Towards Sustainable Distribution of Health Centers Using GIS: A Case Study from Nigeria

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Case Study

ABSTRACT

Aim: This research is aimed to assess the spatial distribution of health centres in Lokoja, Nigeria.

Study design: Case study.

Place and Duration of Study: Lokoja is located in Kogi State of Nigeria and lies within latitude 7º45´N and 7º51´N and longitude 6º41´E and 6º45´E of Greenwich meridian, between June 2010 and may 2011.

Methodology: This study was conducted within 5 neighborhoods in the study area. The Global Positioning System (GPS) was used to pinpoint the location of existing health centres. The inferential statistical tool applied in analyzing the data in this research is the "Nearest Neighbour Analysis" (NNA). This was used in establishing the distribution pattern of public and private health centres in the study area. Nearest Neighbour Analysis is the method of exploring pattern in the locational data by comparing mean distance (Do) of the phenomena in question to the same expected mean distance (De) usually under a random distribution.

Results: An output of 0.99228 was found, an indication of weak randomness, because it exceeds the Z-score table value of -0.723417 which is indicative of insignificant accessibility. This scenario is a microcosm of state of health facility distribution in typical Nigerian cities where health facility distributions do not adhere to any particular pattern or criteria

Conclusion: In the area where population is not evenly distributed, the mean centre of population distribution is calculated as the "demand", which forms the origin of location. The facility location point is considered as destination points or "supply". The travel time can then be estimated as the shortest time through the road networks between the pair of population and the healthcare facility locations. The best route can then be created using network data set and network analysis in arc/info.

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1. INTRODUCTION

Good health is no doubt a prerequisite for global livability of man, and it is a critical component of societal needs, hence a need for equitable distribution of health facilities as a factor for sustaining the population in cities. Accessibility to health facilities has a strong influence on people's earning capacity and it is fundamental to people's ability to enjoy and appreciate other aspects of life.

Aregbeyan (1992) regarded accessibility to health facilities for an individual in spatial perspective and that the physical accessibility of a household member to health care facilities is of considerable importance, but it is however constrained by distance.

As a general principle, it has been stated that the greater the distance between two (2) points, the lower the probability of these points being functionally related. A large number of studies have shown a regular decline in accessibility to health facilities with increasing distance in road transport journeys to hospitals. Similarly, some studies that were undertaken in different parts of Nigeria have equally shown variation in maximum distance which people travel to utilize health facilities, for instance, Adejuyigbe (1977) and Adeyemo (2005) noted that there is a limit to the distance, which people are ready to travel in order to enjoy some health services. They further maintained that attendance at each medical centre is a function of both type of services available in the medical centre and the distance from other medical centre providing similar service.

By way of further explanation Lewis *et al.,* (1999) have stressed that accessibility was constrained more by convenience of the day and hour of operation and waiting time and quality. However the factors of constrained in the study area have been found to be that of unplanned and chaotic distribution of health facilities and with a negative consequence on the health quality and the environment.

Hospitals and health centres have been found to be areas of remedies for health related problems, they have been described as the most complex of building types, providing wide range of services and other fundamental units, such as diagnostic and treatment functions, also with a laboratory emergency rooms and surgery. Hospital functions   such as food in – patient care or bed-related function. However what is called hospitals in most Nigerian cities fall short of all these. Hence health centres have been categorized in this research into, Small clinics, health centres and major centres based on the facilities and services provided (Carr, 2006).

1.1 Evolution of Health Centres in Nigeria

The advent of the provision of health facilities in Nigerian cities can be retraced back to the colonial period, when the Army corps provided free medical services to the colonial army and the then civil servants. This was in conjunction with a few private agencies and societies like the Young Men Christian Association (Y.M.C.A), the St John and the Red Cross societies, who established hospitals, dispensaries and maternities all over the country. Between 1946 and 1956 the then colonial government attempted provision and development

of medical services, which was referred to as Harkens-Walker's ten year development plan (Adeyemo, 2005).

The Harkens-Walker plan was established with the main objectives of providing portable water, hospitals and maternity centres and the training of medical personnel. This attempt however failed due to lack of coordination of the several agencies created by the central government, for instance in 1954 there was the adoption of the federal system of government in Nigeria where each regional government was made to create separate health schemes. The inability to successfully coordinate this health schemes led to the failure of the plan.

This was followed by another plan from 1970-1974, which was to correct the problems   of the initial development plan   as already explained, this plan was aimed at improving health service delivery and to restore facilities that were destroyed by Nigeria civil war (1967-1970), emphasis was given to environmental sanitation and the training of medical personnel. This plan also failed due to the inability to cushion the tremendous devastation of the civil war, which left the cities bereft with high poverty level, malnutrition and economic inflation. After this, came another plan called, the Basic Survey Health Scheme (BHSS) entrenched in the Nigerian third National development plan of 1975-1980, which served as a corollary of the earlier scheme. The idea here was to increase access of large segment of the populace to health care facilities, from 25%to 60%. It was also aimed to adjust and readjust locational distribution of health care institutions for preventive health programme, where health care was to be taken to the local level. The government was to provide Comprehensive Health Centers (CHC) at each local government council. They were to build four health centres in every local government area council, including twenty health clinics to form basic healthcare units. At the moment Nigeria is divided into 774, local government area councils in 36 states, with the federal capital, Abuja. So with these one can best imagine the number of healthcare centres that will be provided.

Studies have shown that with increase in population and rapid urbanization the present number of health centres are inadequate and worst still not equitably distributed .This have been attributed to haphazard location of the available health centres where a large percentage of the population in the city have no access to the existing health centres.

1.1.1 Study area

Lokoja is located in Kogi State of Nigeria and lies within latitude 7º45´N and 7º51´N and longitude 6º41´E and 6º45´E of Greenwich meridian.

It is situated at the confluence of river Niger and river Benue and lies in the western bank of the river Niger at an altitude of 45 – 125 meters above sea level (asl) towards the north-west and at the foot of the patti ridge, which rises to an altitude of 400m asl.

Before the creation of Lokoja as a state capital, the population was below 40,000 and by 1991 it increased to 43,784 (Kogi State Ministry of Budget and Planning). The 2006 census declared that over 196,643 persons inhabit Lokoja (National Population Commission, 2010). It has a heterogeneous population with various tribes from all part of Nigeria. The rapid urbanization witnessed in Lokoja has greatly affected the occupational structure of the people living in the area; from the predominantly primary activities (farming, fishing and trading) to secondary and tertiary activities.

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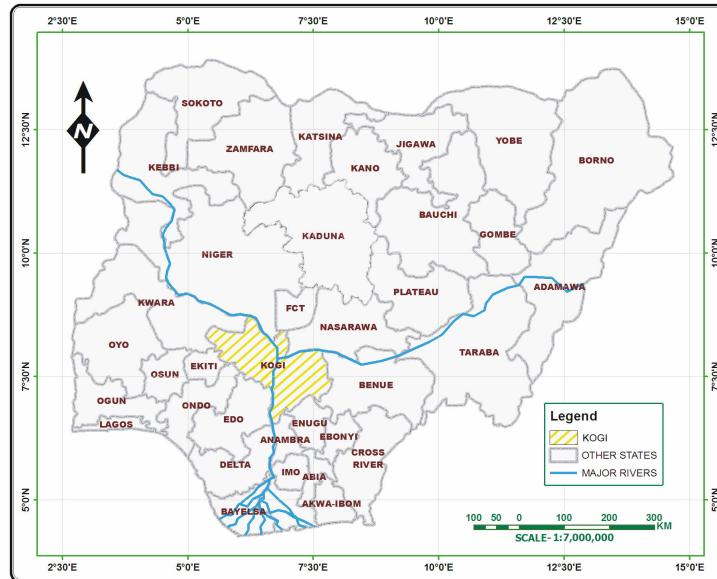

Figure 1: Kogi state in Nigeria

2. MATERIALS AND METHODS

This study was conducted within 5 neighborhoods in the study area. The Global Positioning System (GPS) was used to pinpoint the location of existing health centres.

The inferential statistical tool applied in analyzing the data in this research is the "Nearest Neighbour Analysis" (NNA). This was used in establishing the distribution pattern of public and private health centres in the study area. Nearest Neighbour Analysis is the method of exploring pattern in the locational data by comparing mean distance (Do) of the phenomena in question to the same expected mean distance (De) usually under a random distribution.

2.1 Examining the Existing Situation

Lokoja being a fast growing urban centre, have continued to receive the influx of migrants from other parts of the country which is attributed to its proximity to two giant industries of Ajaokuta still rolling mills and the Obajana cement factory and recently the outcome of the dredging of the river Niger. More so due to its location at the confluence of the river Niger and Benue acts as a very important trade center between the north and the south part of the country. Nevertheless it's still has challenges in the area of the health sector.

Table 1: Existing health centres in the selected neighborhood

Neighborhood	Health centre	Population
Felele	6	*8060
Otokiti	1	*7092
adankolo	1	*2906
Lokoja centre	5	139765
Lokongoma	3	18820
Total	16	196643

Projected population, 2011.
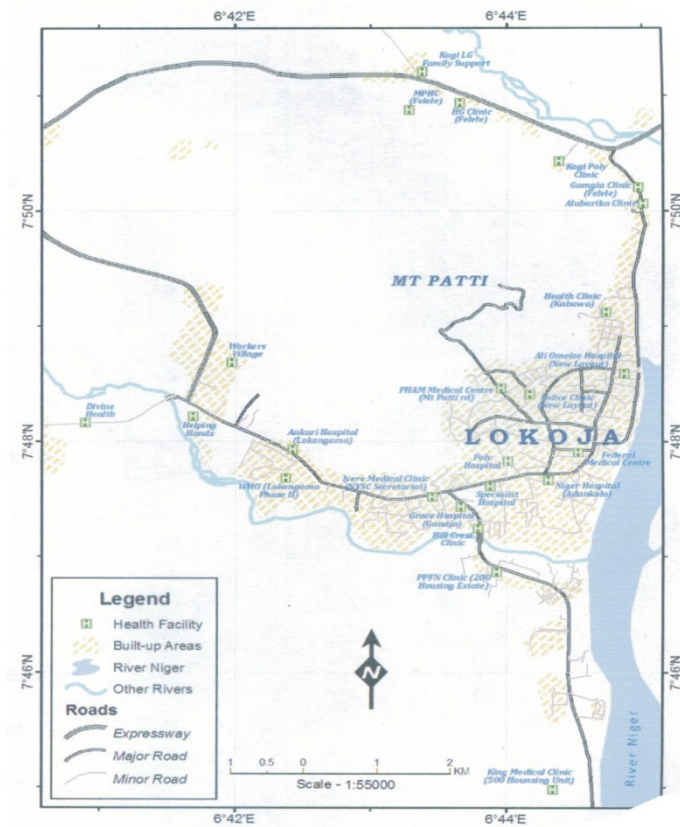
Figure 2: GIS map showing health centre distribution in study area

Observing the Table 1 above, the inadequacy of distribution of health facilities is obviously indicated, where the Felele area has only 6 health centres with an estimated population of 8060, Otokiti area has only one with a population of 7092, similarly Adankolo area also has one with a population of 2906, while Lokoja central has 5 with a population of 139765 and Lokongoma, 16 with a population of 18820.

It was found also that there 24 health centres in the study area, 5 of which are public health centres owned by the government and the remaining 19 were privately owned. A cursory observation shows most of this facilities were clustered within the northeastern and southwestern part of the city (see figure -2). The figure -2 shows that there are only 4 health

facilities in the northwestern and southwestern part of the study area, this are area called Sigma area (between the Otokiti and Lokongoma phase 2 area).another health facility can be found opposite the phase one, near the UNICEF office. But at the northwestern part of the town, there is a total absence of health facilities.

3. RESULTS AND DISCUSSION

3.1 Data Analysis

The nearest neighbor analysis was applied as

Rn=DO/De--------------------1
Where, Do-Ex/n ------------2
Where Ex= summation of distance between all points and n=number of points. And De=0.5√a/ n
A=area of the region under study; N=number of points in the study area

3.1.1 Results

The following was found as
Observed mean distance= 775.10;
Expected mean distance=839.93;
Nearest neighbor ratio=0.92212;
Z-score= - 0.723417;
Standard derivation P-Value=0.469424;
Observed mean distance/Expected mean distance=0.92;
Significant level =0.01;
Critical value= -258

To corroborate this observation, the nearest neighbor analysis (NNA) was conducted to determine the level of randomness and accessibility to these facilities, and an output of 0.99228 was found, an indication of weak randomness is, because it exceeds the Z-score table value of -0.723417 which is indicative of insignificant accessibility.

This scenario is a microcosm of state of health   facility distribution in a typical Nigerian city where health facility distributions do not adhere to any particular pattern or criteria (Omajali, 2010).

3.1.2 Discussion

The result shows a random distribution of facilities where accessibility is not uniform. This is more so because no method or pattern was applied during the allocation of these facilities. It is suggested that a method that considers spatial impediments in terms of availability, accessibility should be considered, it is also suggested health facility should be located at travel distance of at least 20 minutes from residential areas. The location of health facilities can be computed by the use of the computer with the Arc/info software (Bagheri, Benwell, Holt, 2005).Here the drive time and the least cost path analysis model is applied to find to the access to the facilities, then the best route or shortest time from population by computing the travel time and travel distance using the Arc/info. In the area where population is not evenly distributed, the mean centre of population distribution is calculated as the "demand",

which forms the origin of location. The facility location point is considered as destination points or "supply". The travel time can then be estimated as the shortest time through the road networks between the pair of population and the healthcare facility locations. (Environmental System Research Institute, 2005).The best route can then be created using network data set and network analysis in arc/info.

With the method elaborated above, best points at which facilities could be located to give about 95% access can be computed for a population to arrive at the facilities within 20 minutes drive time.

4. CONCLUSION

In the area where population is not evenly distributed, the mean centre of population distribution is calculated as the "demand", which forms the origin of location. The facility location point is considered as destination points or "supply". The travel time can then be estimated as the shortest time through the road networks between the pair of population and the healthcare facility locations. The best route can then be created using network data set and network analysis in arc/info.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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