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Distribution and Accessibility of Road Networks to Educational Facilities in Delta State: Transport Geographical Appraisal

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ABSTRACT

This study examined the geospatial distribution and accessibility of road networks to the educational facilities in Delta State: A transport geographical appraisal. The administrative map of Delta State was acquired and used to prepare the geographical information of the entire road networks of the study area. The choice of nodes was based on population size. Based on the adopted operational definition of major centres, 50 major centres were identified. The Pearson's product-moment correlation coefficient, as well as the regression techniques, were used in the analysis. A high correlation coefficient value (r = 0.60) was obtained between post-secondary institutions (x1) and primary institutions (x3). For access to have meant it should be people-oriented. The correlation between population and functional index of educational facility occurrence gives (r = 0.13). This means that large population centres tend to have fewer numbers and lower order types of educational facilities in the study area. The coefficient of determination of the relationship is given as 0.017 which indicates that population has no effect on the distribution of educational facilities in Delta State. This implies that population alone does not attract the establishment of educational facilities while small population centres tend to be favoured in the study area. Based on the findings recommendation was proffered.

Keywords: Transport geographical, Educational facilities, Road networks, Accessibility, Geospatial.

1. INTRODUCTION

One of the goals of regional planning is to ensure that infrastructural facilities necessary for development are made accessible to as many people as possible within the region. One way that planners have tried to meet this goal is the establishment of growth centres or poles where facilities are concentrated with the hope that the benefits of concentration will gradually trickle down to the surrounding areas (Atubi, 2011f and 2019c)

However, Brian and Rodney (2009) observed that the comparatively low levels of economic activity in many of the less developed countries is often reflected in the modest scale of their transport systems. As a complement of creating more physical capacity through major investment in urban transport infrastructure, many cities have attempted to make more effective use of existing road space by traffic engineering techniques. Some have attempted to translate these techniques into effective traffic management schemes to reduce demand and/or give priority to moving people rather than vehicles – by providing facilities for high occupancy vehicles such as buses, (Midgley, 1995 and Chengliang Liu and Ruilin, 2012).

This assumption of conventional transport planning has however been under criticism (Susilawati et al, 2013). Planning for accessibility or accessibility planning as referred to by some, involves more than provision of transport, facilities without regard to the individual. Rather it is seen as being concerned with providing opportunities to an individual at a given location to take part in a particular activity or set of activities. Geurs and Vanwee (2004, p. 127) have observed that "transport disadvantage is not equally or randomly distributed throughout society, but follows the

well-established lines of structural society inequality". What we might call 'mobility gaps' are tending to become bigger and to affect large numbers of people.

In areas where the population is unequally distributed as in rural areas, distributional equity may be seen in terms of the minimum number of people that lie beyond certain threshold distance from the location of facilities. Access defined as the weighted cost of travel to consume a public service can be regarded as a set of locational efficiency and equity in the distribution of public facilities (i.e. educational facilities).

Spatial accessibility has become a prerequisite to the integration of the urban centre and its circumference (Cao and Yan, 2006). The spatial evolution of metropolitan area and the development of its transport network are in interactive process (Wang and Jim, 2005). A well-developed transport network has become the basic condition and essential prerequisite to the systematic operation of the whole metropolitan area, the accessibility of which determines whether or not the material flow, the energy flow as well as the information flow is smooth between the urban centre and its circumference.

However, studies of accessibility are more concerned with issues of efficiency and equity with respect to location of public facilities. An efficient location of public facilities is defined as that which gives the minimum total systems cost of operation and travel of a given level or volume of service. Equity in location of public facilities (i.e. educational facilities) on the other hand is one which promotes greater equality of conditions (Rich, 1979; Pasquale, 2009; Oluwadare et al 2011; Paul et al, 2012 and Atubi, 2021b).

A new planning paradigm requires more comprehensive accessibility analysis. Our ability to evaluate accessibility is improving as transportation and land use planners develop better tools for quantifying accessibility imputes, and models which measure the travel distances, travel time and travel costs required by various types of transport system users to access various types of services and activities. However, accessibility-based planning techniques are still new and practitioners are still learning how to apply them to specific decisions.

In this paper, the author adopted the comparative approach because it is necessary to find out the extent to which the transport network actually relates to the distribution of educational facilities across the 25 local government areas of Delta State, Nigeria.

2. STUDY AREA

Delta State lies roughly between longitude 5°00' and 6°45' East and latitude 5°00' and 6°30' North. The total area of the state is 17,440sq.km about one-third of this is swampy and water logged. Delta State is bounded on the north by Edo State, on the East by Anambra and Rivers State and on the South by Bayelsa State. The Atlantic Ocean forms the western boundary with the northwest boundary in Ondo State. Delta State is endowed with many rivers and waterways. The major rivers are the Niger, Forcados, Warri, Ethiope, Escravos, Benin, Ase and Ossiomo (Refer Fig. 1)

FIG 1: MAP OF DELATA STATE SHOWING STUDY AREAS

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3. RESEARCH METHODS

In order to classify the major centres, data on educational facility provision were collected. The choice of this facility was based on the fact that they are capable of generating home-to-facility travels. In developing the research design, areas that are accessible to the road networks with population of 10,000 and above were taken as activity centres. It is however, important to note that the distribution of this facility reflects conditions in 2016 only. On the basis of the operational definition of major centres, 50 major centres were identified.

To ascertain if a relationship exists between population and functional index of educational facility occurrence in the study area, Pearson's product moment correlation coefficient (r) and regression analysis were employed. The Students 't' test was used for testing for statistical significance of the coefficients.

4. DISCUSSION OF RESULTS/FINDINGS

As at 2015, a summary of educational facilities reveals a total of 1 federal government secondary school, 369 secondary (senior and junior secondary schools), 1146 primary schools, 4 universities, 4 colleges of education, 1 school of marine technology, 3 polytechnics, 1 monotechnic. The post primary institutions which are government owned provides general, or academic, vocational and technical curricula. The number of schools represent 28% increase from 1991 figures. The school enrolment as at 2014/2015 stood at 200,384 representing an average of 543 students per school and 9 teacher/student ratio of 17:1 (Delta State Ministry of Basic Education, 2014). Although there has been an increase in school enrolment from 1991 there has been a decline in school population in recent times.

The primary schools wholly controlled by the Local Government Education Districts Carter for children between the ages of 6 and 12 years with a population of 312,489. In 2014/2015 there was a decrease of primary school enrolment from the 1991 figure of 394,506. The pupil/teacher ratio is about 16 for Delta State. It is estimated that the average home-to-school walking distance ranges from 0.7 kilometres to 2.4 kilometres (Delta State Ministry of Basic Education, 2014).

Figures 2a, b and c shows the distribution of educational institutions in Delta State. There is a wide distribution of educational institutions in Delta State especially of primary schools. However, there is greater concentration of primary schools in Aniocha South, Burutu, Ethiope East, Ethiope West, Ika North East, Ika South, Isoko South, Ndokwa East, Ndokwa West, Sapele, Ughelli South, Ukwani and Warri South Local Government Areas and Bomadi Patani, and Uvwie Local Government Areas has the lowest number of primary schools in Delta State.

While for secondary schools we have greater concentration around Aniocha North Aniocha South, Ethiope East, Ika North East, Ika South, Isoko North and South, Ndokwa East, Ndokwa West, Sapele, Ughelli South and Warri South. And Bomadi, Patani, Udu, Uvwie, Warri north, Oshilimil South, Oshimili north, Okpe and Ethiope West being Local Government Areas that had the lowest concentration of secondary schools in Delta State.

However, there is an obvious unevenness in the distribution of schools in Delta State. The issue of urban/rural dichotomy does not explain the uneven distribution. Uvwie and Oshilimi South Local Government Areas are predominantly urban and has only 8 and 7 secondary schools respectively. Ndokwa East that is mainly rural has 16 secondary schools. One thing that is clear is that the Local Government Areas are not equal in size. Their sizes vary greatly.

There are 4 universities located in Delta State as at 2016; these are Delta State University, Abraka. There is also Novena University at Ogume, Western Delta University, Oghara and Federal University of Petroleum Resources, Ogbomro. There is one monotechnic (that is the Petroleum Training Institute) at Effurun, Delta State. Delta State has three polytechnics, all owned and funded by the Delta State government.

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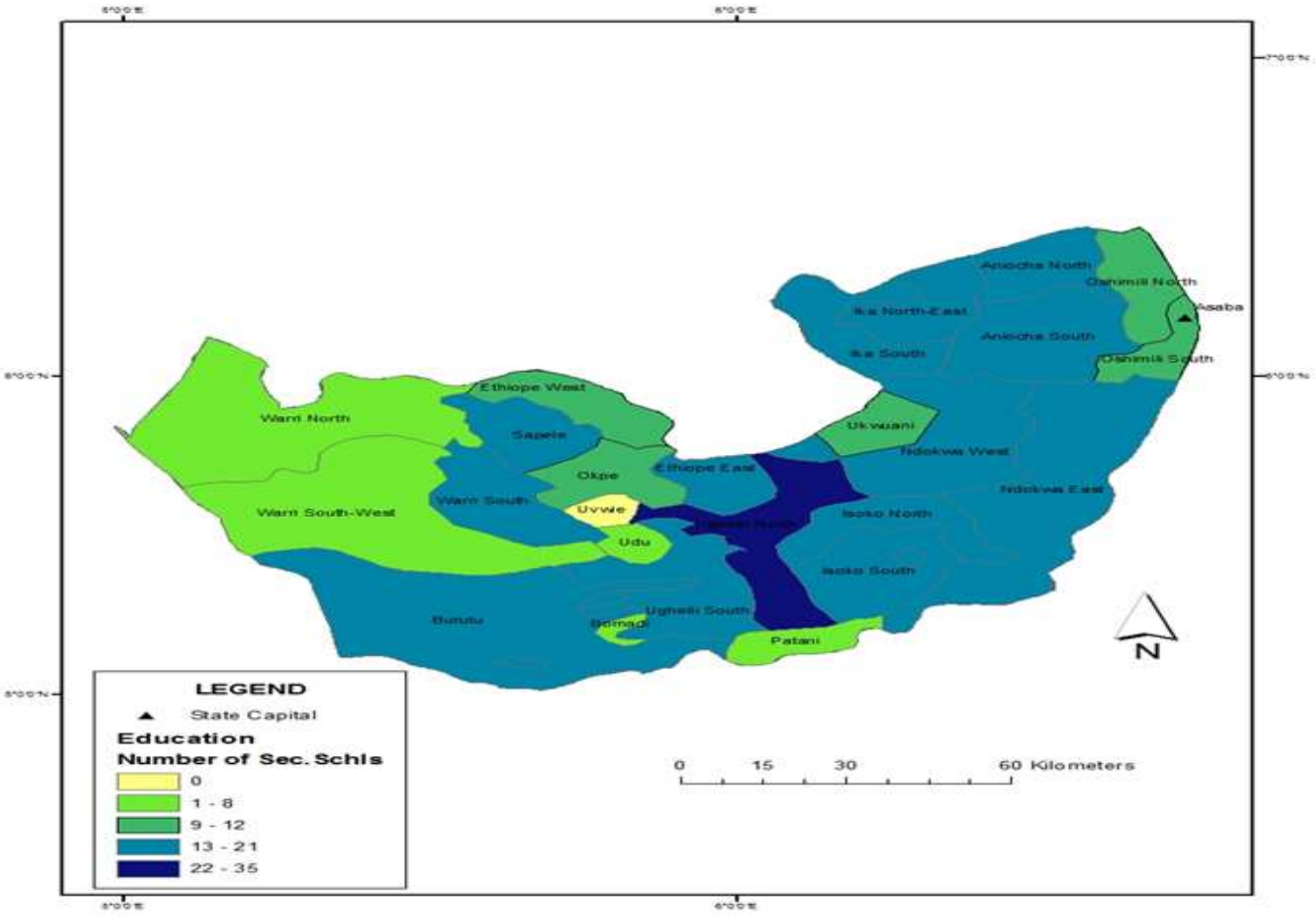

Fig. 2a: Spatial Distribution of Secondary schools in Delta State

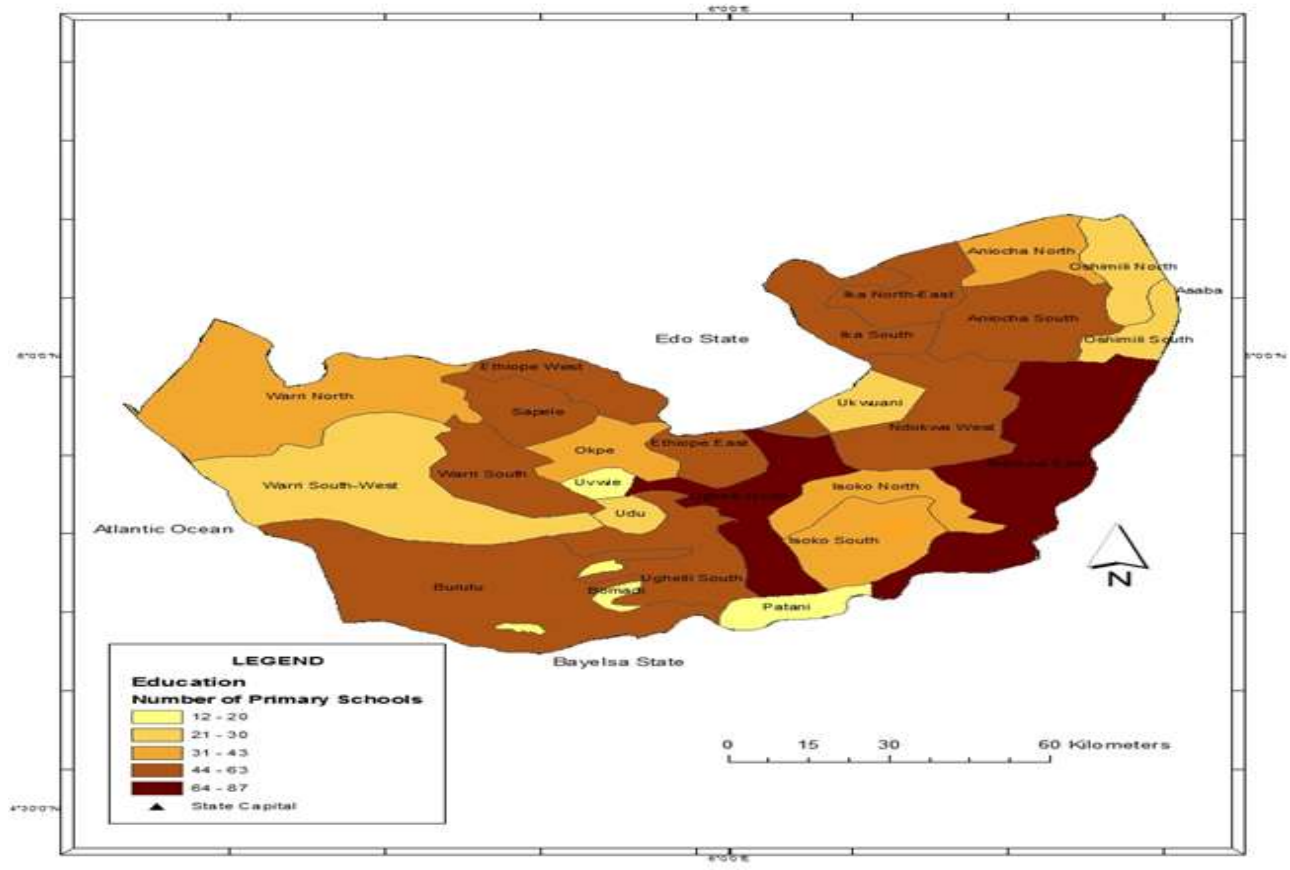

Fig. 2b: Spatial Distribution of Primary schools in Delta State

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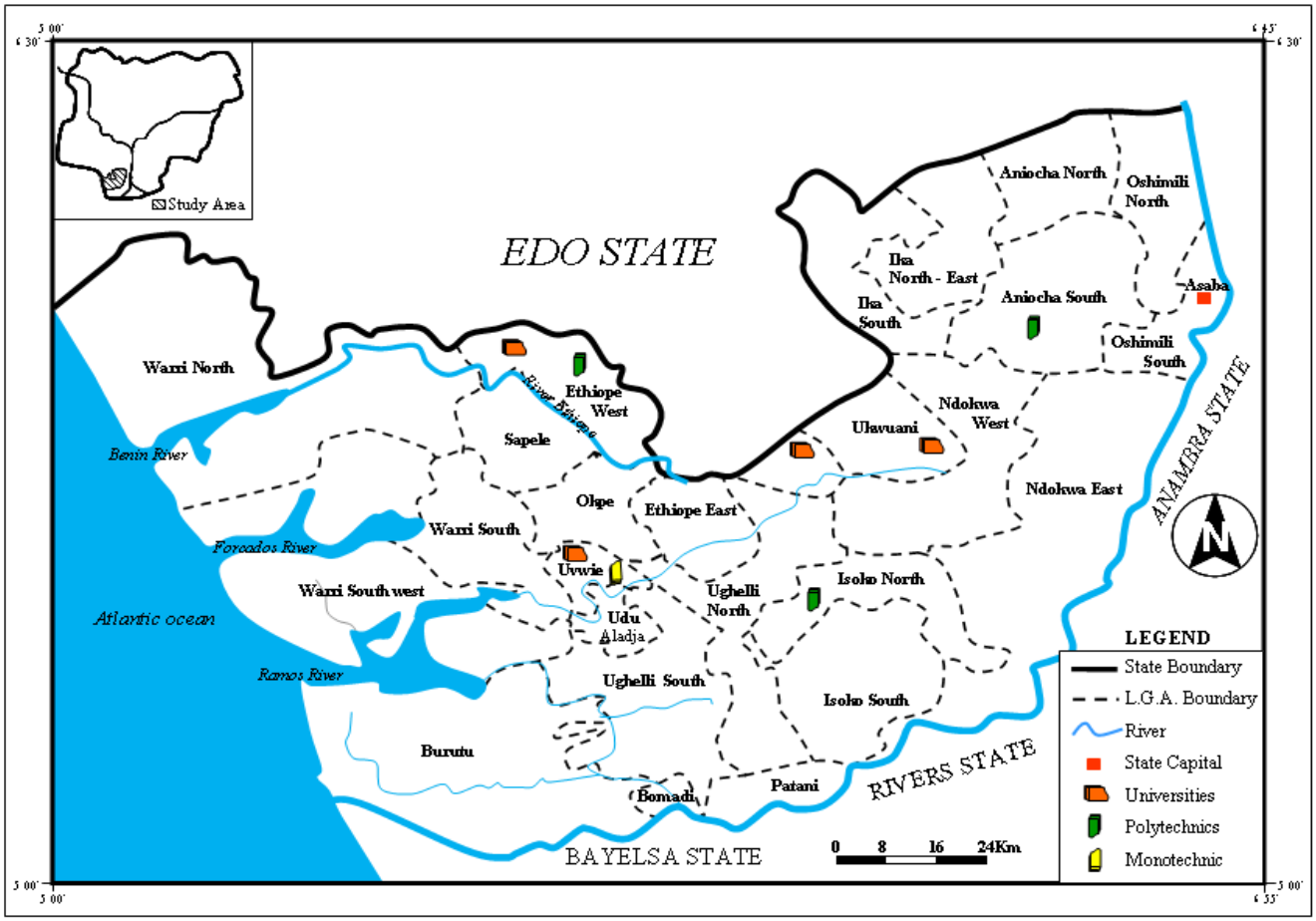

Fig. 2c: Spatial Distribution of Post-Secondary schools in Delta State

The illustrations of the number of educational or functions considered along with the weighting score is shown in Appendix A. The weighting system follows closely that of Atubi (2019c) by attaching 10 to first order functions 5 to second order, and 1 to-third order function.

However, having weighted the function, the product of the number of establishments of each function and the weight is summed up for a centre to give functional index of facility occurrence. This index shows the level of concentration of educational facilities in that centre (See Table 1).

Table 1: The functional index of facility occurrence in Delta State 2016

S/N	Mode No.	Population	X_1		X_2		X_3		Total
		2006 Census	UNF	WV	UNF	WV	UNF	WV	Weight
1	Issele-uku	32101	0	0	5	25	8	8	**17**
2	Ogwashi-Uku	63080	1	10	6	30	13	13	**18**
3	Owa-oyibu	73000	0	0	2	10	10	10	**26**
4	Agbor	84020	2	10	5	25	10	10	**75**
5	Ashaka	41330	0	0	1	5	8	8	**6**
6	Kwale	54064	1	10	3	15	8	8	**10**
7	Ibusa	64231	0	0	5	25	8	8	**18**
8	Asaba	106020	2	20	10	50	11	11	**6**
9	Obiaruku	46231	0	0	3	15	4	4	**6**
10	Abavo	23010	0	0	4	20	8	8	**21**
11	Umuebu	11091	0	0	2	10	2	2	**40**

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12	Bomadi	23072	0	0	2	10	6	6	**20**
13	Burutu	93224	1	10	2	10	6	6	**44**
14	Ozoro	74222	1	10	3	15	8	8	**6**
15	Oleh	102701	1	10	3	15	8	8	**18**
16	Patani	26021	0	0	2	10	4	4	**381**
17	Koko	101232	0	0	2	10	7	7	**9**
18	Warri	201642	1	10	11	55	30	30	**3**
19	Ogbe-ijo	88103	0	0	1	5	3	3	**2**
20	Ogidigbeu	15021	0	0	1	5	1	1	**9**
21	Omadino	23741	0	0	0	0	1	1	**9**
22	Uzere	52061	0	0	1	5	2	2	**63**
23	Kiagbodo	98201	1	10	0	0	2	2	**46**
24	Abraka	86224	1	10	4	20	7	7	**36**
25	Oghara	103060	2	20	6	30	10	10	**60**
26	Orerokpe	68021	0	0	10	50	10	10	**18**
27	Sapele	92101	0	0	10	50	13	13	**48**
28	Otor-utu	101221	0	0	6	30	10	10	**30**
29	Ughelli	183201	1	10	10	50	11	11	**240**
30	Otu-jeremi	104231	0	0	10	50	10	10	**21**
31	Effurun	101021	2	20	12	60	10	10	**6**
32	Isiokolo	34010	0	0	2	10	4	4	**0**
33	Jeddo	16201	0	0	3	15	2	2	**6**
34	Oria	18220	0	0	2	10	2	2	**12**
35	Eku	241221	0	0	2	10	2	2	**6**
36	Aviara	29010	0	0	2	10	2	2	**63**
37	Kokori	30071	0	0	2	10	2	2	**9**
38	Adagbrasa	19772	0	0	2	10	2	2	**11**
39	Aladja (DSC)	31010	0	0	5	25	4	4	**6**
40	Ewu/Urhobo	161222	0	0	2	10	3	3	**9**
41	Forcados	12990	0	0	1	5	1	1	**9**
42	Igbodo	13030	0	0	1	5	1	1	**17**
43	Illah	18241	0	0	2	10	2	2	**12**
44	Obior	12080	0	0	3	30	4	4	**9**
45	Orogun	16209	0	0	3	30	3	3	**9**
46	Okpara	41090	0	0	8	40	10	10	**17**
47	Olomoro	29330	0	0	2	10	3	3	**12**
48	Onicha-ugbo	22410	0	0	2	10	3	3	**9**
49	Ononta	16020	0	0	2	10	3	3	**6**
50	Umunede	28090	0	0	4	20	6	6	**9**
51	Umutu	26220	0	0	2	10	3	3	**6**

UNF = Un-weighted number of facilities, WV = Weighted value

X_1 = Post-secondary institutions (Universities, polytechnics, colleges of education, etc)

X_2 = Secondary school + vocational schools

X_3 = Primary schools

Appendix B gives a pair wise correlation matrix of the 3 variables employed in the index construction. However, care should be taken in interpreting the correlation matrix as high correlation coefficient between two variables does not necessarily mean that the occurrence of one will lead to the occurrence of the other. For example,

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that the high correlation coefficient between post-secondary institution (X_1) and primary institutions (X_3) (r = 0.60) does not mean that occurrence of post-secondary institution, necessary lead to the occurrence of primary institutions, but it does imply that both tend to be located in the same place within the study area.

Table 2 gives the rank order of nodal accessibility by 2016 based on the shortest road distance. Figure 3 is a map of equal accessibility surface in Delta State up to 2016 based on table 2.

Table 2: Rank order of Nodal accessibility using road distance of Delta State, 2016

Node No.	Nodal Title	Accessibility Index (km)	Rank order
29	Ughelli	2698.8	1
30	Otu-jeremi	2747.4	2
46	Okpara	3077.6	3
14	Ozoro	3184.8	4
28	Otor-udu	3202.1	5
39	Aladja (DSC)	3268	6
40	Ewu-Urhobo	3328.1	7
16	Patani	3334.1	8
6	Kwale	3351.2	9
32	Isiokolo	3356.5	10
45	Orogun	3465.5	11
36	Aviara	3491.4	12
43	Illah	3515.1	13
9	Obiaruku	3567.9	14
22	Uzere	3589	15
34	Oria	3665.2	16
31	Effurun	3779.8	17
44	Obior	3817.6	18
3	Owa-oyibu	3872.2	19
5	Ashaka	3882.3	20
48	Onicha-ugbo	3945	21
10	Abavo	4047.4	22
49	Owonta	4061.8	23
18	Warri	4091.2	24
15	Oleh	4092.1	25
24	Abraka	4095.7	26
4	Agbor	4113.9	27
47	Olomoro	4146.7	28
8	Asaba	4197	29
23	Kiagbodo	4232.5	30
2	Ogwashi-Uku	4278.9	31
33	Jeddo	4279	32
12	Bomadi	4328	33
35	Eku	4422.6	34
1	Issele-Uku	4433.6	35
20	Ogidigbeu	4467.6	36
11	Umuebu	4477.7	37
21	Omadino	4560.7	38
37	Kokori	4616	39
7	Ibusa	4634.7	40
26	Orerokpe	4709.1	41

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51	Umutu	4720.6	42
13	Burutu	4808.5	43
42	Igbodo	5007.6	44
38	Adagbrasa	5015.5	45
19	Ogbe-Ijo	5182.4	46
50	Umunede	5233.1	47
27	Sapele	5310.1	48
25	Oghara	5550.1	49
17	Koko	5951.3	50

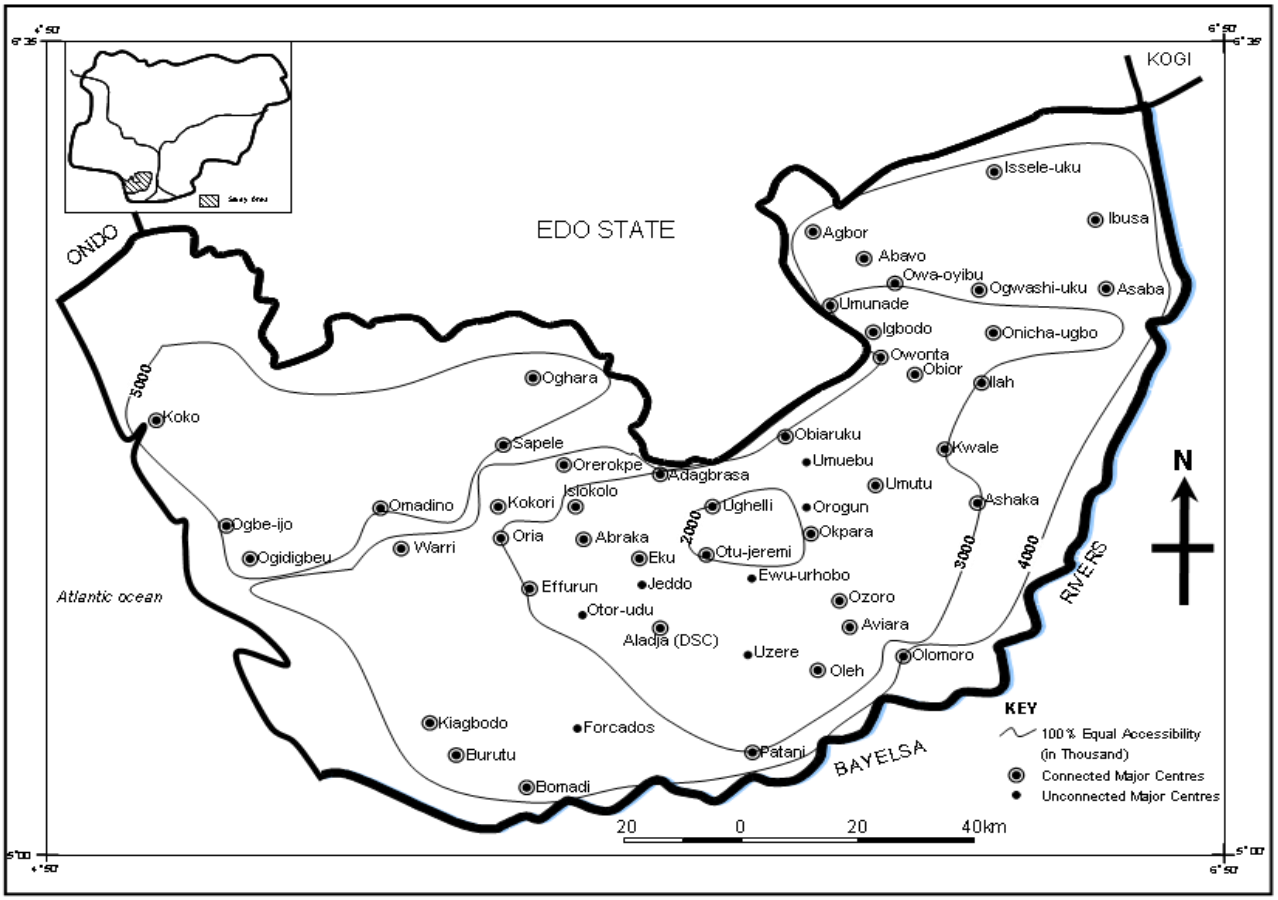

Fig. 3: Delta State showing areas of equal accessibility as at 2016 (2006-2016)

From the table we observe that Ughelli (Ai = 2698.8) is the most accessible centre followed by Otu-jeremi (Ai = 2747.4) and Okpara (Ai = 3077.6) as the second and third most accessible centres in the network. Again we note that Koko, Oghara, Sapele and Umunede remained the least accessible centres with (Ai = 5951.3; 5550.1; 5310.1 and 5233.1) respectively. The pattern of nodal accessibility shown in figure 3 emphases the existence of a central area of highly accessible centres.

For access to have meaning it should be people oriented. Hence, the attempt to account for how much population distribution affects the distribution of educational facilities.

The correlation between population and functional index of educational facility occurrence gives r = -0.13 which is considered insignificant at 1% level of probability (See appendix C-1 to 4). This means that large population centres tend to have less number and lower order types of educational facilities within the study area.

The regression line illustrated in figure 4 is given as

Log (FIE) = -201.79 Log (POP) – 44.071 …… (1)

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The standard error or the estimate is 0.35 as shown in appendix C-4). The coefficient of determination of the relationship is given as 0.017 which indicates that population has no effect and explains 0.98% of variation in the distribution of educational facilities in Delta State.

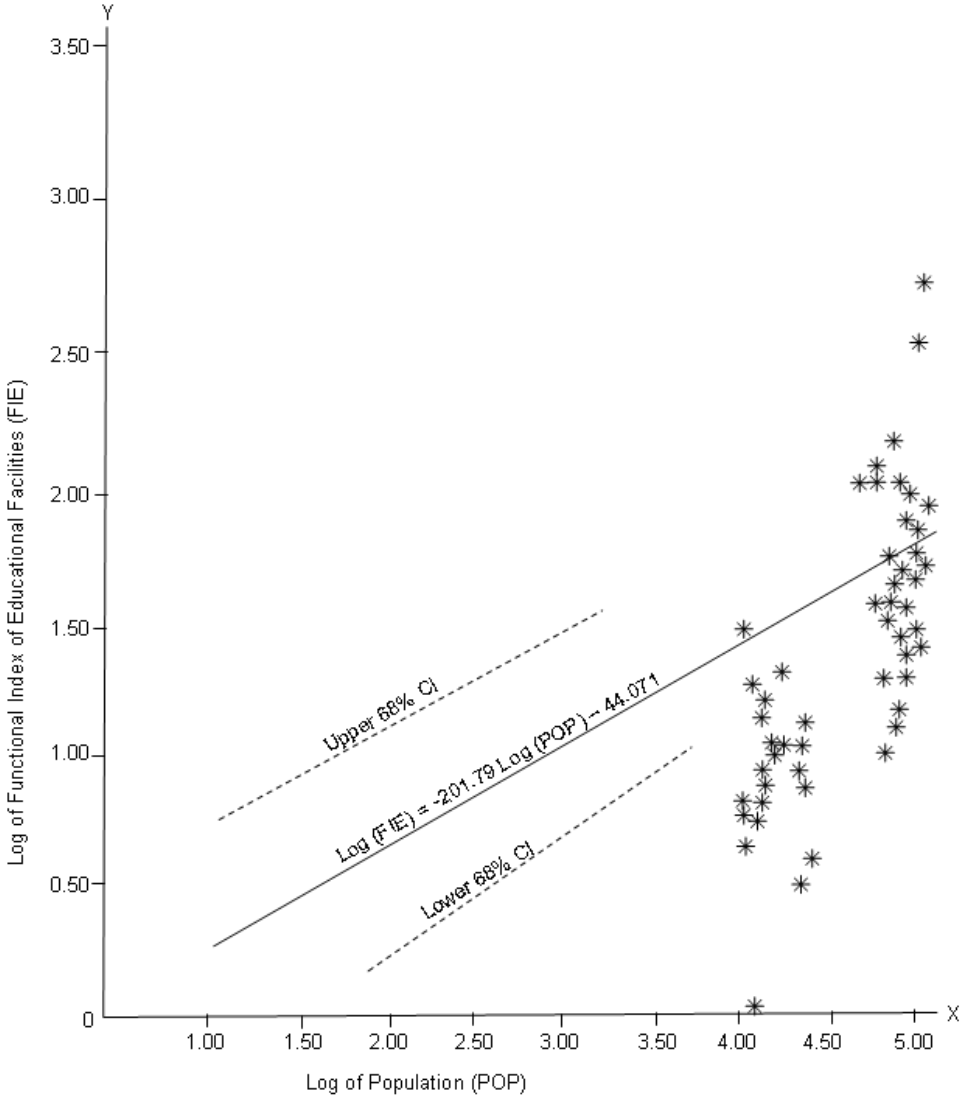

Fig. 4: Relationship between Functional Indices and Population

Figure 5 shows the pattern of distribution of residuals from the regression of functional index of population. The pattern of residuals from the regression of functional index on population shows areas of negative residuals being sandwiched by areas of positive residuals. Areas of positive residuals are found scattered in between areas of negative residuals.

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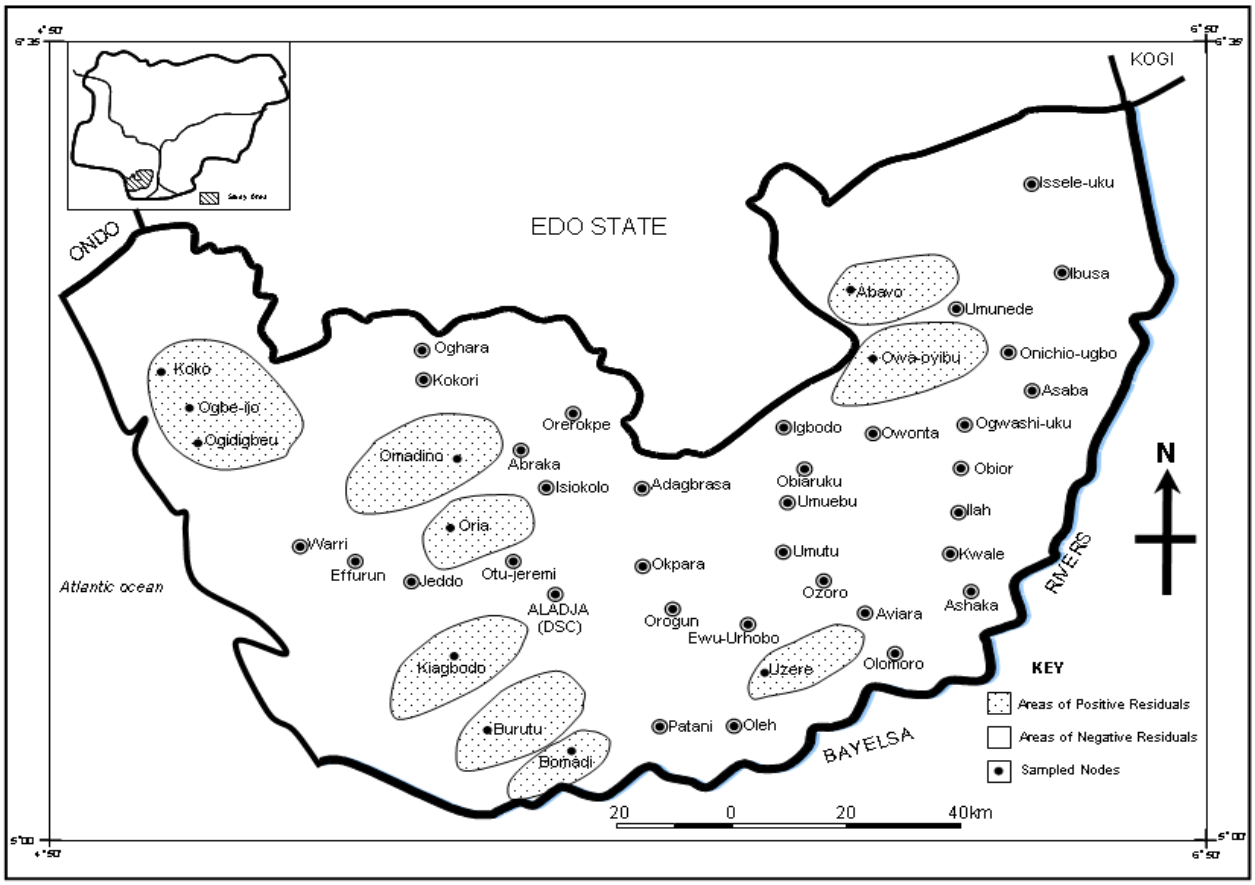

Fig. 5: Positive and Negative Residuals from the Regression of Functional Index on Population

The areas of negative residuals in this case indicate that there are less educational facilities than expected at a given population level. These areas are identified as:

I: The northern zone made up of Abavo area and Owa-oyibu. These area was identified as having poor accessibility but here it would seem that based on the population size centres are also under supplied with educational facilities.

II: Burutu-Ogbe-ijo (Southern zone) which has also large population centres that seem to lack important educational facilities relative to their populations.

III: Central Abraka area which comprises Oria (18,200), Isiokolo (34,000), Kokori (30,071) and Ewu-Urhobo (16,222) were identified as highly accessible centres. Although possessed of large population these centres do not seem to have attracted enough facilities relative to their population especially Eku-Oria axis.

Within the areas of positive residuals it was observed that some of the centres with the exception of Ashaka, Owonta, Aladja (DSC) and Jeddo have positive residuals implying that they have more facilities than their estimated population levels. This is irrespective of the level of accessibility. We can safely say then that population alone does not attract the establishment of educational facilities while small population centres tend to be favoured in the study area.

It is therefore recommended that in areas where the population is unequally distributed as in the rural areas, distributional equity may be seen in terms of the minimum number of people that lie beyond certain threshold distance from the location of facilities. Access defined as the weighted cost of travel to consume a public service can be regarded as a test of locational efficiency and equality in the distribution of public facilities.

CONCLUSION

Road network planning (or design) problems consist of determining the best investment decisions to be made with regard to the improvement of a road network. The degradation of the quality of service provided by the network that may occur in case of fluctuations in travel demand or disruptions in infrastructure supply is typically not taken into account in models designed to represent those problems. Yet this type of occurrences can have a severe impact on both the welfare of individual drivers and the performance of economic systems as a whole.

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Accessibility is an important factor in a road transport system, as it is a measure of the adequacy or otherwise of the system. A well developed and distributed road network will offer high levels of accessibility to facilities (i.e. educational facilities) while less developed and distributed one will have lower levels of accessibility.

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APPENDIX A
DEVELOPMENT OF HIERARCHY OF EDUCATIONAL FACILITIES

X_1 = Post-secondary institutions (Universities, polytechnics, colleges of education, technology, research institutions)

Weighting Score = 10

Attributes

- Training in specialised disciplines or profession
- Institution headed by Vice-Chancellor, Rector or Provost
- Staff oriented towards research writing or creation of new ideas
- Age limit for admission is 16 years hence students are considered as adults

X_2 = Secondary (post primary institution)

(Secondary grammar, vocational/domestic science schools)

Weighting Score = 5

Attributes

- Courses are geared towards entry into the tertiary institution or use towards lower level manpower
- The staff are oriented towards effective teaching;
- Students are mostly adolescents (11-16 years)
- Institution is headed by a principal

X_3 = Primary institution

Weighting Score = 1

Attributes

- Pupils trained to acquire the 3RS – reading, writing and arithmetic
- Staff oriented towards general education
- Age limit for admission is 6 years (that is pupils are generally children)
- Pupils are still in the custody of their parents

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APPENDIX B

PAIRWISE CORRELATION MATRIX BETWEEN THE VARIOUS FUNCTIONS

	X1	x2	x3
x1	0.60	0.21	0.42
x2	0.42	0.24	-0.02
x3	0.00	-0.27	0.02

Note: * Figures in asterisks indicate highly significant coefficients

APPENDIX C

Logarithmic Transformation of Population and Functional Indices (X) Data

Node No.	Population	Log (P) = X	Functional index (FI)	Log (FI) = Y
1	32101	4.506518562	17	1.230448921
2	63080	4.799891685	18	1.255272505
3	73000	4.86332286	26	1.414973348
4	84000	4.924279286	75	1.875061263
5	41000	4.612783857	6	0.77815125
6	54000	4.73239376	10	1.000000000
7	64000	4.806179974	18	1.255272505
8	106000	5.025305865	101	2.004321374
9	46000	4.662757832	18	1.255272505
10	23000	4.361727836	6	0.77815125
11	1091	3.037824751	6	0.77815125
12	23072	4.363085243	21	1.322219295
13	93224	4.969527733	40	1.602059991
14	74222	4.870532653	20	1.301029996
15	102701	5.011574672	44	1.643452676
16	26021	4.415323983	6	0.77815125
17	101232	5.005317817	18	1.255272505
18	201642	5.304580996	381	2.580924976
19	88103	4.944990697	9	0.954242509
20	15021	4.176698846	3	0.477121255

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21	23741	4.375499008	2	0.301029996
22	52061	4.716512506	9	0.954242509
23	98201	4.99211591	9	0.954242509
24	86224	4.935628166	63	1.799340549
25	103060	5.013090138	46	1.662757832
26	68021	4.832643012	36	1.556302501
27	92101	4.964264346	60	1.77815125
28	101221	5.005270624	18	1.255272505
29	183201	5.26292784	48	1.681241237
30	104231	5.017996904	30	1.477121255
31	101021	5.004411663	240	2.380211242
32	34010	4.531606632	21	1.322219295
33	16201	4.209541822	6	0.77815125
34	18220	4.260548373	0	0
35	24221	4.38419207	6	0.77815125
36	29010	4.462547729	6	0.77815125
37	30071	4.478147871	12	1.079181246
38	19772	4.296050602	6	0.77815125
39	31010	4.491501766	63	1.799340549
40	16222	4.210104397	9	0.954242509
41	13030	4.114944416	11	1.041392685
42	18241	4.261048643	6	0.77815125
43	12080	4.082066934	9	0.954242509
44	16209	4.209756222	9	0.954242509
45	41090	4.613736141	17	1.230448921
46	29330	4.467312063	12	1.079181246
47	22410	4.350441857	9	0.954242509

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48	16020	4.204662512	6	0.77815125
49	29090	4.463743721	6	0.77815125
50	26220	4.418632687	9	0.954242509

$\sum x$ = 231.0327112
$\sum x^2$ = 1053.564374
$\sum y$ = 60.2532015871
$\sum y^2$ = 126.3623578
$\sum xy$ = 248.2958936
$\bar{x}$ = 4.620645224
$\bar{y}$ = 1.24613985
δx = 0.336161245
δy = 0.351085124

Where y = Log (Functional Index)
X = Log (Population)

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APPENDIX C - 1

CORRELATION COEFFICIENT BETWEEN POPULATION (POP) AND FUNCTIONAL INDEX OF EDUCATIONAL FACILITIES (FIE)

Correlation coefficient (rxy) is given as

$$rxy = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\sum x^2 - \left(\sum x\right)^2 \times n\sum y^2 - \left(\sum y\right)^2}}$$

$$rxy = \frac{50 \times 248.2958936 - (231.0327112)(60.253201587)}{\sqrt{50 \times 1053.564374 - (231.032712)^2} \times \sqrt{50 \times 126.3623578 - (60.2532015871)^2}}$$

$$rxy = \frac{12414.79468 - 13920.4605211}{\sqrt{52678.2187 - 53376.1140} \times \sqrt{6318.11789 - 3630.4483014957}}$$

$$rxy = \frac{-1505.6658411}{11977.3685903}$$

$$rxy = -0.13$$

Hence the correlation coefficient between population and functional index is -0.13

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APPENDIX C - 2

TEST OF SIGNIFICANCE FOR THE CORRELATION COEFFICIENT BETWEEN POPULATION AND FUNCTIONAL INDEX OF EDUCATIONAL FACILITIES (FIE)

The students 't' test which is given by

$$t = \frac{r\sqrt{n-2}}{\sqrt{(1-r^2)}}$$

Where r = -0.13, n = 50

Hence:

$$t = \frac{-0.13\sqrt{48}}{\sqrt{(1-(-0.13)^2}}$$

$$t = \frac{-0.90064}{\sqrt{0.09936}}$$

$$t = -9.06$$

Ho = There is no significant relationship between population and functional index.

Ho = There is some significant relationship between population and functional index.

Table value n – 2 degree of freedom

50 – 2 = 48

0.01 = 1 – 0.01 = 0.99 or 99% = 2.42.

But t 0.01 > t cal.

We accept Hi and reject Ho

Hence we state "There is no significant relationship between population and functional index of educational facilities in the study area".

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APPENDIX C - 3

CALCULATION OF REGRESSION EQUATION OF POPULATION AND FUNCTIONAL INDEX OF EDUCATIONAL FACILITIES (FIE)

The regression equation is given by

$$b = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}}$$

$$b = \frac{248.2958936 - \frac{(231.0327112)(60.253201587)}{50}}{1053.564374 - \frac{(231.0327112)^2}{50}}$$

$$b = \frac{248.2958936 - 278.409210422}{1053.564374 - 1067.52227288}$$

$$b = \frac{-30.113316822}{-13.95789881}$$

$$b = -44.071$$

$$a = \frac{(\sum y)}{n} - b\frac{(\sum x)}{n}$$

$$a = \frac{(92.31196926)}{50} - (44.071)\frac{(231.0327112)}{50}$$

$$a = 1.846239385 - (44.071)620654224$$

$$a = 1.846239385 - 203.63223165 = -201.79$$

∴ a = - 201.79

Regression equation becomes

Log FIE = -201.79 Log (POP) – 44.071.

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APPENDIX C - 4

CALCULATION OF STANDARD ERROR OF THE ESTIMATE AND CONFIDENCE LIMITS OF THE FUNCTIONAL INDEX OF EDUCATIONAL FACILITIES (FIE) AND POPULATION (POP) EQUATION

Standard error of y on X(SEY on X) is given as

$$S.EY\ on\ X = Y\sqrt{\left(1-r^2\right)}$$

$$S.EY\ on\ X = 0.351\sqrt{\left(1-(0.13)^2\right)}$$

$$S.EY\ on\ X = 0.351 \times 0.999$$

$$S.EY\ on\ X = 0.351$$

Hence at 68% confidence limits or 1(S.E) the regression equation would be:

Log FIE = -20179 Log (POP) – 44.071 ± 0.351.

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