

Access to Healthcare and Spatialisation of Resources in Sub-saharan Africa: A GIS Solution to Mobility and Treatment of Patients in the West Region of Cameroon

Tende Renz Tichafogwe¹, Nkumbesone Makoley², Kana Clavel Djibril³

¹Department of Geography, the University of Yaounde 1, Yaounde, Cameroon

²Department of Geography, the University of Douala, Douala, Cameroon

³Free Lands Consulting, Douala, Cameroon

Email address:

renzende@yahoo.com (T. R. Tichafogwe), nkumbesonemako@gmail.com (N. Makoley), djibril.kana@gmail.com (K. C. Djibril)

*Corresponding author

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Abstract: Access to health and availability of sanitary resources is a major deterrent to mobility and treatment in sub-Saharan African towns. If it is not a problem of distance, perhaps it will be that of existing health infrastructure and know-how. This article posits that the incongruence in the availability of health units and unsatisfactory alertness has affected care in the West Region. A physical-access-ratio analysis was done to determine the distance between the health resources and population through a GPS and WGS 84 for the presentation of results. Some 120 questionnaires were administered to patients and health personnel to have first-hand information on the ratio and health need of the area. Results from findings divulge an unequal distribution of health units in the West with 51.3% concentrated in five districts and 48.7% in fifteen. The ratio of population to available health unit is 2,543 inhabitants per unit which is commendable to the WHO 10,000 inhabitants per unit standard. Unfortunately this ratio is unevenly distributed within the region as districts with a high prevalence level of diseases possess less health units. The region is 78.6% accessible in the distance of households to health unit of 5km maximum of WHO standard with 21.4% of some areas at 20km away. With an uneven distribution of inhabitants to health personnel in the region, there is a need to re-adjust the ratio. This paper advocates for a health unit and resources map to facilitate mobility and reduce health discrepancies at best in the area.

Keywords: Access to Healthcare, Disparity in Health Units, Diseases Exposure, GIS, West Region

1. Introduction

Adopted in 2015 by the United Nations, goal three of the Sustainable Development Goals is on good health and well-being. This falls within the framework of the overall objective which is for everyone to enjoy peace and prosperity by 2030. Unfortunately, in this present 2021 dispensation, good health and well-being has become a herculean task in developing countries and is more felt in Sub-Saharan Africa. This is because access to healthcare and available units is scarce. Health is not only the absence of an ailment or infirmity, but is as well the complete state of the physical, mental and social well-being of a person [15]. Being healthy therefore will

depend on the total holistic state of a person. The right to health constitutes the possibility of having access to healthcare in due time, a qualitative and acceptable treatment at an affordable cost. Such rights can actually be enjoyed when the population at short distance is able to have health units that can attend to their immediate problems with available equipment and personnel. The World Health Organisation norms stipulate that a household is required to be some 5km at maximum proximity to a health unit [15]. The respect of these norms however, leaves much to be desired as it is neither being respected nor implemented in a majority of African cities due to inadequate funds for construction and ignorance.

Much literature on health discrepancies and infrastructure has

been written with less of its focus on the role of mapping in solving the problem of accessibility and care. This work therefore highlights some and draws attention to the GIS as a tool which can be used to curb the difficulties in healthcare and awareness in Cameroon and beyond. The Cameroonian health sector is improving its infrastructure in order to attain emergence by 2035. These improvements however are concentrated in the headquarters of some regions and are yet to be fully equipped to render the required services [7]. As such, proper healthcare for all in Cameroon is a constant nightmare. Even though these health units are mostly found in the urban spaces of the country [9], a lesser percentage of the population have access to these units and can afford the costs. This affordability and awareness difficulties have provoked the spread of diseases in both the urban and rural spaces of Cameroon since a majority of the population can barely withstand proper healthcare. This explains why disparities occur in the spread of some infectious diseases [10] even in the heart of metropolis such as Yaounde influenced by the physical environment and access to health facilities. Aside these influences, the population are exposed to health challenges due to a poor comportment with regards to hygiene and sanitation which needs proper education and care [11]. Accessibility and affordability of healthcare should therefore be within the reach of an average inhabitant in order to reduce disease spread and improve on care [8].

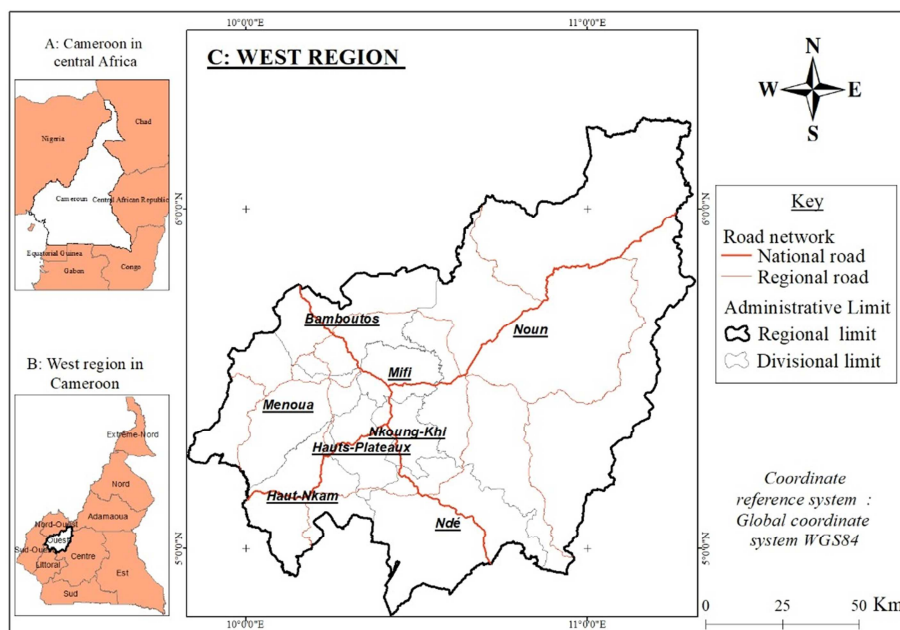
The GIS nowadays is a veritable unavoidable tool to ease data collection and analysis of health problems in the World [2]. Its application has been felt in most developed countries and is being introduced in the developing countries. The GIS has been used to detect and predict diseases such as malaria [3], and has helped to address indiscriminate spread. The prevalence, site, degree of spread and curbing strategies with predictions can be done through this tool. It has varied techniques which are used to collect data, treat and generate

maps to facilitate decision making by authorities [5]. It is clear that with the GIS, new approaches of spatial analysis in healthcare can be done to assure that there is good health and well-being [14].

Most Cameroonian regions are faced with problems of access to healthcare emanating from inadequate infrastructure and affordability. Some households are further off from available health units while others are not even aware of the existence of such units in their area. It is against this backdrop that this article seeks to address the discrepancy that exists in proper healthcare in Cameroon and beyond. The article divulges that the incongruence in the availability of health units and insufficient awareness has affected healthcare in the West Region. The goal is use the GIS to create a map that would be used to indicate the health units and reduce incidence at best in the West Region of Cameroon.

2. Method and Materials

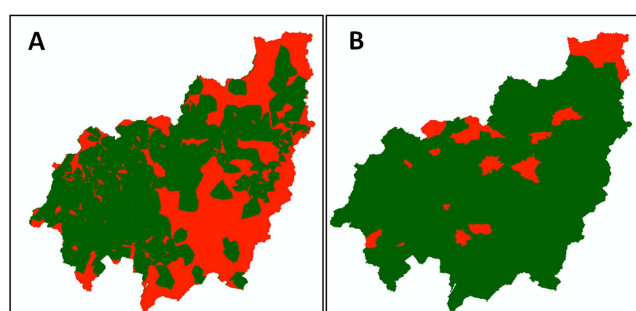
The West region of Cameroon is located between longitude 10°05'17" to 11°06'27" East and latitude 6°11'05" to 6°17'19" North. It is bounded by the North West and Adamawa regions to the north, the Littoral region to the South, Centre region to the East and South West region to the West. The region has a total surface area of 13,955 km² and a total population of close to 2,113,356 million inhabitants divided into eight regions divisions of the area (Figure 1). A physical- access-ratio analysis was done to determine the distance between the health resources and population through a GPS and WGS 84 for the presentation of results. In this process, the available health units in the region were determined by evaluating the number of health units available in relation to the population per district.



Source: Modified by Kana from National Institute of Cartography, 2021

Figure 1. Location of the study area.

This process led to the classification of the health units into public and private such as Regional health centres, District Health centre up to Sub-Divisional as well as Integrated Health centres. These health units were used to determine the available health infrastructure to the population in order to arrive at the ratio of household to medical doctor in charge of the areas. Furthermore, the physical access approach was done to calculate the distance between the health units and the patients. In this process, the distance was determined with the GIS which were measured in function to rays that were up to 25km around the health unit. As such, data gotten from the MINSANTE in 2019 and that from the Regional Delegation of Public Health in the West Region were used to identify some 831 health units in the area. These health units were captured through a Geographical Positioning System (GPS) based on the World Global System 84 (WGS 84). The map of health units in the region was obtained from the Regional Delegation of Public Health so as to determine the matrix of the ratio. In order to match the ratio to the population, the settlement layers were downloaded from an OpenStreetMap WGS 84 and matched with the 2017 population statistics by the Ministry of Public Health (MINSANTE) for analyses and results. The ArcGIS 10.4 was used to determine the ratio through the file calculator formula in ArcGIS and the number of health units to inhabitants and medical follow-up was done. The first step consisted of converting the ratio of the different availability of health units to layers of deserted zones to raster. Secondly, the information was reclassified into privilege and less privilege zones. Zones that respected the WHO norms of 5km to 5000 inhabitants were classified as privilege while those that went above 5km were less privilege (Figure 2).



Source: Field Work on ArcGIS, 2021

Figure 2. Determination of privileged and less privileged Health Units.

Some 120 questionnaires were administered to 80 persons who are potential users of the health units and 40 health personnel to have first-hand information on the ratio and health need of the area. Data from documentary sources was collected from the Ministry of Public Health and Delegation of Public Health of the West Region. This was done in order to evaluate the available resources with respect to the actual need of the population and what was offered so as to determine the gap and propose suggestions to curb the situation. The data collected was treated through the

Microsoft Excel spread sheet to generate tables and diagrams for results and discussion. The ArcGIS 10.4 was used to treat and generate maps for results and discussion.

The ArcGIS treatment of the data revealed the zones favourable of less than or equal to 5km away from the health district in the green colour in A, and those above it in the red colour. While in B, the zones in green colour represent areas where a health unit is responsible for a maximum of 5000 inhabitants and the colour red for those above 5000 inhabitants. All data collected was treated and analysed for the presentation of results and discussion.

3. Results

3.1. Availability of Health Resources in the West Region of Cameroon

Access to healthcare and availability of health resources in the West region of Cameroon leaves much to be desired. Results from the Regional Delegation of Public Health in the area and from field work reveal that there is an uneven distribution of health units in the twenty districts found (Table 1).

Table 1. Available health units in the West Region of Cameroon.

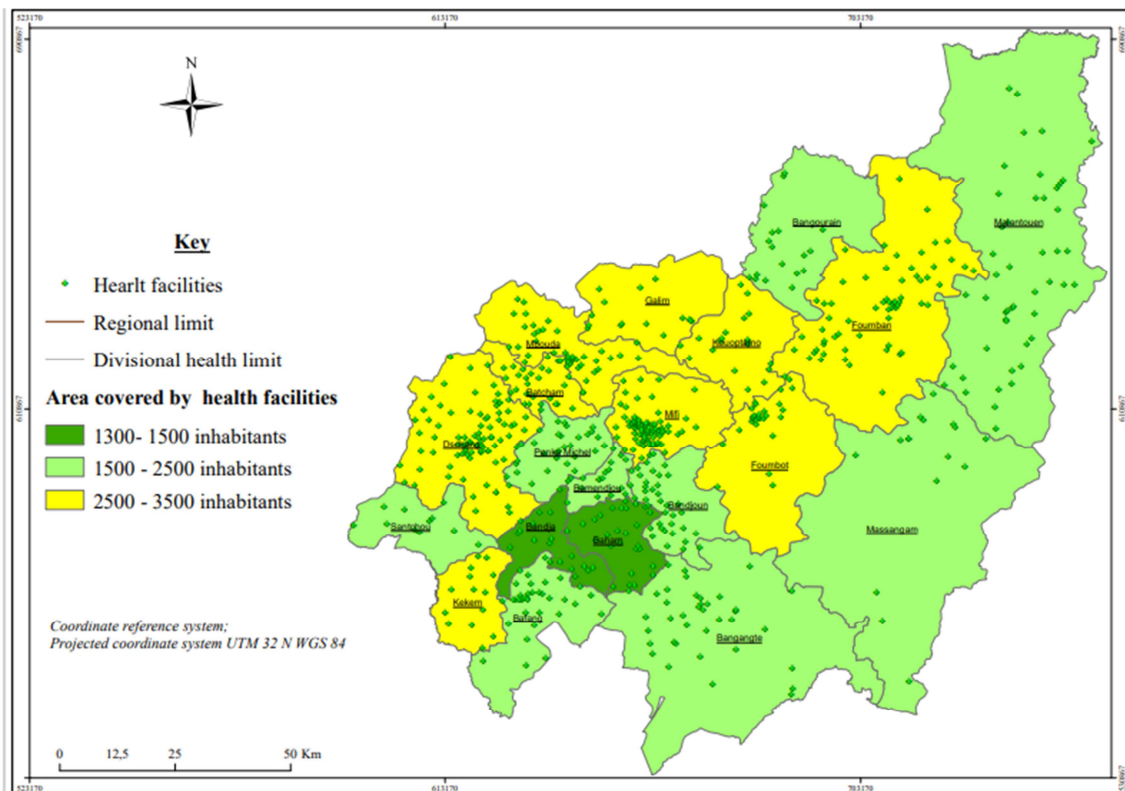
District area	Public unit	Private Unit	Total
Bafang	21	14	35
Baham	18	11	29
Bamendjou	16	7	23
Bandja	17	6	23
Bandjoun	26	8	34
Bagante	38	7	45
Batcham	18	16	34
Dschang	42	44	86
Foumban	43	31	74
Foumbot	17	25	42
Galim	10	7	17
Kekem	9	8	17
Kouoptamo	8	10	18
Malantoum	52	14	67
Massangam	19	7	26
Mbangourain	14	12	26
Mbouda	22	40	62
Mifi	22	100	122
Penka Michel	19	17	36
Santchou	8	7	15
Total	440	391	831

Source: Regional Delegation for Public Health West Region, 2021.

Out of the 831 total health units identified in the region, 440 are public occupying 52.80% of the area. The remaining 391 are private health units whose importance in the area needs not to be over emphasised. The public health units are the regional hospital, district hospitals, integrated health centres and sub-divisional health centres. Some districts possess more than 50 health units while others are less. The ratio between the population and the available health units is more to some and less to others indicating an uneven distribution of the units. The Mifi, Dschang, Foumban, Malantoum and Mbouda are the top five districts with the greater number of health units. The Santchou, Kekem, Galim,

Bandja and Bamendjou are the last five districts with the least number of health districts. Aside these, all the other districts range in between 25 to 75 health units depending on the ratio between units and households. The five districts of Mifi, Dschang, Foumban, Mbouda and Malantouen possess 51.3% of the health units in the area, while the remaining fifteen has 47.7% (Figure 3). These districts vary in the degree of concentration of the health units with some more and others less based on the availability gotten. The Dschang,

Foumban and Malantouen districts have a high concentration of 40 to 50 health units while others such as Santchou, kouoptamo and Galim have less than 20 health units. Map n° 3 reveals the different levels of concentration of health units in the region represented in green dots. The thicker the green dots, the more concentrated the health unit in the area. Further, the thick green, light green and yellow colours represent the number of inhabitants in the various health districts in the West Region.



Source: Data from the West Regional Delegation of Public Health 2021 realised by Kana

Figure 3. Distribution of Health Units in the Districts of the West Region of Cameroon.

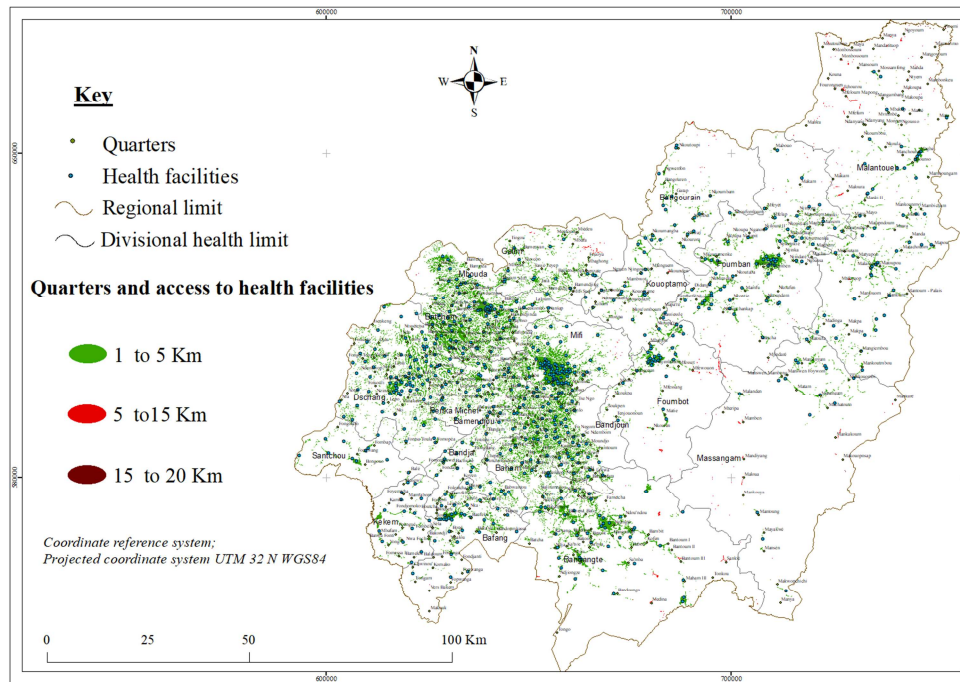
Data from the Ministry of Public Health revealed that the population of the West Region of Cameroon which stands at 2,113,351 in habitants in 2020 has 831 health units. This implies that the ratio between the population and available health units is 2,543 inhabitants to a health unit. With the WHO standards which stipulate that one health unit should carry 10,000 inhabitants [15], the West Region can thus be considered as well equipped with respect to the available health units to the population. The results calculated in Figure 3 shows that the degree of health unit availability to the population varies in between 1,300 to 3,500 inhabitants per health unit with concentration in Bandja and Baham with more units to less population giving them a variety at their disposal. These results however reveal that the availability of health resources in the West Region would have been commendable if it were proportionate to the population of each district. This article therefore shows the unevenness in distribution so as to facilitate the awareness of the population and authorities in periods of need.

3.2. Accessibility to Health Resources in the West Region of Cameroon

Having access to the available health unit and benefiting from proper healthcare in the West Region of Cameroon happens to be a nightmare that warrants quick action. Data from the location of health resources was analysed in correlation with the road network and built-up space to the most accessible health unit. Results gotten revealed that all of the 20 health districts in the West Region faced a problem of long distances to available health units contrary to WHO standards which states that a health unit is required to be 5km maximum away from the population or household [15]. Results from findings revealed that the population or households of the West Region are 78.6% at a 5km or less proximity to the available health units found indicating favourable accessibility rate of the area. Nevertheless, 21.4% of the region is still at more than 5km distance away from the available health units which reduces the chances of the

population in such areas to easily access health units though available. The more accessible population or households to the health units are mostly found around the active parts of

the districts while those that are less accessible of some 20km distance away from the health units are around the zones of high altitudes (Figure 4).

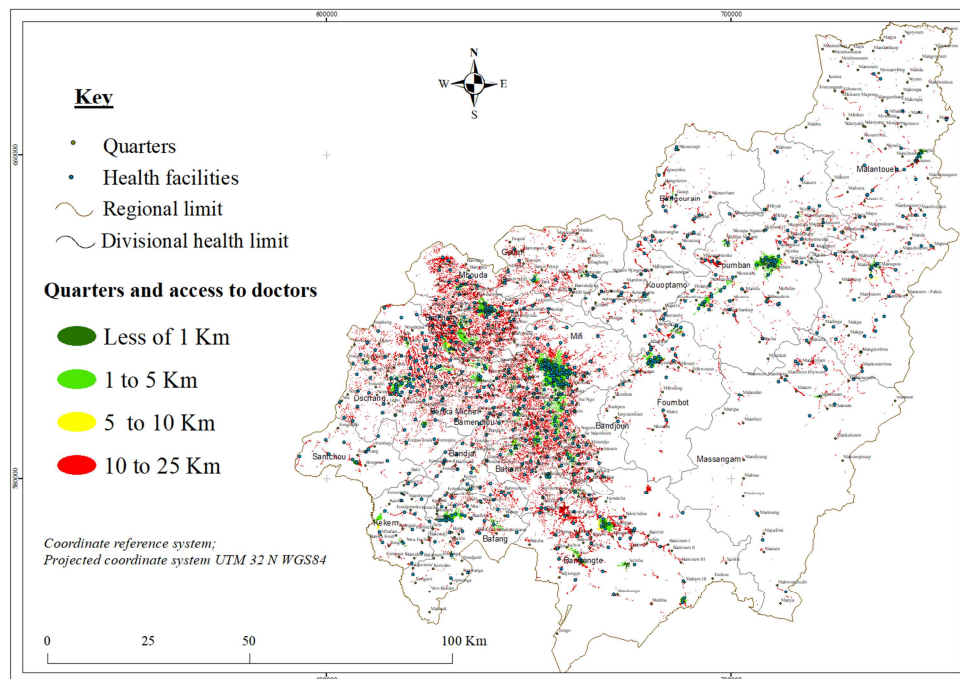


Source: Data from the West Regional Delegation of Public Health 2021 realised by Kana

Figure 4. Household accessibility in the West Region of Cameroon.

The households that are in between 1 to 5km of proximity to health units are represented in green and their dense appearance indicate the 78.6% accessibility rate in the region. Further research revealed that the physical access to medical

services in the West Region of Cameroon is unevenly distributed. Out of the 831 health units found in the area, only 99 have a resident medical officer while the remaining 732 have visiting ones (Figure 5).



Source: Data from the West Regional Delegation of Public Health 2021 realised by Kana

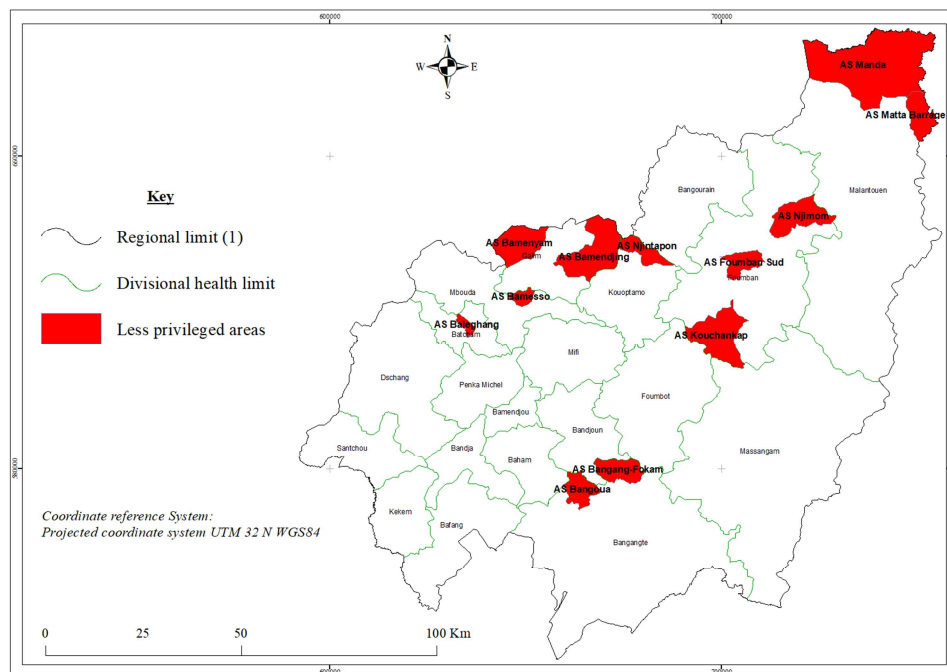
Figure 5. Households and access to medical services.

This is because 21.5% of the built-up space is located at less than or at 5km away from the health units while 78.5% is further at 20km and more from the services of a medical officer. This reduces the chances of proper healthcare and treatment in the region. The proximity quarters are in the thick green cur of the map and the less proximity ones are in red revealing the disparity that occurs in having access to medical services in the West Region. Results from the Delegation of Public Health for the West Region and confirmed with that from the Ministry of Public Health in 2020 revealed that the West Region had 1,208 medical doctors for a population of 2,133,356 inhabitants. An analysis of doctor to patient ratio thus shows that 1 doctor will be in charge of 1,749 persons which is very favourable as the WHO norms indicates 1 doctor to 10,000 persons [15]. Nevertheless, this distribution is uneven as it varies from one district to the other. Such results indicate that in the region, some

areas are more privileged than the others which affects the healthcare of the region.

3.3. Less Privilege Deficiency Health Unit Areas in the West Region of Cameroon

A reclassification of areas in districts of health units was done to determine privilege and less privilege areas. An analysis of the available health units to the physical accessibility was done based on the population and the distance to the health unit. The process was to show that areas further away from health units were more vulnerable than those closer. In the process the results showed that in areas with a minimum of 5000 people to a single health unit at a distance of more than 5km away from the health unit were considered less privilege (Figure 6).



Source: Data from the West Regional Delegation of Public Health 2021 realised by Kana

Figure 6. Less privilege areas to health units in the West Region of Cameroon.

Aside that, any other closer to the health unit at less than 5km is considered privilege. From this analysis it was found that less privilege areas exist in districts such as Bangang, Bangoua, Bamenyam, Manda as well as Bamesso which have populations or households further away from health units with difficult access roads. Such less privilege areas at times might not have the information on the health services at their disposal and some may even just be able to afford for these services. It is however important that the awareness on such service are made public to facilitate proper healthcare in the region.

3.4. Perception and Use of Health Resources in the West Region of Cameroon

The knowledge of the available health resources and what they offer to the population is as well a major problem that

needs to be addressed in the West Region of Cameroon and beyond. Results from the field indicate that some 29.27% of the population in the West are not aware of the available health facilities in the region (Table 2).

Table 2. Healthcare offers perception index in the West Region.

Reasons	Respondents	Percentage
Knowledge of health facilities	35	29.27
Willingness to consult health facilities	20	16.27
Inadequate finance or poverty	25	20.84
Proximity to the health facilities	14	11.66
Available medical personnel	15	12.51
Influence of customs and tradition	11	9.45
Total	120	100

Source: Fieldwork, 2021.

There is not enough information on the available health facilities that the region offers despite their availability which has greatly affected healthcare in the region. Aside this insufficient information, willingness to consult health facilities is as well another problem. Some 16.27% of the inhabitants in the region are reluctant to go for medical care once they are ill. They either go for auto medication or just focus on traditional treatment which at times leaves much to be desired. Inadequate finance or poverty is as well another difficulty to appropriate healthcare to the inhabitants of the West Region of Cameroon. Results from the field revealed that some 20.84% of the population cannot afford proper healthcare and are thus exposed to diseases attacks. Furthermore, 11.66% of the population faces a problem of proximity to health facilities in the region. This goes a long way to confirm the objective of the research which is to indicate the length of some health units to the population and problems they face. At such far distances, it is difficult for the people concerned to enjoy the services of proper healthcare. Some other problem of healthcare in the West Region emanates from the available medical personnel in the region. Results connote that 12.51% of the inhabitants of the West Region raised the problem of limited medical personnel especially doctors which makes it difficult to obtain adequate healthcare in the area. The people are thus left with no choice than to seek for proper healthcare in other regions especially in the Littoral and Centre regions of Cameroon. The influence of customs and tradition have some 9.45% influence on the type of healthcare offered in the West Region of Cameroon. Some inhabitants of the region are so attached to their customs and traditions so much so that getting care from designed medical units becomes a problem. This explains why some will still go for their indigenous treatments despite the diagnoses or treatment gotten from health units. These results reveal that the inhabitants of the west region of Cameroon will enjoy adequate healthcare from the available resources found if enough awareness and mapping is done to sensitise the people.

4. Discussion

The West Region of Cameroon like any other region is pruned to disease attacks which affects the inhabitants and warrants intervention from health personnel. The region is endowed with 831 available health units which are distributed into 20 districts as defined by the Ministry of Public Health in Cameroon. Unfortunately, the distribution is unequal as some areas have more and others less as compared to the population leading to difficulties to extend healthcare to all. The uneven distribution of health units is not new in Cameroon as it is the cause of numerous diseases spread in some rural settings of the Country [12]. Using the example of the North West Region of Cameroon, the authors revealed how with the quest for proper healthcare, households are forced to make a choice on which health unit to use from the other. Such is the case in the West Region of Cameroon where despite the available health units, areas

which are unable to have specialised services and are in need are forced to go for such services in other districts. Since it is most likely not possible to render such services in all the districts of the region, this paper introduces mapping as a solution to education and awareness of where required services can be offered in the region.

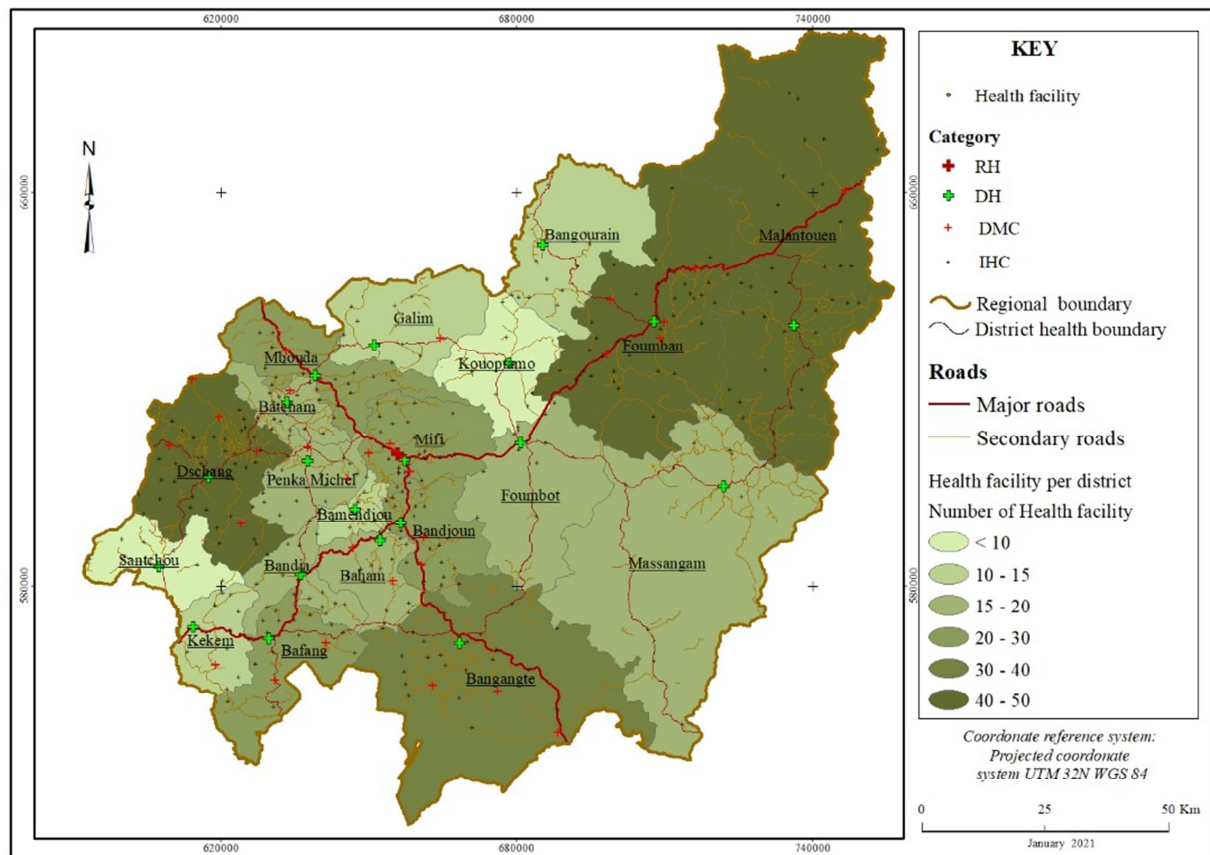
Even though the West Region of Cameroon is blessed with available health units that can adequately render proper services to the population of the area, having access to these services is a herculean task. A greater percentage of the health units in the region are less accessible at a more than 5km distance while the lesser part is at a less than 5km. This explains why despite the available health units, more people in the West Region find it difficult to benefit from the services offered. The effect is thus a persistent use of auto medication and traditional treatments which increase the chances of disease spread and death in the area. The issue of access to health units and proper healthcare happens to be a major discrepancy in most African countries. Such is the case of Nigeria [1], where the residents of Ibadan have to move for several kilometres in search for specialised healthcare which exposes the patients to grave situations even before arrival. This is as well observed in the West Region which has made some areas of the health districts to be more privilege than the other. Readjusting such situations and rendering healthcare accessible to all is of paramount importance.

The fact that some areas are inaccessible and unevenly classified in the number of health units has caused this paper to term them as less privilege areas. They are less privilege because of the number of persons to the available health unit as well as the distance covered to get to these units. Some of these less privilege areas have undesirable infrastructure which does not facilitate proper healthcare. The presence of health units may not be a major but the type of infrastructure and available equipment to facilitate care. Some health units lack adequate facilities which do not permit them to receive and treat patients. This was experienced in the Rwandan community [4], where rural healthcare faced difficulties because of inadequate infrastructure and available healthcare equipment. Some of the health units in the West Region of Cameroon encounter such problems as in Rwanda and with this paper much can be done to savage the situation.

A lot of the difficulties encountered in healthcare in the West Region emanates from lack of information and awareness. Despite the available health units found in the area, results from the field revealed that most of the inhabitants are not aware of the services rendered, hence do not go for them. With the GIS, mapping of the health units and site can be done to ease education and direction even to those coming from out of the region [13]. This has been proven to be true in several countries of the developed world and this work suggests it be implemented in Cameroon to help reduce health discrepancies at best. Having knowledge of the type of ailment someone is suffering from and the exact area to receive treatment is the first step to solving the problem. The solution therefore to such discrepancies is the

production of a map which will have the detailed information of the available health units their location and type in order to

help the resident population and those around to have access to healthcare (Figure 7).



Source: Data from the West Regional Delegation of Public Health 2021 realised by Kana

Figure 7. Health infrastructure map of the West Region of Cameroon.

The population of the West Region of Cameroon and beyond can easily be informed on the type of health unit and its location and benefit from proper healthcare if this information is used.

5. Conclusion

Access to health and available health resources remains a major problem to appropriate healthcare and treatment in developing countries. This work which was aimed at revealing the discrepancies accrued from inaccessibility to healthcare in the West Region due to mobility and awareness found out that much is yet to be done to actually educate the population on the available health facilities present. The SDG quest for good health and well-being can be possibly attained if the health promotions such as vaccines and other free medications introduced are accepted by the population [6].

Nevertheless, the West Region was found to be well equipped in terms of available health units as 831 of these units were identified to cater for 2,113,351 inhabitants of the region. These available health units can adequately reduce health discrepancies in the region but for the fact that 29.27% of the population is not aware of the presence of these health units and more so they are unevenly distributed. Having access to the available health units as well means to get there

in the West Region is a major problem as some are located at further distances away from the household residential areas. This exposes the population to long distance movements in search for proper healthcare. Some of such health units still lack good roads which makes it difficult for rapid evacuation or even on the spot treatment due to the nature of the terrain. The willingness to go for proper treatment can be there but the financial means to pay for it is yet another problem in the area. Further difficulties emanate from the available specialists to handle critical health cases in the region. Faced with all these irregularities, proper healthcare can hardly be offered in the West Region if these drawbacks are not adequately handled. This paper therefore has been introduced to accelerate the process of rendering proper healthcare by identifying the total number of health units and producing the map with its varied locations as a solution to awareness and treatment. Once the population of the West Region of Cameroon is educated enough on the advantages they have in terms of available health units, it will facilitate their gradual use of these resources despite the distances and reduce health discrepancies at best. The spatial location of these health units in the twenty health districts in the region will facilitate indication and use to the mobile population and neighbouring regions since information is available.

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