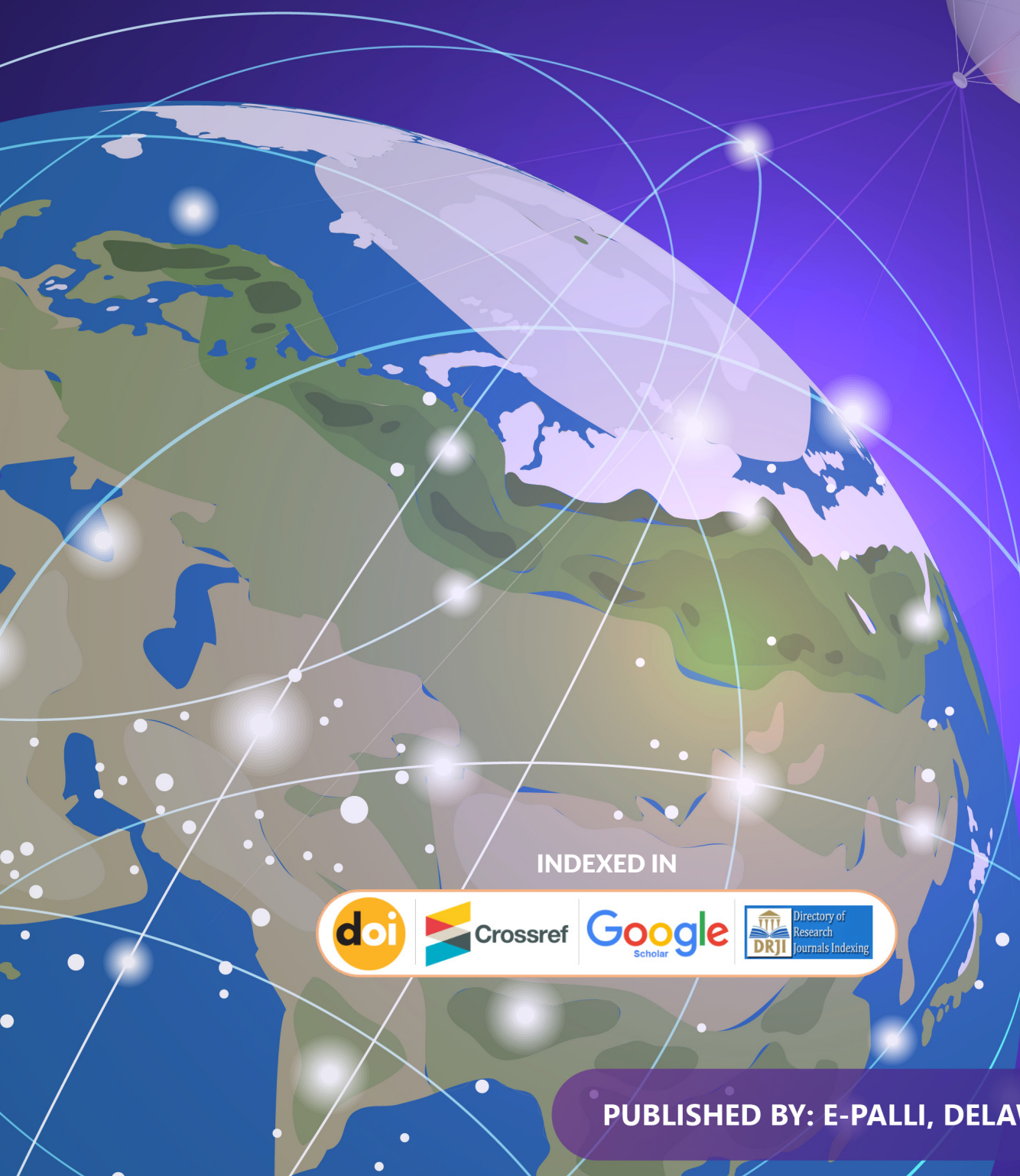
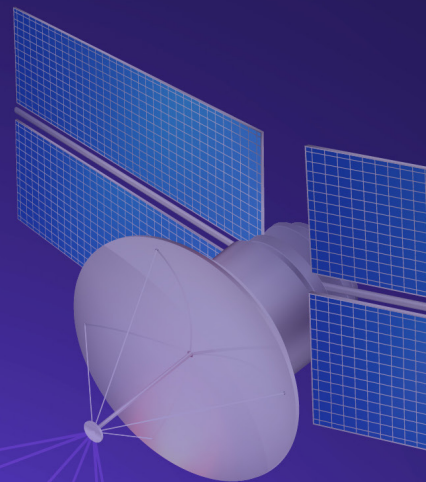




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## Geospatial Distribution of Health Centers in Dass Local Government Area of Bauchi State, Using Geographic Information System (GIS) Tools

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*Health Facilities, Geographical Information System, Spatial Distribution*

### ABSTRACT

This paper examined the spatial distribution of health care facilities in Dass local government area of Bauchi state using GIS tools. Data were obtained from primary and secondary sources: a GPS was used to collect the coordinates of each health care facility. Data from the Ministry of Health (Bauchi State) about the location, name and types of health care facilities in the study area included one general hospital; one model primary health centre, fourteen primary health centers, one clinic, one dispensary and one health post. Population data was obtained from the National Population Commission (NPC, 2006). GIS analysis was used in analyzing the data. The analysis of nearest neighbour was done by using the extension of Arc GIS 10.5 in the spatial analyst tool and average nearest neighbour. The result shows that there is less than 1% (0.01 level of significance) likelihood that the spatial pattern of the distribution of health care facilities in Dass Local Government Area is dispersed and this could be as a result of random chance. This might be as the result of the fewer number of health facilities. The research recommends that government should locate health care services close to the people as possible as distance was found to influence utilization.

### INTRODUCTION

Among the commanded objectives of creating local government is to bring development nearer to the populace. A vital aspect of development that the creation of local government was expected to offer, is the health care service. In Nigeria, spatial considerations have usually been given insufficient consideration in provision of health care facilities for rural areas (Kamorudeen, 2013).

According to Ajaero and Madu (2008) the ease and comfort with which public can utilize health facilities are among the most important variables determining the benefits individual can obtain from these facilities. Health care facilities are mostly determined by major factors such as distance that the patients must cover in order to obtain treatment. This is more pronounced in rural areas of less developed countries where health facilities are low and majority of patients prefer alternative sources of medicine because they are cheaper and also very easy to access. The type of facility, socio-demographic variables, type of illness and the care or treatment services can be influenced by distance covered (Ajaero & Madu 2008)). The pattern of distribution of health care facilities have been a thing of interest considering the effect it poses on the developmental level of any region (Cheptum et al, 2014). In most cases, distribution of health care facilities is determined by the degree of fairness.

There are many challenges faced by rural communities concerning health care access which include economic destabilization, shortages of medical personnel; as well as transportation and barriers to care (Isaac 2011). Inadequate infrastructures led to serious impact on the wellbeing of rural inhabitants. It has led to increasing decline in productivity and efficiency of production. Similarly,

inaccessibility of public infrastructures especially health care services is contributed by serious poverty in Nigeria more especially in rural areas (Mukhtar 2018). According to Igberase & Ebeigbe (2007) Location of health care facility influences utilization and also efficiency more when compared with influence of decision to seek and receive care. There are several factors that influence the utilization of health facilities which include social and economic systems, cultural beliefs and practices, status of women, level of education, gender, socio demographic variables and also location of health facilities.

Various studies such as (Atser & Akpan 2009; Ifatime et al., 2009) undertaken to examine the spatial distribution of health care facilities in Nigeria found that the major challenges with health care in Nigeria is lack of access to the health facilities by the people in need as well as lack of fairness in their distribution not only the services rendered.

In Dass local government, the need for equity and fairness in the distribution of health care facilities has not been given much concern and this may not be unconnected with the present emergence of many settlements in the local government headquarter in order to obtain care (Tshuma et al, 2015). In the Bauchi state, attempt has been made in relation to the subject matter such as Ismail et al, (2018), however, the scope of the research was limited to only the main town of Bauchi uncovering the current study area. Similarly, there is gap in methodological aspect of their research as little effort was made as regard to using GIS to address health issues. This research is an attempt to fill the identified gap in knowledge and to provide continuity in the subject area for other researchers.

Geographic Information System (GIS) forms a good

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information system in addressing such issue of lack of fairness in the spatial distribution. This has been used by many researchers of this kind in addressing spatial analysis problems in the world. This study therefore, finds it important to apply Geographic Information System (GIS) tools to analyze the spatial distribution of health care facilities in Dass Local Government Area, with a view to identifying areas that are not sufficiently provided and improving the spatial distribution of and equitable access to healthcare facilities in the study area. This is important because the health status of residents has implications on their productivity and the development of the local government.

There are three tiers of health services that Nigeria operates namely; Primary Health Services, Secondary Health Services and Tertiary Health Services.

## MATERIALS AND METHOD

### Study Area

The geographical location of Dass Local Government Area is approximately latitude 9.448 to 12.705 N latitude and 10.055 to 10.880 E longitudes. It is bordered by Tafawa Balewa LGA to the south-east and north-east, and Toro LGA in the North-west and South-west. It has an area of about 737 square kilometers with a total population of 2006 people (Dai et. al, 2004). Dass LGA has 12 wards namely; Polchi, Bununu south, bununu East, Bununu north, bununu west, dott, bundot, wandi, zumbul/lukshi, Baraza/Durr, Bajar/Bagel and BununuDass.

### Research Protocol

The first step in conducting this study involves collecting information from records in government files from Dass Primary Health Care Department in Dass Local Government in order to identify all the settlements with health care centers in the study area. Study visit conducted in all wards in the study area to find out the availability or otherwise of the health care center so that no settlement with health care center is excluded.

The second step involves taking coordinates (Latitude and Longitude) of the various health care centers using Global Positioning System (GPS) that enable mapping.

The third step involves collecting population data of Dass Local Government and various wards in Dass from National Population Commission.

## RESULTS AND DISCUSSIONS

### Spatial Distribution of Health Facilities in Dass L.G.A

The study of the distribution of health care facilities is important as it enable us to establish a pattern to show the distribution of health facilities in the study area.

Table 1 gives the geo-data base of the healthcare facilities across the wards in Dass local government area. It can be seen from the table 1 that there are 12 wards comprising fifteen healthcare facilities in the local government both private and public

From the table 2 above it can be seen that 12 out of the 15 health facilities were owned by the Public, which means they were maintain and manage by the state government or the local government. While the remaining ones are owned and maintain by private individual be it a personal or organizational. This shows that majority of the health facilities are public because majority of the people are in the rural areas cannot afford to pay fees for services in the Private clinics. This is in line with what Eniolorunda, and Dankani, (2012) observed, that access to health facilities is centered on economic accessibility and pointed out that 25% of the population in extreme poverty lacks access to health services. Also, health workers mostly if not living nearby usually, shun away from working in the rural areas. Furthermore, running a private clinic requires enormous sum of money and skill that might not be obtainable in the rural areas.

Table 3 gives the summary of the services rendered by each health facilities in the study area. All the health facilities offer Outpatient Services and Antenatal Services, some offer Routine Immunization Services, some offer Outreach Services, all offer Community Management of Acute Malnutrition (CMAM) and Family Planning and Inpatients Services. This has implication in terms of utilization since only General Hospital Dass offer various services where other health facilities do not offer such as

**Table 1:** Geo- database of the health care facilities in Dass L.G.A Bauchi State.

S/NO	Name of Health Facility	Ward	Latitude	Longitude
1	Bazali Primary Health care	Polchi	9.984	9.533
2	Dumba Clinic and maternity	Polchi	9.981	9.540
3	General Hospital Dass	BununuDass	10.000	9.516
4	Magayaki Clinic	BununuDass	10.088	9.670
5	Primary health care dass	Bununu south	10.083	9.500
6	Gaskoli Dispensary	Baraza/durr	10.033	9.383
7	Zumbul Primary Health care	Zumbul	9.415	9.969
8	Bundot Primary Health care	Bundot	9.515	9.968
9	Wandi Primary Health care	Wandi	9.616	9.985
10	Dot Primary Health care	Dott	9.983	9.516
11	Bajar/Bagel Primary Health care	Bajar/bagel	10.133	9.467
12	Kwaltukurwa Primary Health care	Kwaltukurwa	9.933	9.550
13	Waziri Patent	Bununu north	10.167	9.483
14	Bilyaminu Othman Private Clinic	Bununu east	10.017	9.550
15	Primary Health care Bununu	Bununu west	10.017	9.083



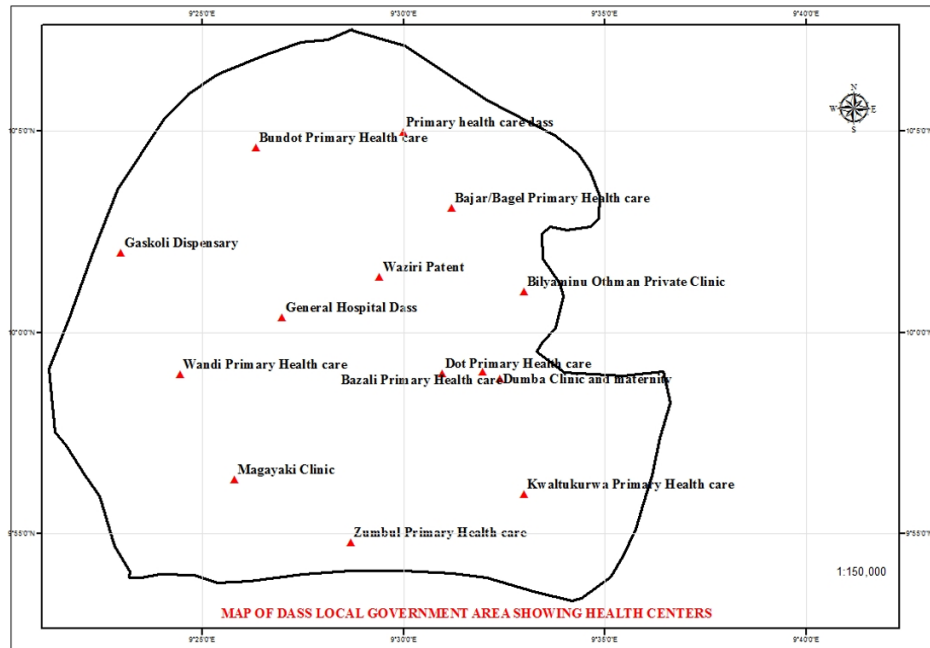


Figure 1: Map of dass local government area showing health centers

Table 2: Distribution of Health Care Facility by Ownership

S/NO	Name of Health Facility	Ward	Type of Facility by Ownership
1	Bazali Primary Health care	Polchi	Public
2	Dumba Clinic and maternity	Polchi	Public
3	General Hospital Dass	BununuDass	Public
4	Magayaki Clinic	BununuDass	Private
5	Primary health care dass	Bununu south	Public
6	Gaskoli Dispensary	Baraza/durr	Public
7	Zumbul Primary Health care	Zumbul	Public
8	Bundot Primary Health care	Bundot	Public
9	Wandi Primary Health care	Wandi	Public
10	Dot Primary Health care	Dott	Public
11	Bajar/Bagel Primary Health care	Bajar/bagel	Public
12	Kwaltukurwa Primary Health care	Kwaltukurwa	Public
13	Waziri Patent	Bununu north	Private
14	Bilyaminu Othman Private Clinic	Bununu east	Private
15	Primary Health care Bununu	Bununu west	Public

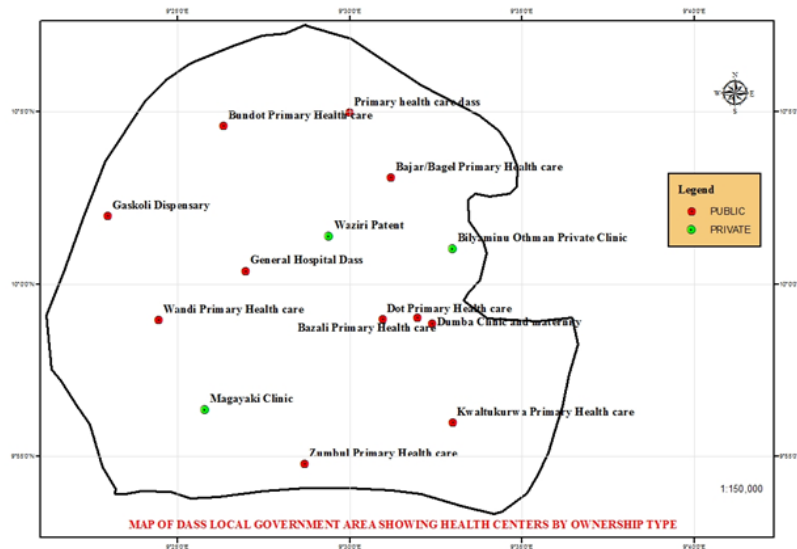


Figure 1: Map of dass local government area showing health centersby ownership type

Eye Clinic, Integrated Monitoring and Childhood Illness (IMCI), Pharmacy, Physiotherapy, Prevention of Mother to Child Transmission (PMTCT), Gynaecology and Obstetrics. Patients must opt for the use of the services which are not accessible to many patients, more especially those from dispersed settlements.

Table 3 gives the summary of the services rendered by each health facilities in the study area. All the health

facilities offer Outpatient Services and Antenatal Services, some offer Routine Immunization Services, some offer Outreach Services, all offer Community Management of Acute Malnutrition (CMAM) and Family Planning and Inpatients Services. This has implication in terms of utilization since only General Hospital Dass offer various services where other health facilities do not offer such as Eye Clinic, Integrated Monitoring and Childhood Illness

**Table 3:** Health Facilities by Type of Services Rendered

S/NO	Name of Health Facility	Ward	Type of Services Rendered
1	Bazali Primary Health care	Polchi	Antenatal, Outpatient cases.
2	Dumba Clinic and maternity	Polchi	Antenatal, Outpatient and Inpatient.
3	General Hospital Dass	BununuDass	With the exception of Orthopaedic cases Dass General Hospital handles all kind of services.
4	Magayaki Clinic	BununuDass	Antenatal cases
5	Primary health care dass	Bununu south	Antenatal, Outpatient cases.
6	Gaskoli Dispensary	Baraza/durr	Antenatal, Outpatient and Inpatient.
7	Zumbul Primary Health care	Zumbul	Antenatal, Outpatient cases.
8	Bundot Primary Health care	Bundot	Antenatal, Outpatient and Inpatient.
9	Wandi Primary Health care	Wandi	Antenatal, Outpatient and Inpatient.
10	Dot Primary Health care	Dott	Antenatal, Outpatient cases.
11	Bajar/Bagel Primary Health care	Bajar/bagel	Antenatal, Outpatient cases.
12	Kwaltukurwa Primary Health care	Kwaltukurwa	Antenatal, Outpatient cases.
13	Waziri Patent	Bununu north	Antenatal, Outpatient cases.
14	Bilyaminu Othman Private Clinic	Bununu east	Antenatal, Outpatient cases.
15	Primary Health care Bununu	Bununu west	Public

(IMCI), Pharmacy, Physiotherapy, Prevention of Mother to Child Transmission (PMTCT), Gynaecology and Obstetrics. Patients must opt for the use of the services which are not accessible to many patients, more especially those from dispersed settlements.

#### Result of Nearest Neighbour Analysis

The result of the Average Nearest Neighbor (ANN) analysis revealed that, the overall distributions pattern of the Health Centers in the wards in Dass local government is clustered with Z-score (critical value) of -4.563132. Therefore, given the z-score of -4.56313240348, there is a less than 1% likelihood that this clustered pattern could be the result of random chance. At p-value of 0.000005, using observed Mean Distance of 364.6445 Meters and Expected Mean Distance of 630.4964 Meters; the Nearest Neighbor Ratio is 0.578345 and hence concludes that the result of their spatial distribution of the filling stations is random.

Average Nearest Neighbour Summary

Observed Mean Distance: 364.6445

Expected Mean Distance: 630.4964

Nearest Neighbor Ratio: 0.578345

Z-score: -4.563132

P-value: 0.000005

#### Report of Special Autocorrelation Analysis

The result of the Special Autocorrelation (Moran's I) reveals that, Given the z-score of 1.178209, the pattern of distributions of the Health Centers wards in Dass Local Government does not appear to be significantly different than random. The result of the Moran's index value is 0.182322 with a P-value of 0.238714 at variance of 0.033169

#### DISCUSSION

The major findings in the analysis shows that the health centers were not evenly distributed in the local government which much emphasis for concentration of the health centers in the local government headquarter.

The result of the spatial statistical analysis returned five values within the software interface: Observed Mean Distance, Expected Mean Distance, Nearest Neighbour Ratio, zscore and P-value respectively and it calculated for the L.G.A the average nearest neighbour ratio automatically by dividing the observed average distances by the expected average distances with expected average distances being based on a hypothetical random distribution with the same number of facilities covering Dass L.G.A.

Figure 1 shows that there is less than 1% (0.01 level of significance) likelihood that the spatial pattern of the distribution of health care facilities in Dass Local Government Area is clustered in the local government headquarter and this could be as a result of random chance and it may not be unconnected with the clustering number of Health facilities in the local government headquarter. This analysis was used by Bogoro (2018) and found that the spatial pattern of distribution of health facilities in Bogoro L.G.A of Bauchi State, Nigeria is dispersed which differs with what is obtainable in Dass L.G.A of Bauchi State. The reason for this contrast might be because in Dass L.G.A, government did not worry about fairness in the number of health care facilities in other part of the local government thereby concentrating them in the headquarter.

In contrast, similar studies on spatial distribution on

health such as [Ichoku et al, (2011), Khalid et al, (2022), Hazrin et al (2013), Samli et al, (2020) and Almohamad et al, (2018)] were conducted in different part of the country and the result returns similar when compared to that of Bogoro (2018). Only result from Tali et al. (2017) shows a clustering of health facilities and that may be due to clustering of health centers in one part of the study area. Also, another findings shows that there are less private hospitals in the study area which may cause overconcentration of patients in the public hospitals and less ratio of Doctor per patient in the hospital which is

against the WHO 2021 standards.

### Limitations

The researcher conducted a GIS based field analysis using Global Positioning system. The researcher did not ask patients and health workers directly about the conditions of the health centers; the researcher particularly relied on GIS analysis report that presented the result based on the hypothetical analysis.

This study was limited to identifying the patterns of distributions of health centers and their ownership types in the study area. Time and financial constraints did not

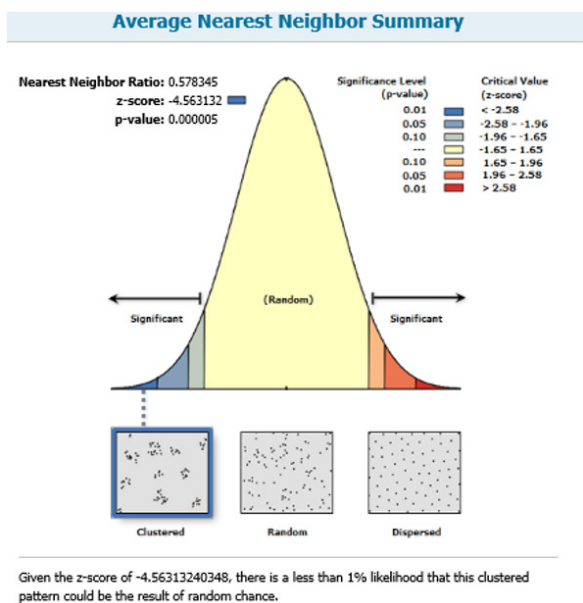


Figure 1: Nearest Neighbour Analysis

permit the researcher to interview both patients and staff to ascertain on the level of facilities as well number of health workers per hospital and the punctuality of the staff which can be identified as a major gap for subsequent research and for researchers to fill.

It is recommended that knowledge of GIS tools should be given to all and sundry as the world is becoming more of computerized one. This will help government and individuals in the identification of health centers everywhere and to reach hospitals based on the type of services rendered and the type of illness the person might have since it is stored in the GIS environment and can be accessed everywhere.

### CONCLUSION

This research examined the spatial distribution of health care facilities in Dass Local Government Area. The spatial pattern of the distribution of health care facilities in Dass Local Government Area is clustered; this could be as a result of farming activities in the area. This might as the result of the fewer number of health facilities. There is less fairness in spatial distribution of health care facilities. 9 wards out of 12 wards have at least one health facility and a maximum of 2. There are a total of 15 health facilities: 13 are public health facility and only three are owned by private individuals.

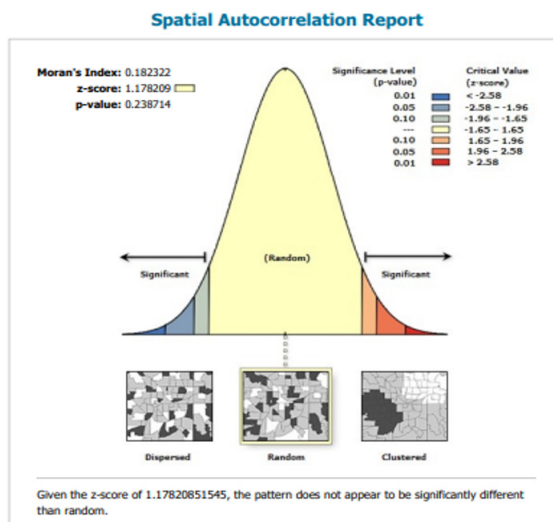


Figure 2: Special Autocorrelation Analysis

### Recommendation

In view of the hardship experienced by the people in the health service delivery which could be due overconcentration of patients and inadequacy of physicians, government should focus on creating new health centers in villages rather than the local government headquarter as well as recruitment and re-training of medical staff so as to reduce the wide ratio that already exist between the population and health care personnel. This will reduce waiting time, enhance attention to patient by medical personnel and will improve good access to the health facilities.

There is the need for government to show fairness in the distribution of health facilities in the local government. This will assist in decongesting people in the local government headquarter.

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