure 4.12 shows the spatial distribution of HCF with immunizations.

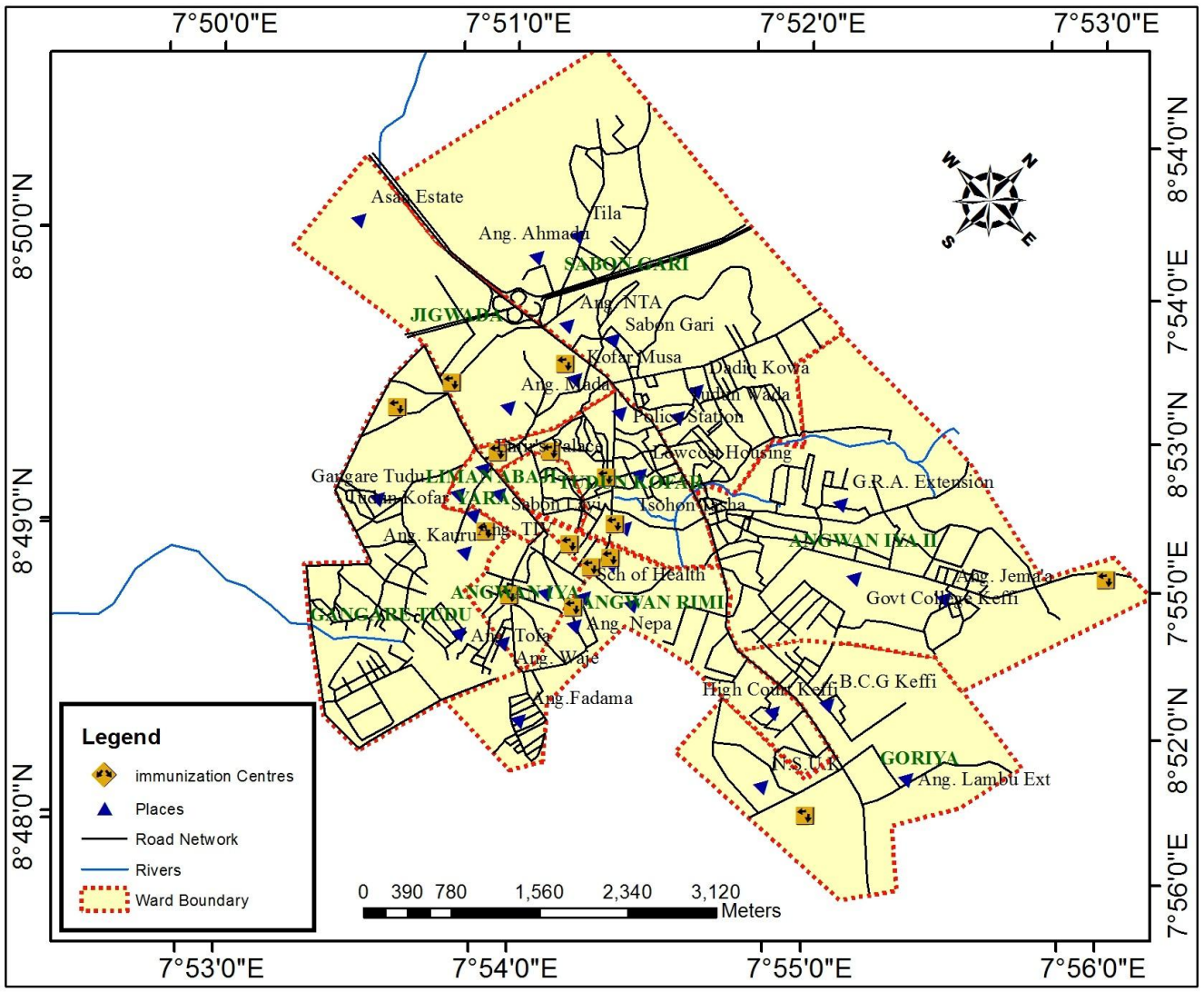


Figure 4.12: Spatial Distribution of Healthcare Facilities with Immunization in the Study Area
Source: Authors Analysis

Figure 4.12, show the distribution of health facilities with immunization centres, out the 30 health facility visited, only 15 have immunization services, this services were available in only four government health facilities while, eleven private health facilities had immunization services.

4.3.12 Distribution of HCF with Ambulance Facility

Figure 4.13 and table 12 show the spatial distribution of HCF with ambulances.

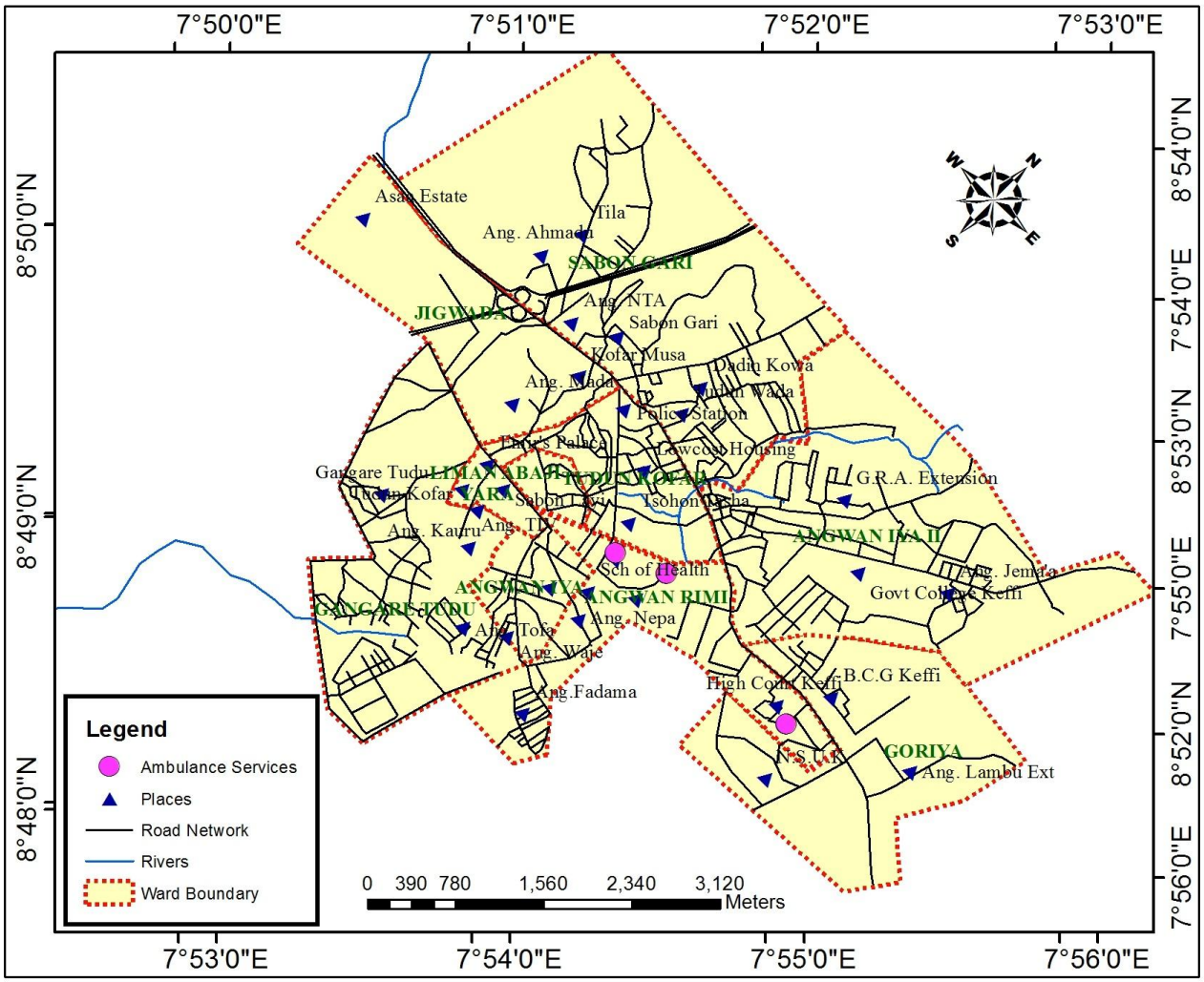


Figure 4.13: Distribution of Healthcare Facility with Ambulance Services in the Study Area
Source: Authors Analysis

Table 4.12: The availability of Ambulance Services in both Public and Private Facilities

HCF	NO OF AMBULANCE SERVICE	PERCENTAGE (%)
PRIVATE	0	0
PUBLIC	3	100
TOTAL	3	100

Source: Author's Analysis

Ambulance service for emergency referral was available only in 3 health facilities. The availability of ambulance in state run health facility was (100 percent.) which empties that ambulance were only found in public hospital and there is a need for an ambulance in the private primary healthcare in case of emergencies. Private hospitals had no ambulance service.

4.3.13 Availability of Beds in Both Public and Private HCF

Table 13 shows the spatial distribution of HCF with available beds space in both the public and private.

Table 4.13: availability of beds in both public and private healthcare facilities

HCF	NO OF BEDS	PERCENTAGE (%)
PRIVATE	159	34.7
PUBLIC	299	65.2
TOTAL	458	100

Source: Author's Analysis

Table 4.13, respectively show the availability of beds in the surveyed wards, a total of 458 beds where available in all, 159 where available in the private healthcare facilities which represent (34.7 %) and 299 where available in the state run facilities which represent (65.2%).

4.4 DOCTOR TO PATIENT RATIO

Table 4.14 show the ratio of doctor to patient

Table 4. 14. Ratio of Doctor to Patients

S/NO	Wards	Population	Numbers of Doctors	Doctor to Patient Ratio
1	ANGWAN RIMI	16420	64	1:256
2	GANGARE	8,100	0	0:8100
3	T-KOFAR	14,000	4	1:3500
4	L-ABAJI	14,840	5	1:2968
5	SABON GARI	4,320	8	1:540
6	GORIYA	5,420	0	0:5420
7	ANGWAN IYA I	8,860	6	1:1477
8	YARA	12,000	2	I:6000
9	ANGWAN IYA II	2,550	0	0:2550
10	JIGWADA	6,000	0	0:6000

Source: Author's Analysis

4.14 show that doctor patient ratio has a wide variation by wards. The most favorably supplied wards are Angwan Rimi with a ratio of 1:256, Sabon Gari 1: 540, and Agwan iya1 1:1477 whereas, Jigwada had a Doctor- Patient ratio of 0: 6000. Agwan Iya ii 0: 2550 and Goriya ward 0: 5,420. The figure shows that, there is a concentration of medical doctors in the

most populated area (Agwan Rimi) which can be attributed to the presence of the Federal Medical Centre (FMC). The recommendation by W.H.O that, the standard for doctor-patient ratio in developing countries is 1:10,000 is observed at Agwan Rimi, Sabon Gari, and Agwan iya1. However, the situation at Agwan Iya ii, Goriya, and Jigwada ward is in complete contrast to W.H.O standard due to the absence of Medical Doctors. W.H.O (1997).

4.5 NURSES TO PATIENT RATIO

Table 4.15 shows the ratio of nurses to patient.

Table 4.15. Ratio of Nurses to Patient

S/NO	Wards	Population	Numbers of Nurses	Doctor to Patient Ratio
1	ANGWAN RIMI	16420	101	1:163
2	GANGARE	8,100	1	1:8100
3	T-KOFAR	14,000	4	1:3500
4	L-ABAJI	14,840	5	1:2968
5	SABON GARI	4,320	15	1:288
6	GORIYA	5,420	0	0:5420
7	ANGWAN IYA I	8,860	11	1:805
8	YARA	12,000	5	I:2400
9	ANGWAN IYA II	2,550	2	1:1275
10	JIGWADA	6,000	0	0:6000

Source: Author's Analysis

Table 4.15 shows a treat in the distribution of nurses by ward, very poor situation is observed at Goriya ward with a Nurse Population ratio of 0: 5420 and Jigwada ward 0:6000

while the most favorable situation is observed at Rimi 1: 163, followed by Sabo Gari 1: 291, and then Agwan iya i 1:805. This is in line with W.H.O standard of one Nurse to a thousand people 1:1000

4.6 TRAVEL DISTANCE AND TIME TO FMC

4.6.1 Travel Distance and Time from Settlements to FMC

The analysis of travel distance and time from settlements to FMC in the study area is shown in figure 4.14 and table 4.16 respectively.

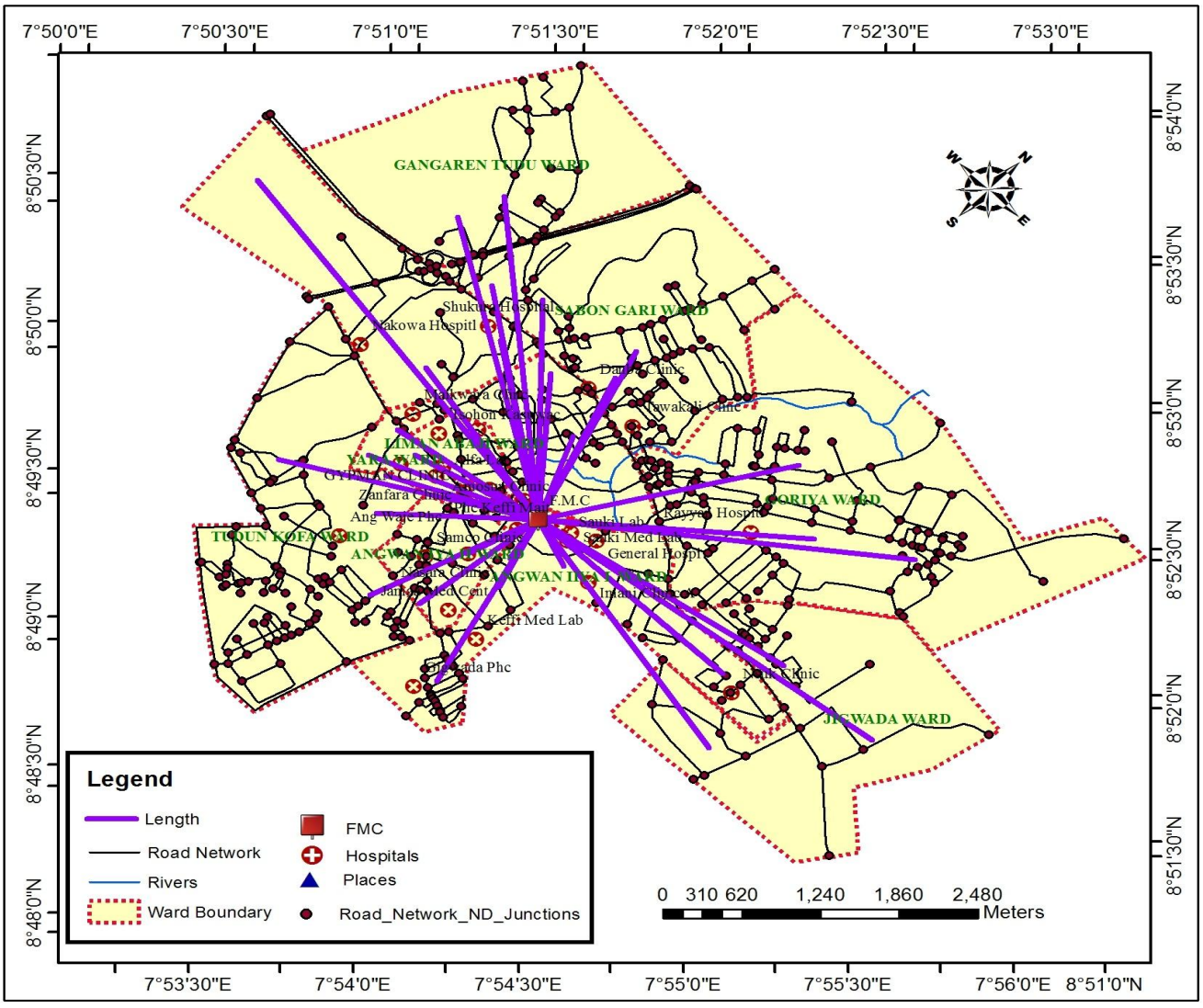


Fig. 4.14: Travel time from settlements to FMC in relation to the road Network
Source: Author's Analysis

TABLE 4.16: Travel Time from Settlement to FMC

FID	Destination	Origin	Distance (m)	Avg. Speed (m/min)	Travel Time (min)
1	Lowcost Housing	F.M.C.	788.04	500	1.58
2	Police Station	F.M.C.	1292.55	500	2.59
3	Tudun Wada	F.M.C.	1391.43	500	2.78
4	Ang. Mada	F.M.C.	1606.80	500	3.21
5	Emir's Palace	F.M.C.	1361.49	500	2.72
6	Sabon Layi	F.M.C.	1124.35	500	2.25
7	St Peters Church	F.M.C.	635.78	500	1.27
8	Ang. Nepa	F.M.C.	667.53	500	1.34
9	F.G.C Keffi	F.M.C.	457.42	500	0.91
10	Govt College Keffi	F.M.C.	2180.40	500	4.36
11	Ang. Jema'a	F.M.C.	2989.50	500	5.98
12	G.R.A. Extension	F.M.C.	2108.33	500	4.22
13	Kofar Musa	F.M.C.	1598.28	500	3.20
14	Dadin Kowa	F.M.C.	1678.16	500	3.36
15	Sabon Gari	F.M.C.	1939.92	500	3.88
16	Ang. NTA	F.M.C.	2099.00	500	4.20
17	Ang. Ahmadu	F.M.C.	2747.72	500	5.50
18	Tila	F.M.C.	2866.96	500	5.73
19	Asaa Estate	F.M.C.	3726.32	500	7.45
20	Tsohon Tasha	F.M.C.	309.02	500	0.62
21	Ang. Waje	F.M.C.	1195.10	500	2.39
22	Ang.Fadama	F.M.C.	1639.31	500	3.28
23	Gangare Tudu	F.M.C.	2111.45	500	4.22
24	Sch of Health	F.M.C.	408.50	500	0.82
25	High Court Keffi	F.M.C.	1991.08	500	3.98
26	B.C.G Keffi	F.M.C.	2325.46	500	4.65
27	N.S.U.K	F.M.C.	2426.86	500	4.85
28	Ang. Lambu Ext	F.M.C.	3274.97	500	6.55
29	Ang. Tofa	F.M.C.	1484.78	500	2.97
30	Tudun Kofar	F.M.C.	1450.23	500	2.90
31	Ang. Kauru	F.M.C.	1256.44	500	2.51
32	Ang. TIV	F.M.C.	1273.71	500	2.55

Source: Author's Analysis

The result of the GIS analysis on travel distance and time to the FMC from the wards in the study area is presented in Figure 4.14 and Table 4.16 respectively. The result showed that the travel time from settlement to FMC range between less than a minute to about seven (7) minutes. The shortest travel distance is from Tsohon Tasha, Federal College Keffi, and School of Health respectively, which have a distance of less than a meter each and which takes less than a minutes each. While the highest travel distance is from Asaa Estate and Angwan Lambu Extension with a travel time of 7.4 and 6.5 minutes respectively.

Travel time to FMC in Keffi LGA is mostly affected by the nature and type of roads settlement density and road network. Most of the road are tarred but are heavily congested with motor bikes and smaller cars. In addition, all the roads have several speed bumps along many sections which slow down vehicular movement. While some of the speed bumps are justifiable like the ones near the Nasarawa State University along Keffi-Akwanga Road, however, they impede vehicular movement in case of emergency

4.6.2 Travel Distance and time from Wards to Federal Medical Centre

The analysis of travel distance and time from wards to FMC in the study area is shown in figure 4.15 and table 4.17.

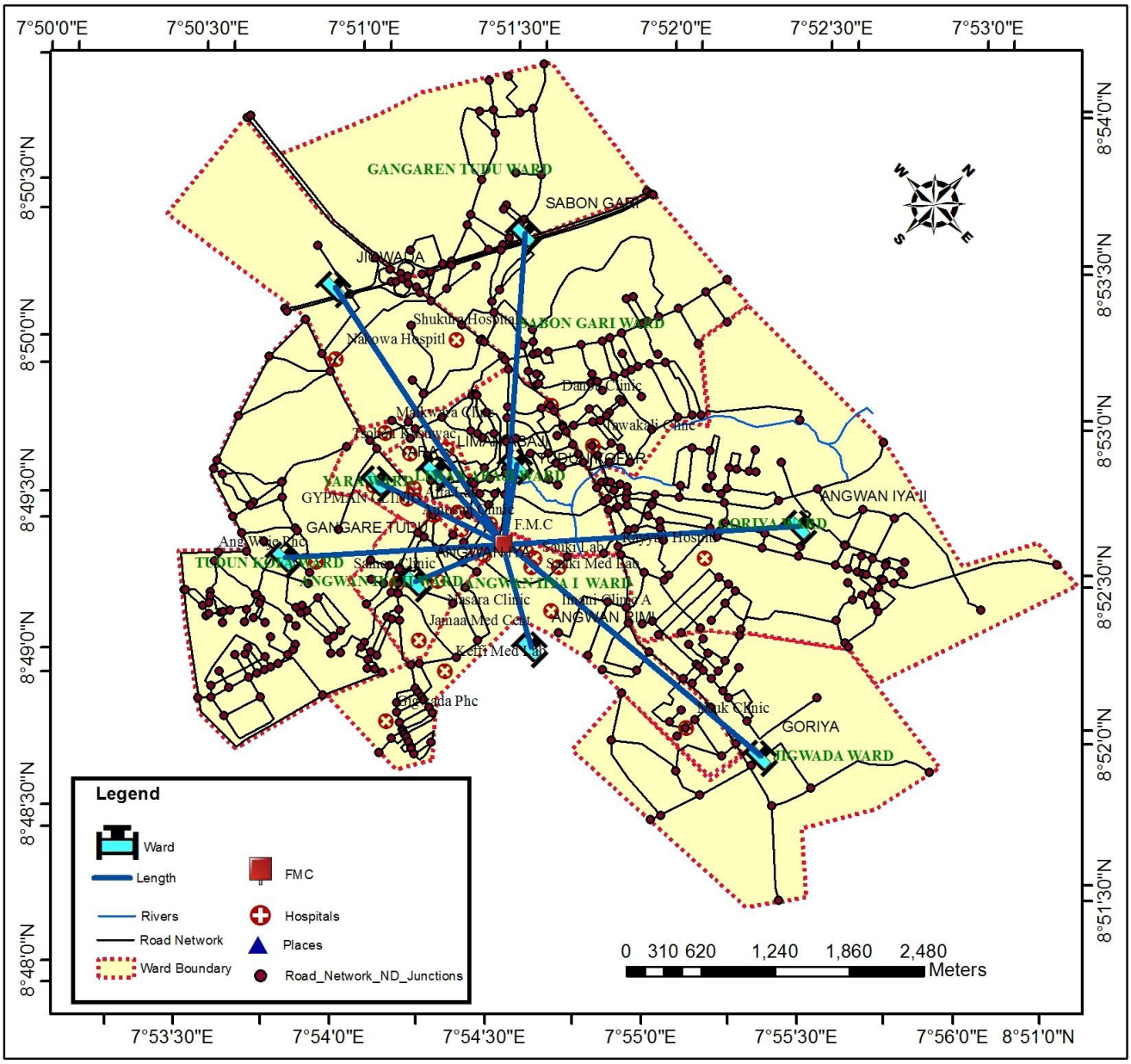


Fig 4.15: Travel Time from ward to FMC
Source: Author's Analysis

Table 4.17: Travel time from ward to FMC

FID_	Origin	Destination	Distance (m)	Avg. Speed (m/min)	Travel Time (min)
1	Gangare	F.M.C.	1822.89	500	3.65
2	Yara	F.M.C.	1172.07	500	2.34
3	Goriya	F.M.C.	2795.92	500	5.59
4	Tudun Kofa	F.M.C.	676.48	500	1.35
5	Jigwada	F.M.C.	2566.73	500	5.13
6	Angwan Iya 1	F.M.C.	801.37	500	1.60
7	Angwan Iya 2	F.M.C.	2473.18	500	4.95
8	Liman Abaji	F.M.C.	829.19	500	1.66
9	Angwan Rimi	F.M.C.	880.28	500	1.76
10	Sabon Gari	F.M.C.	2606.13	500	5.21

Source: Author's Analysis

As shown from figure 4.15, Table 4.17 showed that the travel distance from ward to FMC range between a minute to about five (5) minutes. The shortest travel distance is from Tudun Kofa to the FMC, which have a distance of 676.48m (metres) one minute. While the highest travel distance is from Goriya ward to FMC, which has a travel time of 5.59 (m) minutes and a travel distance of 2795.92 (m) metres.

4.7 DATABASE FOR HCF IN THE AREA

Tables 4.18 to 4.20 show the results of database of healthcares facilities in the study area is show in appendix 1.

4.8 PROPOSED LOCATIONS FOR NEW HCF

The choice for the selection of the proposed site was based on the population of the wards. On the bases of the population, the areas selected have the population that is required for the sitting of primary healthcare based on the World Health Organization Standards.

The areas that require new healthcare facilities are Sabon Gari, Agwan Iya ii, and Agoriya wards. They areas are the developing areas in Keffi town with a considerable number of people and infrastructures. Goriya ward has a population of 4,520 people, Agwan Iya ii has population of 2,550 people and Sabon Gari has a population of 4,360 people N.P.C (2006). When new health centres are established in the proposed area it will go a long in increasing accessibility in terms of emergencies.

CHAPTER FIVE: SUMMARY, CONCLUSION, AND RECOMMENDATION

5.1 INTRODUCTION

In this chapter, an attempt was made to give a summary of the whole study and consequently a conclusion was drawn according to the findings. Finally, some recommendations were made to improve the unfavorable situations.

5.2 SUMMARY

The aim of this study was to assess the distribution of Healthcare facilities in Keffi L.G.A of Nasarawa State. The research revealed that there were 30 HCF in Keffi L.G.A of this number, 23 or 66.7% are PHC, 6 area SHC (or 20%) and 1 HCF (i.e 3.33%) is a Tertiary HCF. The result from the research further revealed that the location of healthcare facilities does not take into account the size of population and specific examples include Agwan Iya I ward with 4,150 inhabitants has only 1 private secondary healthcare facility while Angwan Iya II-Ward has 4,097 inhabitants but is served by six P.H.C Similarly, location of healthcare facilities is not based on the administrative units.

The situation of medical doctors, in both public and private health facilities in the ten wards, revealed that there was a total number of 91 medical doctors with the bulk in the government run facilities, specifically the FMC which is a referral centre and the employment there is permanent pensionable. The situation with Nurses is not different, the research revealed a total of 180 nurses in the study area. The public healthcare facilities have a total of 101nurses which represent (56.1 %) and that of private sector was 79 which represent (43.9 %). The geographic distribution of Nurses and Doctors was unbalanced in the surveyed wards. Certain wards had too many Nurses and Doctors for instance, Agwan Rimi, and Agwan iya. This will

invariably affects the equitable distribution of these medical professionals in the study area, thereby, reducing the chances of other people from nearby settlements of accessing such a vital service

The result of the GIS analysis on travel distance to the FMC within wards in the study area showed that the travel distance from settlement to FMC range between less than a minute to about seven (7) minutes. The shortest travel distance is from Tsohon Tasha, Federal College Keffi, and School of Health respectively, which have a distance of less than a minute each and less than a metre each. While the highest travel distance is between Asaa Estate and Angwan Lambu Extension respectively with a travel time of 7.4 and 6.5 minutes respectively.

Also, the result of the GIS analysis on travel distance from wards to the FMC in the study area showed that the travel distance from ward to FMC range between a minute to about five (5) minutes. The shortest travel distance is from Tudun Kofa to the FMC, which have a distance of one minute, and 676.481903m (metres). While the highest travel distance is from Goriya ward to FMC, which has a travel time of 5.591848814(m) minutes and a travel distance of 2795.924407(m)metres.

5.3 CONCLUSION

After the analysis, it was found that healthcare facilities has been provided but not equally distributed. Healthcare planning is a challenging field that depends on the spatial data such as location and characteristics of health centres demand. Today, health planners have a task to ensure that health services are provided at the best location in Keffi LGA. This analysis has revealed significant variability in the distribution of healthcare facilities and professionals in the study area. These findings were made possible through the development of a GIS methodology that is appropriate for this research setting, and through careful consideration of the required data to use. There is a need for ongoing examination of the distribution of healthcare professionals and healthcare facilities in the study area. Examination of the spatial the distribution of healthcare professionals and healthcare facilities in additional L.G.A in the State will help to further the understanding on how healthcare facilities and professionals are distributed in the entire state for effective health service delivery.

5.4 RECOMMENDATIONS

Based on the findings from this study, the following recommendations which are in line with the study variables but also touch on policy issues:

i. The mapping of healthcare facility shows that there is great disparity in terms of location of healthcare facilities; example Agwan rimi ward has a concentration of healthcare facilities, while Goriya ward, Sabon gari ward, and Agwan iyaII don't have any healthcare facility. The government is in a better position to intervene in order to reduce the spatial disparities in distribution of healthcare facilities by

observing and comparing the spatial distributions of the hospitals with WHO standards.

ii. The location of healthcare facilities should reflect upon the dynamics of urban population which differs from both urban characteristics. This is due to the fact that some private healthcare providers may not afford the required capital needed to invest in a higher healthcare system.

iii. Although it has been seen that physical accessibility is a key determinant of location of private healthcare facilities, the overall observation is that infrastructure such as roads, electricity and water are central to attract healthcare providers in urban areas. Therefore, to create attractive Environments for private investment government should focus on physical infrastructure such as roads, electricity and pipe born water to other area as to serve as an attraction to development partners there by Providing comprehensive care in an integrated manner to the population of the Local Government Area.

iv. The survey showed the significance presence of non-state health facilities providing curative as well as preventive health services. This implies the need for healthcare policy towards governance, regulation, motivation and promotion of non-state health facilities to provide health services to the wider community as per the national rules, regulations and standards.

v. In initial phase of survey only keffi Local Government Area was covered. To provide a total picture the survey needs to be continued. Spatial location, service availability and health workforce data from rest of the Local Government Areas needs to be collected in a future research so as to give a complete coverage of the entire States.

To use the full potentiality of GIS in Keffi Local Government Area and Nigeria as a whole, it needs to be institutionalized. Institutionalizing here refers to make GIS as an integral part of health service planning, monitoring and evaluation and applying it in the field of health care management, research and health information education.

5.5 AREAS FOR FURTHER RESEARCH

This study proposes a need to identify and examine government interventions and their spatial implications on urban development patterns and service delivery in general and location and distribution of healthcare facilities in particular. Findings from the study area suggest the need to define spatial focus and areas of concentration for government and private sector in order to achieve equity in public service delivery in urban areas. Another area that needs to be looked into is the socio-economic aspect of the people in the study area, so as to ascertain the economic status of the population in questioned as to their ability to afford medical services irrespective of cost. Another area of interest in further research should the aspect of waiting time at health facilities.

There is need to carry out a comprehensive mapping of health facilities in the entire 13 local government area in the state so as achieve a total coverage of the state.

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APPENDIX 1

Table 4.18: Data base of Healthcare Facilities

FID	EASTINGS	NOTHINGS	CLASS	NAME 1	LOC GOV	WARD	HLTH FAC	HLTHFAC	ND	N-N	N-MW	N-P
1	376803	978503	PHC	Alfa Lab	KEFFI	RIMI	PRIVATE	PHC	0	0	NIL	0
2	376438	977751	PHC	GYPMAN	KEFFI	I YA II	PRIVATE	PHC	0	2	NIL	1
3	376595	977577	PHC	Allah Bamu	KEFFI	YARA	PRIVATE	PHC	1	4	5	1
4	376943	977885	PHC	Amosun Cli	KEFFI	RIMI	PRIVATE	PHC	2	1	0	0
5	376341	976800	PHC	Ang Waje F	KEFFI	GANGARE	PUBLIC	PHC	0	1	1	0
6	380526	981012	PHC	Angwa Jal	KEFFI	GIGWADA	PUBLIC	PHC	0	0	0	0
7	376802	978503	PHC	Danbe clini	KEFFI	RIMI	PRIVATE	PHC	2	6	0	0
8	377187	977819	SECONDARY	Ebenezer	KEFFI	RIMI	PRIVATE	SECONDARY	2	4	0	0
9	377367	978057	TERTIARY	F.M.C	KEFFI	RIMI	PUBLIC	TERTIARY	250	300	100	50

10	374931	977695	SECONDARY	General HO	KEFFI		PUBLIC	SECONDARY	4	18	2	2
11	375839	974257	PHC	Gigwada PI	KEFFI	GIGWADA	PUBLIC	PHC	0	4	0	0
12	377454	978140	PHC	Hamamah I	KEFFI	RIMI	PRIVATE	PHC	0	0	0	1
13	376447	976669	PHC	Imani Clinic	KEFFI	RIMI	PRIVATE	PHC	1	6	0	1
14	377537	976903	PHC	Jamaa Mec	KEFFI	RIMI	PRIVATE	PHC	0	2	0	1
15	377555	976923	PHC	Keffi Med L	KEFFI	RIMI	PRIVATE	PHC	0	0	0	0
16	376055	978026	PHC	Maikwara C	KEFFI	RIMI	PRIVATE	PHC	1	4	0	4
17	377105	978291	SECONDARY	Nagari	KEFFI	SABON	PRIVATE	SECONDARY	8	15	2	2

				Hos								
18	375161	978122	SECONDARY	Nakowa Hos	KEFFI	RIMI	PRIVATE	SECONDARY	2	4	0	1
19	377360	977510	PHC	Nasara Clinic	KEFFI	RIMI	PRIVATE	PHC	0	5	1	0
20	380115	977660	PHC	Nsuk clinic	KEFFI	RIMI	PUBLIC	PHC	4	11	0	2
21	376640	977523	PHC	Phc Keffi M	KEFFI	YARA	PUBLIC	PHC	1	5	0	1
22	377978	978521	SECONDARY	Rayyan Ho	KEFFI	RIMI	PRIVATE	SECONDARY	4	4	0	1
23	376884	977188	PHC	Samco Cli	KEFFI	RIMI	PRIVATE	PHC	0	2	0	1
24	377489	978161	PHC	Sauki Lab	KEFFI	RIMI	PRIVATE	PHC	0	0	0	1
25	377488	978158	PHC	Sauki med	KEFFI	RIMI	PRIVATE	PHC	0	0	0	0

26	375763	979008	SECONDARY	Shukura Ho	KEFFI	I YA 1	PRIVATE	PHC	2	7	1	3
27	376165	978292	PHC	St Gabs Lab	KEFFI	TUDUN KO	PRIVATE	PHC	1	4	0	1
28	376339	977434	PHC	Tawakali Cli	KEFFI	I YA 1	PRIVATE	PHC	1	2	1	0
29	376093	978056	PHC	Tsohon Kas	KEFFI	I YA 1	PRIVATE	PHC	0	2	0	0
30	376440	977751	PHC	Zanfara Clini	KEFFI	LIMAN	PRIVATE	PHC	0	5	0	0

Source: Author's Analysis

Table 4.19: Data base of healthcare facilities

No. Dentist	No. Anesthetics	No. Lab Technician	No. Radiographers	No. Outpatient Attendant	No. Ward Attendant	No. Dresses	No. Outpatient attendant	No. Cleaners	No. Optometrists	No. Pediatrician	No. Cardiologist	No. X-technician
0	0	2	0	0	0	0	0	2	NILL	NILL	0	0
0	0	2	0	0	2	0	3	4	0	0	0	0
0	0	0	5	5	5	5	5	3	0	0	0	0
0	0	1	0	0	5	0	0	5	2	0	0	0
0	0	3	0	0	10	0	0	7	0	0	0	0
0	0	1	0	0	3	0	2	1	0	0	0	0
0	0	0	1	1	1	2	1	2	0	0	0	1
0	0	1	0	1	2	1	2	4	0	0	0	0
10	20	20	10	15	150	10	50	80	5	3	0	3

0	1	2	0	4	8	2	4	12	0	0	0	2
0	0	0	0	0	0	0	3	4	0	0	0	0
0	0	2	0	0	0	0	0	1	0	0	0	0
0	0	1	0	0	4	0	3	4	0	0	0	0
0	0	2	0	0	2	0	1	4	0	0	0	0
0	0	2	0	0	0	0	0	0	0	0	0	0
0	0	2	2	4	4	0	4	4	0	0	0	0
1	0	3	0	3	16	2	2	7	0	1	0	1
0	1	2	5	2	5	0	2	0	0	0	1	1
1	0	1	0	2	5	2	3	5	0	0	0	0
0	0	2	0	0	4	0	3	6	0	1	0	1
0	0	1	1	0	0	4	0	4	0	0	0	0
1	0	1	0	1	2	1	1	2	0	0	0	1
0	2	1	0	0	1	0	2	2	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0

0	0	2	0	2	0	0	0	2	0	0	0	0
0	0	2	0		3	0	3	6	0	0	0	0
0	1	0	0	0	2	2	4	0	0	0	0	0
0	0	1	0	1	4	0	3	2	0	0	0	0
0	0	1	0	0	2	2	4	2	0	0	0	0
0	0	1	0	0	2	2	2	2	0	0	0	0

Source: Author's Analysis

Table 4.20: Data base of healthcare facilities

No. Pathologist	**No. Gynecologist**	**No. Psychiatrist**	**No. Obstetrician**	**No. Ward**	**No. Beds**	**Immunization Unit**	**Emergency Service**	**Ambulance Service**	**Blood Bank**	**HIV-Screening Centre**
0	0	0	0	1	2	NO	NO	NO	NO	NO
0	0	0	0	2	6	NO	NO	NO	NO	NO
0	0	0	0	3	16	NO	NO	NO	NO	NO
0	1	0	2	8	6	YES	NO	NO	NO	NO

0	0	0	0	1	7	NO	NO	NO	NO	NO
0	0	0	0	2	16	YES	NO	NO	NO	NO
0	0	0	0	3	6	YES	NO	NO	NO	NO
0	0	0	0	3	8	YES	YES	NO	NO	NO
1	5	5	0	15	200	YES	YES	YES	YES	YES
0	0	0	0	4	40	YES	YES	YES	YES	YES
0	0	0	0	4	8	NO	NO	NO	NO	NO
1	0	0	0	0	0	NO	NO	NO	NO	NO
0	0	0	0	2	6	NO	NO	NO	NO	NO
0	0	0	0	3	6	NO	NO	NO	NO	NO
0	0	0	0	0	0	NO	NO	NO	NO	NO
0	0	0	0	6	15	YES	NO	NO	NO	NO
0	2	0	3	5	10	YES	YES	NO	YES	YES
0	0	0	0	4	8	YES	YES	NO	YES	YES
0	0	0	0	2	8	YES	NO	NO	NO	NO

1	0	0	0	4	20	YES	NO	YES	YES	YES
0	0	0	0	2	8	NO	NO	NO	NO	NO
0	2	0	0	3	3	NO	YES	NO	NO	NO
0	0	0	0	2	2	YES	NO	NO	NO	NO
0	0	0	0	1	2	NO	NO	NO	NO	NO
0	0	0	0	0	2	NO	NO	NO	NO	NO
0	0	0	0	3	12	YES	YES	NO	NO	NO
0	0	0	0	4	8	YES	NO	NO	NO	NO
0	0	0	0	4	12	YES	NO	NO	NO	NO
0	0	0	0	2	8	NO	NO	NO	NO	NO
0	0	0	0	2	5	NO	NO	NO	NO	NO

Source: Author's Analysis

APPENDIX II

LOCATIONAL ANALYSIS OF HEALTHCARE FACILITIES, IN KEFFI LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA.

This research is conducted as part of the fulfillment of the requirements for the award of M.Sc degree in GIS and Remote Sensing, at Ahmadu Bello University, Zaria.

Respondents are assured that all information provided shall be used purely for academic purposes.

HEALTHCARE SERVICE INPUT AND OUTPUTS

Kindly fill in the space provided

Date of interview: day_____Month_____20_____

Name of village _____Ward_____

District _____LGA_____

Health facility type _____

Health facility location_____

Health facility grade _____

I Manpower

1. Number of Doctors _____
2. Number of Nurses _____
3. ,, ,, Midwives _____
4. ,, ,, Pharmacists _____
5. ,, ,, Dentists _____

6. ,, ,, Anesthetists _____

7. ,, ,, Laboratory Technicians_____

8. ,, ,, Radiographers _____

9. ,, ,, Theatre Attendants _____

10. ,, ,, Ward Attendants _____

11. ,, ,, Dressers _____

12. ,, ,, Out-patient Attendants_____

13. ,, ,, Cleaners _____

14. ,, ,, Opticians/Optometrists _____

15. ,, ,, Pediatrician _____

16. ,, ,, Cardiologist _____

17. ,, ,, X- technician _____

18. ,, ,, Pathologist _____

19. ,, ,, Anesthetist _____

20. ,, ,, Psychiatrist _____

21. ,, ,, Obstetrician _____

22. ,, ,, Gynecologist _____

II. <u>Facilities</u>

1. Number of wards _____

2. ,, ,, Beds _____

3. Drugs_____(a)Adequate_____(b) Inadequate_____

4. Laboratory (a)Available_____(b)Not available_____

5. Available Laboratory (a)Functional_____(b)Not Functional____

6. Number of Ambulances_____

7. Surgical theatres (a) available_____(b) Not available

8. Source of water Supply_____

9. Electrical Supply (a) Adequate_____(b) Inadequate_____

10. Surgical Equipment (a)Available_____(b) Not available_____

11. X-Ray (a) Available_____(b) Not available_____

12. Dental ward (a) Available_____(b) Not available_____

13. Children's Cots (a)Available_____(b) Not available_____

14. Maternity Beds (a) Available_____(b) Not available_____

15. Pharmacy Dept. (a)Available_____(b)Not available_____

16. Administrative Blocks (a)Available _____(b)Not available_____

17. Dressing rooms (a)Available_____(b) Not available_____

18. Delivery room (a)Available_____(b) Not available_____

19. HIV Screening centre (a) Available_____(b)Not available_____

20. Intensive care unit (a)Available_____(b)Not available_____

21. Emergency unit (a)Available_____(b)Not available_____

22. Mosquito treated net (a)Available_____(b)Not available_____

23. Orthopedic unit (a)Available_____(b)Not available_____

24. Blood bank (a)Available_____(b)Not available_____

25. Immunization Unit (a)Available_____(b)Not available_____

26. Family planning unit (a)Available_____(b)Not available_____

27. What are the problems encountered by your Dispensary/Clinics/Hospital?

_____

_____

_____

THANK YOU