Locational and Coverage Analysis of the Vital Registration Centres In Gombe State, Nigeria

Adam M. Abbas (PhD)
National Population Commission, 17 Ibrahim Dabo Rd, Kano

Abstract: *This study assesses the levels of spatial accessibility, birth registration coverage and efficiency of vital registration centres in Gombe State. This was achieved through mapping out the locations and catchment areas of the existing vital registration centres; determining the influence of distance from vital registration centres and identifying areas where birth registration coverage is high. Both attribute and geometric data were used, and for the measurement of distance, Euclidean Distance was used. The study indicates that there is more concentration of a large number of the centres (11) on a small land mass (53km^2) of urban Gombe and hence making their availability in the rural areas distorted and accessibility poorer, especially by the rural communities of the five LGAs with larger land expanse of 8,964km^2 which shared the remaining 11 centres of the 22. The result of the study also shows that, with additional 7-10 registration centres in the five rural LGAs the average settlement distance would change from 24.12km to 2.09km (trekable distance). The study recommends the usage of location-allocation models for the optimum location of any new centres with sizeable catchment areas, full enforcement of the registration law and embarking on mass enlightenment campaigns and establishment of more centres.*

Keywords: *Accessibility, Efficiency, Euclidean Distance, Location-allocation Models, Vital Registration Centre,*

I.   Introduction

1.1   Background to the Study

There are four major sources of demographic data for planning processes. They are census, civil or vital registration, sample surveys and administrative records. Of these, census is the most comprehensive source, which provides the benchmark against which data from other sources, such as vital registration are measured [1]; [2]; [3]. A complete coverage of vital events provides data to complement the census and when sustained over time reduces the need for census taking [4].

Birth registration, an aspect of civil/vital registration is the official recording of the occurrence of birth in accordance with the laws of the country is therefore, not only a fundamental right in itself but also a key to ensuring the fulfillment of additional rights. Thus, such a system and its instruments value in safeguarding human right, contributes to the normal function of any society [1]; [5].

In Nigeria, vital registration took off in 1988 as a project after an elaborate preparation under the technical assistance of a United Nations expert in vital registration. Decree (now Act) No 39 of 1979 marked the commencement of universal registration system in the country. The births and deaths decree (now Act) no. 69 of 1992 saddled National Population Commission with the responsibility of establishing and maintaining a national system of registration of births, still births, deaths, marriages, divorces, migration etc and made the registration compulsory. Section 24 of the third schedule of the 1999 constitution further strengthened the registration system. The responsibility is therefore core to the Commission because it is a continuous and permanent exercise which transcends the census period. Thus, a fully functional civil registration system should be compulsory, universal, permanent and continuous and should ensure the confidentiality of personal data it collects, transmits and stores in an effective way, guarantees their quality and integrity. Generally, vital statistics generated from the vital registration system is very important for development planning, especially in the areas of education, health, housing and food security [6]; [7]. There is therefore, the need improved coverage of the vital events.

Currently, vital registration is in the second expansion phase covering all the 774 Local Government Areas of Nigeria. Unfortunately, with an average of only two (2) registration centres per LGA, which is grossly inadequate considering the landmass, population size, diverse nature of the terrain and large number of localities, vital registration suffers a coverage problem. Disparity in terms of coverage occurs as a result of sizes of catchment areas depending on the available registration centres and or number of informants and or methods adopted, active or passive.

Principally, some of the problems of vital registration identified by the literature in addition to the inadequacy in the number of operational centres and low level of awareness are spatial location/problem of accessibility; and other issues related to the existing vital registration centres. It has been observed by many

researchers including [8]; [9] that, 'children born in rural areas were less likely to be registered than their counterparts in urban communities'. Whatever method of registration is adopted, it can always be assumed that the greater the distance to the point of registration the more the opportunity and travel costs rise for parents and thus, lesser the rate of registration. More so, accessibility is influenced by location and terrain, the condition of infrastructure such as road and the availability of public transport as rightly opined by [5]. It has therefore, been widely acknowledged that, a significant barrier to birth registration is geographic distance to the nearest registration facility [10]; [11]; [12].

In general terms, birth registration coverage has been low in Gombe State and even the percent distribution of registered live births by residential sector (urban/rural) as indicated in [13] is 65.33 for urban and 34.67 for rural. This indicates lower coverage at the latter residential sector compared to the former and the difference is substantial.[14]. And the role played by the location of the registration centres in determining differential levels of birth registration coverage has been given less attention by researchers.

Since the location of registration centres plays a very important role in the efficient conduct of the registration exercise, research into it in a young but rapidly developing State like Gombe is quite worthy of undertaking. This research work therefore, aims to answer the following questions: Are the locations of the current operational vital registration centres appropriate in relation to the localities within their catchment areas? What is the relationship between level of patronage of the services and distance from the registration centres?

The main aim of this study is to assess the levels of spatial accessibility and efficiency of the birth registration centres to the people of Gombe State. The objectives of this research are:- Identifying and mapping out the locations of the existing Vital Registration Centres in relation to their areas of coverage using GPS and GIS technology; examining and assessing the efficiency levels of the registration centres and rank them according to their captured birth events and the population of their catchment areas and according to LGAs and determining the spatial accessibility of the registration centres to all the localities in their catchment areas.

There is a large body of literature on locational analysis and the application of location-allocation models to public sector services. This is because since 1960's the models have been applied to a wide variety of problem contexts [15]; [16]; [17]. Thus, studies on the location of other infrastructures such as health facilities, using location-allocation models and gravity model have received a lot of attention. There have also been even comprehensive reviews of location-allocation models provided by [18]. They classified these models by sector (public & private), formal model structure (P-median problems & covering problems) and the nature of the real world. However, relatively very few if any studies exist on its application to vital registration centres.

For instance, [19] examined availability, geographical accessibility and efficiency levels of primary health centres (PHCs) and private registered medical practitioners (RMPs) in India. It was observed that, location decisions of both types of these services do not correspond effectively to the needs of rural population. Also, most of the time administrative, political and economic factors supersede location-suitability of new services resulting into inter-section and interregional disparities. However, the re-location of any service may not be feasible economically, but location-allocation models can be used to identify new potential locations. Other similar studies include: [20]; [21]; [22]; [23]; [24]; [25]; [26]; [27]

A number of other studies have also indicated the effect of geographic barrier though not in detail and locally specific, on the effectiveness of vital registration system, especially using the passive model (the registrar waiting for the registrants at the registration center) of the registration. Examples of such studies include those by [10]; [5]; [9]; [28]. In fact, [28] applied GIS in assessing existing birth registration centres in Gombe LGA. The study was however restricted to Gombe LGA which is an urban setting and the GIS application too was limited to locating the registration centres for easy access and retrieval of information only. Also, [29] has applied GIS to study hospital availability and accessibility in Gombe LGA. The quantification and understanding of such effects were however, not treated anywhere in detail. Studies where they exist have employed highly aggregated data at macro and country level unit of analysis. These are usually of limited value to explain grassroots scenarios. Hence, there is a knowledge gap in this regard, more especially, in terms of the magnitude of the effect of distance in a particular area.

Thus, in the light of the fact that location of registration centres plays very important role in the efficient conduct of birth registration exercise, research into it in a young but rapidly developing State like Gombe is quite worthy of being undertaken. This is the focus of this research work.

This research is significant because the results will assist population planners and policy makers in the National Population Commission and Gombe State Government to achieve their goal of 100% coverage of the vital events by the year 2015.

First, accurate information and maps are provided about where patronages of such services are best received and where patronage is low (geographic disparities of the registration) and hence these will serve as models and proto types for planners.

1.2 Study Area

Gombe State occupies a total land area of about 20,265 sq. km and made up of eleven (11) local government areas. It is located between latitude 9^0 30' and 12^0 30' north and longitude 8^0 45' and 11^0 45' east. It shares boundaries with Yobe in the north, Borno State in the east, Adamawa and Taraba in the south and Bauchi in the west (see fig. 1). It has a total provisional population of 2,353,879 which comprises of 1,230,722 males and 1,123,157 females (National Population Commission, 2006). The State is characterized by mixed ethnicity.

Figure 1: Gombe State Showing the Study Area (The Selected LGAs)

Source: Department of Geography BUK (2012)
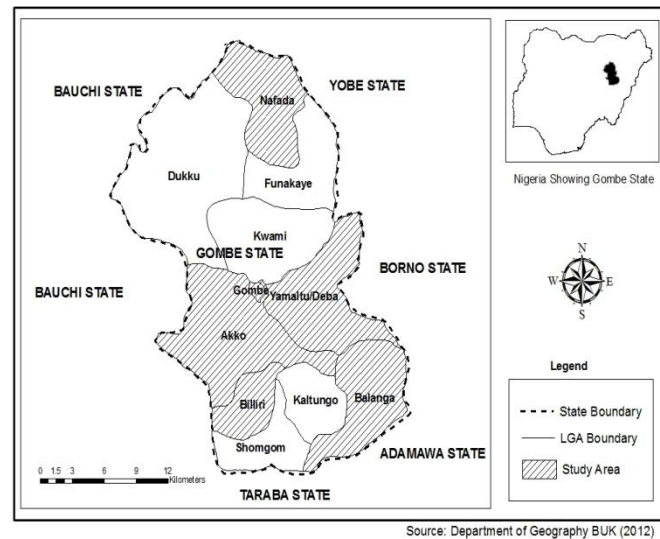
II.   Research Methods

2.1 Data Types and Data Sources

To achieve the stated objectives of this study, two major sources of data (primary and secondary) were explored. Both quantitative and qualitative research strategies were also adopted for this study.

2.2 Geometric and Attribute Data Collection

Since all the above exercises were complemented conscientiously with field observations, geo-coordinate samples from the localities were collected at the sites, using GPS (one reading in each locality) and the list of the existing vital registration centres were obtained from National Population Commission. For each sampled village, one GPS reading was collected, giving the total of about twelve (12) localities in each LGA (the two (2) vital registration centres and ten (10) sampled localities) and a total of about one hundred and ninety-nine (199) localities in the State.

The attribute data in the form of tables generated from vital registration forms on daily and monthly basis found in annual reports of Gombe State were obtained from National Population Commission. Other attribute data are the population of all the sampled locations and the number of captured events from each sampled locality and each vital registration centre.

The study is restricted to six purposively sampled out of the eleven LGAs in the state and the data spanned over the period of eight years (2000-2008). This is because, before year 2000 the services were carried out on skeletal basis and awareness was relatively lower. Maps and locality lists were collected from the National Population Commission and Gombe State Ministry of Land and Survey and geo-coordinates/Euclidean distances were recorded on a GIS platform.

2.4 GIS Demarcation of Catchment Areas of Vital Registration Centres

The road networks of all the sampled LGAs were acquired in the GIS platforms and accessibility was assessed using Euclidean distance measurements. All the accessibility characteristics were stored in a relational database system linked to the GIS database. They were then all used to obtain the partitioning of the catchment areas and the location of the registration centres.

2.3 Analytical Techniques:

Data collected from the field were subjected to mathematical and statistical analyses, such as ranking, percentages, charts etc. Registration coverage in this study is the proportion of the registered births to the

estimated births in an area. The Crude Birth Rate (CBR) of 40 per 1000 was used to calculate the estimated births based on its projected population from 1991.

III. Results And Discussions

3.1 Mapping of the Existing Vital Registration Centres and their Catchment Areas

Fig. 2 shows the current registration centres in the six sampled LGAs whose locations were captured using GPS. It indicates that Gombe LGA has a large number of the centres on its relatively smaller land area of 53 KM^2. Thus, accessibility to those centres by its population and those from neighbouring LGAs like Akko and Yamaltu-Deba where some of their localities are engulfed by Gombe metropolis is noticeable. Some parents from those LGAs register their children's births in Gombe rather than travelling to their LGAs' registration centres which are located farther away from their areas of residence.
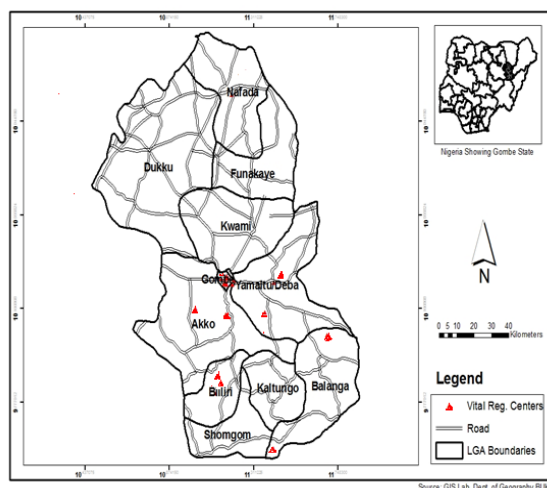

Figure 2: Gombe State Showing the Existing Vital Registration Centres

3.2 Birth Registration Coverage by Registration Centres

Table 1 presents levels of birth registration coverage and non-coverage by registration centres (current) in the six sampled LGAs. It further indicates that all the remaining five rural LGAs have over three-quarters (8 in 10) of their children's births not registered and thus, there was a larger percentage of registration over 6 in 10 in Gombe LGA compared to rural areas with only about 2 in 10. In fact, according to [5] and [9], in many developing countries, disparities in terms of birth registration coverage between regions and between urban and rural areas exist. For example in India, urban areas have higher registered birth rates than the rural and geographically inaccessible areas because civil registries are often centralized. Similarly, because the registration process is often carried out in hospital, babies born at home are less likely to be registered.

Table 2 displays the birth registration coverage by ranking of the centres. Out of about 22 registration centres (this does not include registration centres that had no registrars during the period under study), half of this number has registration coverage that is greater than 100% and all the centres are in Gombe LGA, the State capital. The high rate of registration in urban Gombe as against the other centres is attributable to the existence of large number of registration centres, large influx of people into it during the period under study, some backlogs of unregistered children within that age range were registered during the period under study, while people from other neighbouring LGAs like Akko and Yamaltu-Deba were found to have registered their births in Gombe LGA. Figures 3,4,5,6 and 7 show the designated catchment areas of the registration centres and 5km buffers around the centres indicating areas of high registration.

Table 3 illustrates levels of birth registration coverage by LGA and by year of registration. Table 4 shows the coverage and ranking by LGA. To have fair ranking of the selected LGAs, the population sizes and the expected crude birth rates during the period under study were all considered. Surprisingly, of the six (6) sampled LGAs, only one (1) LGA that is, Gombe has registration coverage of over 100% and above, while the remaining ones have only between 7% to 20%.

Table 1: Birth Registration Coverage and Non- Coverage by Registration Centres (2000-2008)

S/N	LGA	RCen Code	Rcen	CBR T	Brec T	Diff.	% Covered	% not covered
1	AKKO	1	kumo	57097	9,683	47,414	17	83
		2	Pindiga mater	43600	6,002	37,598	14	86

2	BALANGA	1	Talasse	25013	4,150	20,863	17	83
		2	Bambam	26100	2,992	23,108	11	89
		3	Gelengu	12000	793	11,207	7	93
3	BILLIRI	1	NPC OFF BLR	26180	6,079	20,101	23	77
		2	Gen Hos BLR	34303	8,400	25,903	24	76
4	GOMBE	1	NPC ST. OFF.	7988	9,989	-2,001	125	-25
		2	NPC LGA OFF	9761	11,001	-1,240	113	-13
		3	FMC GME	6754	10,198	-3,444	151	-51
		4	Spel. Hosp	9765	9,722	43	100	0
		5	NasHosp	7542	8,851	-1,309	117	-17
		6	UrbMatn	7784	9,311	-1,527	120	-20
		7	Pan Matn	5443	8,801	-3,358	162	-62
		8	BolMatn	8776	9,132	-356	104	-4
		9	Town Matn	7886	9,887	-2,001	125	-25
		10	T/wada PHC	4364	8,954	-4,590	205	-105
		11	H/GanaMatn	3568	7,889	-4,321	221	-121
5	NAFADA	1	NPC OFF Nafada	22745	4,511	18,234	20	80
		2	BirrI Mat	19089	3,333	15,756	17	83
6	Y/DEBA	1	NPC OFF Deba	35527	7,099	28,428	20	80
		2	D/KowaMatn	40786	6,498	34,288	16	84

Source: Computed from NPC, Abuja Figures: 2008. N.B.-Rcen=Registration Centre; Brec T=Birth Record Total; CBR T=Crude Birth Rate Total
Birth Registration Coverage by LGA

Table 2: Ranking of Vital Registration Centres According to % Coverage of Registered Births (2000-2008)

S/N		LGA	Rcen Code	Rcen Name	% Coverage	Ranking
1	4	GOMBE	11	HerwaGana Maternity	221	1
2	"	"	10	Tudunwada PHC	205	2
3	"	"	7	Pantami Maternity	162	3
4	"	"	3	FMC Gombe	151	4
5	"	"	9	Town Maternity	125	5
6	"	"	1	NPC State Office	125	5
7	"	"	6	Urban Maternity	120	7
8	"	"	5	NassarawoHosp	117	8
9	"	"	2	NPC LGA Office	113	9
10	"	"	8	Bolari Maternity	104	10
11	"	"	4	Specialist Hosp	100	11
12	3	BILLIRI	2	Gen HospBilliri	24	12
13	"	"	1	NPC Office Billiri	23	13
14	6	Y/DEBA	1	NPC Office Deba	20	14
15	5	NAFADA	1	NPC Office Nafada	20	14
16	"	"	2	Birri Maternity	17	16
17	1	AKKO	1	Kumo Gen. Hosp	17	16
18	2	BALANGA	1	NPC Office Talasse	17	16
19	6	Y/DEBA	2	D/Kowa Maternity	16	19
20	1	AKKO	2	Pindiga maternity	14	20
21	2	BALANGA	2	Bambam PHC	11	21
22	"	"	3	Gelengu Maternity	7	22

Source: Computed from NPC, Abuja Figures: 2008.

The reason for the above high % in Gombe LGA is traceable to Gombe receiving patronage from neighbouring LGAs. In generality however, the number of registered births for all the LGAs is far lower than the crude birth rates of the period and population under study.

Even comparison of estimated births and registered births coverage in the state made by the vital registration department, Abuja shows that there were 690,905 estimated births and only 166,878 were registered

from 2000-2007 giving a difference of 524,027 with less than one-third coverage in the whole of the state [13]. Table 4 shows percentage and ranking of coverage and non coverage by LGA.

**Table 3: Registered Births By LGA and Year of Registration in the Six SampledLGAs in Gombe State: 2000-2008**

| LGA	Brec T 2000	Brec T 2001	Brec T 2002	Brec T 2003	Brec T 2004	BrecT 2005	Brec T 2006	Brec T 2007	Brec T 2008	Total
AKKO	9	864	864	781	1,014	1,014	1,885	2,341	6,913	15685
BALANGA	338	681	681	613	214	336	279	3,834	959	7935
BILLIRI	1,372	2,563	2,563	2,563	199	439	862	2,797	1,121	14,479
GOMBE	5,270	11,001	11,001	14,962	5,890	9,009	11,296	22,900	14,408	105,737
NAFADA	752	337	337	601	236	373	682	2,140	2,386	7844
Y/DEBA	1,181	734	734	1,315	390	1,257	1,641	5,234	1,111	13,597
TOTAL	8,922	16180	16180	20835	7,943	12,428	16,645	39,246	26,898	165,277

Source: Fieldwork, 2008

Table 4: Birth Registration Coverage, Non-Coverage, Diff and Ranking by LGA(2000-2008)

S/N	LGA	CBR T	BREC T	DIFF	% COVERED	Ranking	% NOT OVERED	Ranking
1	AKKO	100697	15685	85012	16	5	84	2
2	BALANGA	63113	7935	55178	13	6	87	1
3	BILLIRI	60483	14479	46004	24	2	76	5
4	GOMBE	79631	105737	26106	133	1	-33	6
5	NAFADA	41834	7844	33990	19	3	81	4
6	Y/DEBA	76313	13597	62716	18	4	82	3

Source: Fieldwork, 2008
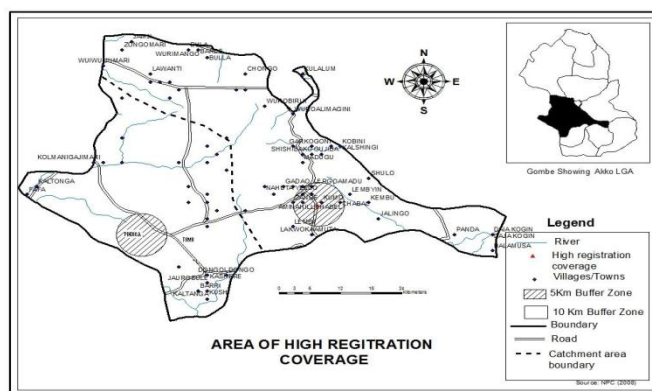
Figure 3: Akko LGA Showing Reg. Centres, Catchment & Areas Of High Birth Reg. Coverage
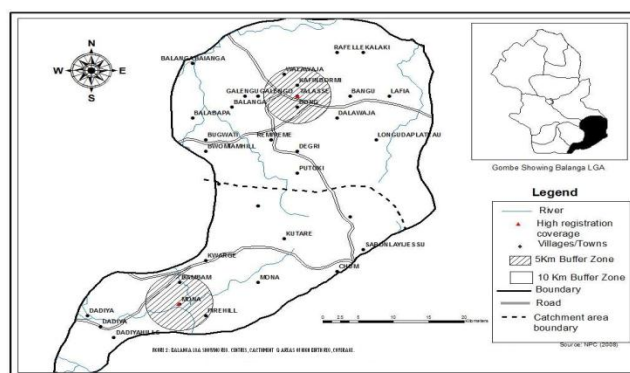
Figure 4: Balanga Lga Showing Reg. Centres, Catchment & Areas of High Birth Reg. Coverage
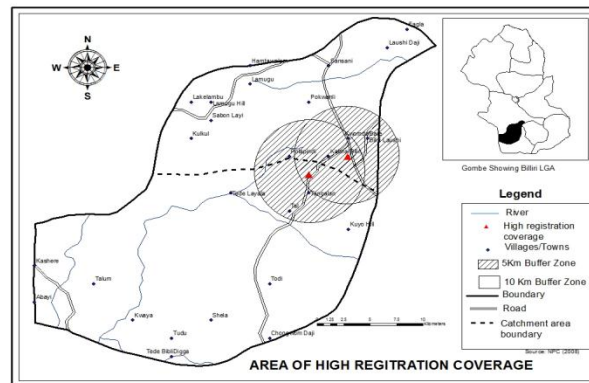
Figure 5: Billiri LGA Showing Reg. Centres, Cacthment & Areas of High Birth Reg. Coverage
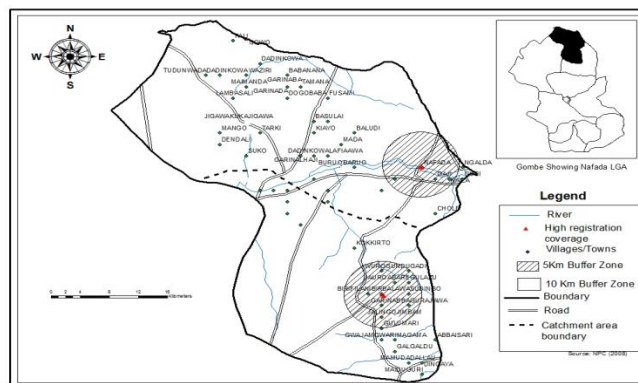

Figure 6: Nafada LGA Showing Reg. Centres, Catchment & Areas of High Birth Reg. Coverage
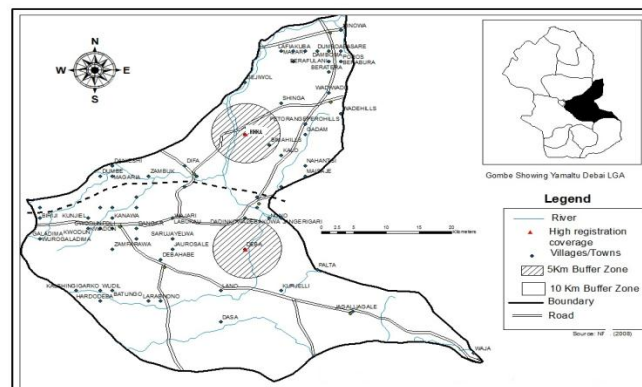

Figure7: Yamaltu-Deba LGA Showing Reg. Centres, Catchment & Areas Of High Birth Reg. Coverage

3.3   Spatial Accessibility of all the Registration Centres in Relation to Localities intheir Catchments Areas

The effect on accessibility of adding 1-10 new registration centres in each of the five rural LGAs using total weighted distance/average settlement distance objective can be seen in figures 8, 9, 10, 11 and 12.

The Nagfur report in India as cited by [29] recommended that areas lying 4km from transportation point are 'fairly accessible', beyond 8km are 'inaccessible' and beyond 16km are 'very inaccessible'. For the purpose of this study, an area is considered as having a good access if it is located on a flat land within 4-5km radius (trekable distance) from a facility according to [30] and within 10km as fairly inaccessible. Table 5 highlights accessibility statistics for all the registration centres in the selected LGAs. [32] also suggested something similar to this assertion.

Fig. 8 shows that for Akko LGA, the average weighted distance expressed in kilometer decreases from 24.12km with 2 registration centres to only 4.02km with 12 centres. That means, if the number of registration cenres could be optimally increased to 12, all the localities within a catchment area would averagely be located

within only 4.02Km. The same thing is applicable to all the LGAs as displayed by their respective figures. The furthest distance in the situation of 2 centres with respect to Akko LGA, is 52.62km, coming down to as low as only 8.77km in the event of 12 registration centres.

Fig. 9 indicates that, the average weighted distance in Balanga LGA decreases from 12.54km with 2 registration centres to 2,09km with 12 registration centres. In this case, the furthest distance is 26.98km with 2 centres and only 4.50km with 12 centres. The average catchment population also reduced from 105,745 to 17,624 respectively. Balanga LGA however, has a difficult terrain and therefore, the lower the distance to be travelled by a registrant, the better.

For Gombe LGA, the average weighted distance is only 1km under the present situation of 11 registration centres. Each of the 11 centres serves only an average of 24, 259 people as against for instance, Akko LGA with only 2 registration centres, and each serving an average of 168,718 people. That means, in Gombe LGA with additional 10 registration centres, the average catchment population of 12,707 people would be served and thus fractions of a kilometer in terms of average weighted distance would be covered by registrants. In practical terms however, Gombe LGA registration centres may be serving the neighboring LGAs of Akko Yamaltu-Deba.
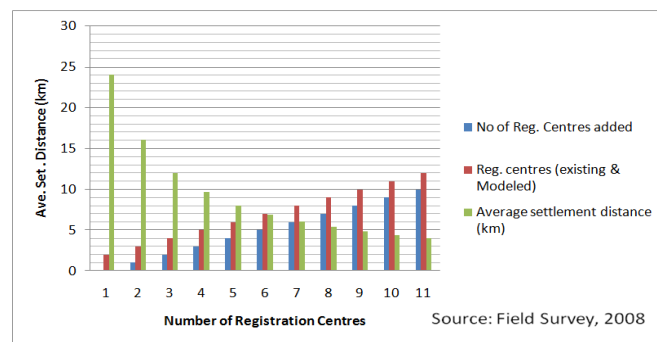

Fig. 8: Accessibility Statistics for Akko LGA's Current and Potential Vital Registration Centres
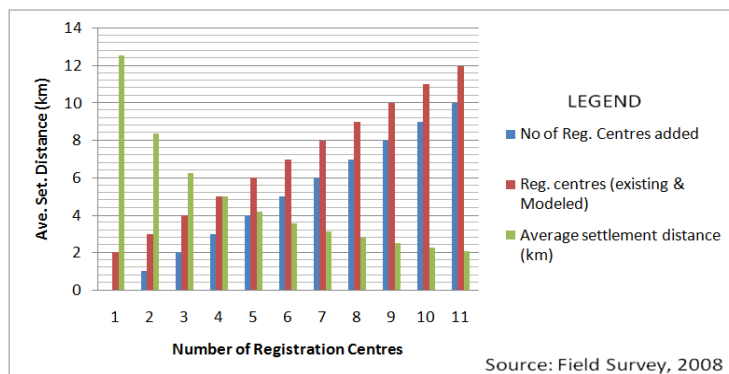

Fig. 9: Accessibility Statistics for Balanga LGA's Current and Potential Vital Registration Centres
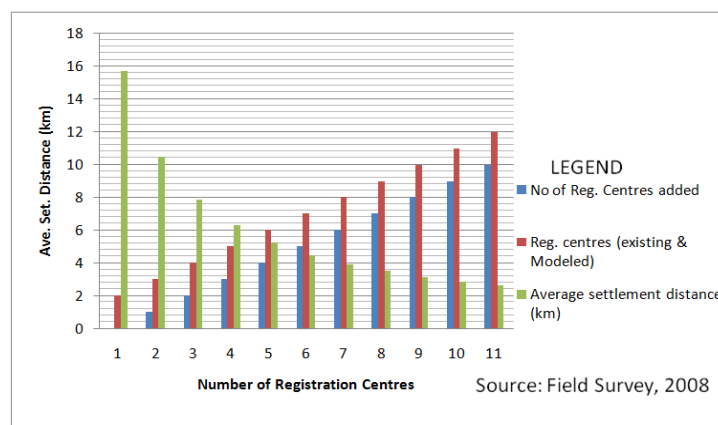

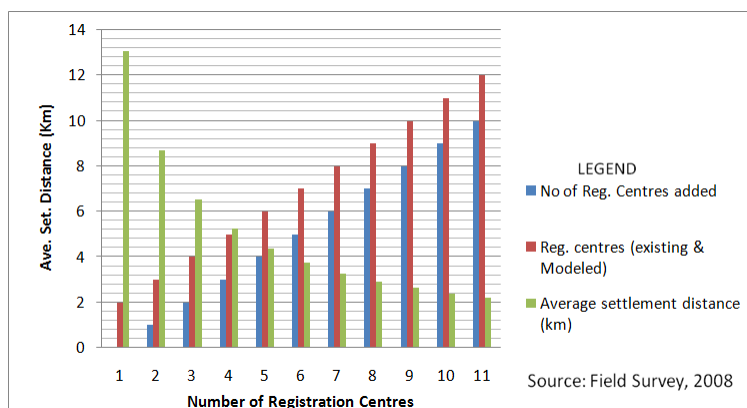Fig. 10: Accessibility Statistics for Billiri LGA's Current and Potential Vital Registration Centres

Fig. 11: Accessibility statistics for Nafada LGA's current and potential vital registration centres
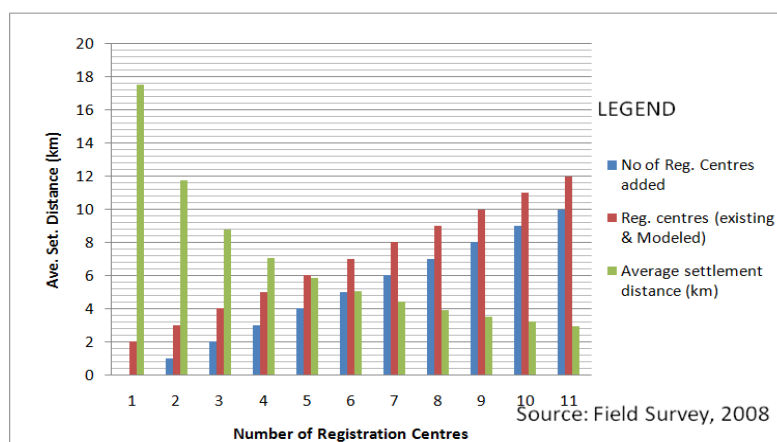

Fig. 12: Accessibility Statistics for Y/Deba LGA's Current and Potential Vital Registration Centres

IV.   Conclusion And Recommendations

4.1   Conclusion

It is clear from this study that accessibility affects vital registration coverage. This study provides information and maps about where patronages of such services are best received and where patronage is low (geographic disparities of the registration) and hence these will serve as models and proto types for planners. They will thus, be useful for determining where to launch new birth registration campaign and for tracking future progress by comparing birth registration levels at different points in time and different places in the state. Distance to registration has also been demonstrated by this study as having significant negative effect on birth registration coverage, however Euclidean distance measurement was used and in only the six sampled LGAs out of 11 LGAs. Hence, other aspects of accessibility indexes such as cost and time could be used and extension of such a study to other LGAs could immensely aid planners in planning for any future establishment of registration centres.

A number of factors however, posed some inherent limitations to this study. First of all, as the 2006 census figures were yet to be disaggregated to locality levels, the 1991 locality population was projected by the researcher and used for this work. Second, a crude birth rate index was also used for this study, instead of the actual birth rates since vital registration in a Nigeria suffers from completeness in coverage as well as scope.

4.2   Recommendations

i.   Establishment of more functional registration centres especially at health centres that are centrally located, coupled with intensive enlightenment campaigns on the importance of birth certificate at the grass root level to be undertaken by all the key stake holders such as Traditional Councils, media, Local Government Officials, Opinion leaders and NGOs among others should be given much priority.

ii.   In general, a long-term approach is needed to create birth registration systems that are permanent and sustained to generate consistent supply and demand. Birth Registration should be addressed as a core development issue alongside poverty reduction and universal access to basic services [7]. Thus, it has to be attacked from all angles viz: legal, economic, social,

political and geographical. This is because the system itself is a multi faceted phenomenon like poverty or underdevelopment.

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