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Spatial Patterns of Residential Water Supply Accessibility Levels in Anambra State, Nigeria

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ABSTRACT
The aim of this study was to determine the extent of regional imbalances in residential water supply in Anambra State. To achieve this aim, primary data were collected between June and July 2012 from interviews on respondents and field observation, while secondary data were obtained from published materials from the State Ministry of Public Utilities, Water Resources and Community Development. Data generated were analysed to produce clusters using Cluster Analytical Technique which was calculated with the aid of MINITAB version 16 statistical package. Result shows that residential water supply accessibility pattern in Anambra State is structured into 4 zones (clusters). From the findings it was suggested that to improve the residential water supply access in various parts of the State, urgent water resources planning is needed to address the water poverty areas identified in the study.
KEYWORDS: Analysed, clusters, regional, resources, utilities.

I. Introduction

In many developing countries, the problem of inadequate supply of water in the residential sector has been studied (Banji, 2000, Jallo; 2001; Lomu, 2006). Phil-Eze and Ezenwaji (2008) however traced some of the factors giving rise to this inadequacy to continued increase in the population of such countries and their associated socio-economic activities which impose enormous pressure on the fresh water supply. The result is that the WHO minimum recommendation of per capita water consumption of 20 litres per day is becoming increasingly difficult for many developing countries to realise even with the intervention of relevant government authorities and Donor agencies.

In Nigeria, water supply has only achieved 75% of demand in the urban areas and 63% in rural areas (NBS, 2009), but despite this somewhat average achievement, it is doubtful that Nigeria will ever meet the MDGs target giving the short time remaining from now (2012) to the target year of 2015.

Even this level of water supply achievement in Nigeria published by NBS has not been properly felt by the populace. Very worrisome in this regard is the low level of water quality which was even though addressed in the year 2000 National Water Supply and Sanitation Policy document of the Federal Government of Nigeria, it is still recording a poor performance. As a result of this, majority of Nigerian citizens are still exposed to the high rate of water borne diseases such as cholera, diarrhoea, dysentery and other diseases arising from the consumption of unsafe drinking water (Obeta, 2003, Mohammed, 2007). In fact, Anene (1999) gave a graphic account of how some children are consistently absented themselves from school as well as and some women who find it difficult to engage in productive household labour activities because of their frequent affliction by water borne diseases in low urban communities of Jos, Plateau State, Nigeria.

In Anambra State, the wide gap existing between residential water demand and supply shows that supply was only able to achieve 45% of demand leaving a wide gap of 55% (Ezenwaji, 2003). Our findings in 2003 has not departed much from the current situation, eight years after as could be ascertained from recent findings by Agili and Umeze (2011) that residential water supply in the State achieved only 51% of demand showing a marginal improvement of 6% from the 2003 situation.

In absolute terms, residential water supply scarcity is, therefore, one of the problems facing the government of Anambra State, but the nature and magnitude of the shortages are not felt uniformly within the State, meaning that its degree and severity varies from one Local Government Area to the other. For example, the scarcity appears more acute in areas of the State without surface water like the major parts of Aguata and Anaocha Local Government Areas. In these localities, women and children who bear the major burden of residential water supply expend a large part of the day fetching water. According to Madu, Mohammed and Liwan (2011), these are raising

concerns worldwide that the benefits from economic growth and infrastructural development including water supply have been unequally distributed. The spatial variation or inequality in the supply of water results in spatial disparities in living standards both within and between regions and localities (Madu 2008). Thus inequalities exist between spatial units as they do between individuals (Kambur *et-al*, 2003). Water is one amenity whose supply exhibits clear spatial variations as Adenwumi (2007) noted that regional inequality in the supply of water contributes to different development profile in the constituent polities of an area. This explains why the analysis of regional inequalities is important since according to Madu et al (2011) it helps in the identification of the lagging areas which is necessary for the design of adequate targeting measures.

A number of researchers have investigated the magnitude of water scarcity in some parts of Anambra State (Ezenwaji, 1991, 2003, 2010, Onuegbu, 2006; Ikedi, 2010), but the study of spatial patterns of residential water supply access in the State is very scanty. This paper, therefore, seeks to determine the regional imbalances in residential water supply in Anambra State so as to close this gap in knowledge. This is important because having the knowledge of the level of access of residential water supply in various parts of the State on account of informed knowledge will surely aid in its development. Based on the foregoing, the need for this study cannot be overlaboured because it will provide the necessary framework for the physical planning and development of residential water supply in Anambra State.

II. MATERIALS AND METHODS

Area of study

Anambra State of Nigeria is one of the 36 States of Nigeria. Located in the South-Eastern parts of the Country, it is situated between Latitudes 5° 32' and 6°45'N and Longitude 6°43' and 7° 22'E respectively. With an estimated land area of 4,865sqkm or 486,500ha, the State is varied in terms of topography, population distribution and regional development. Created in 1991 from the old Anambra State, which has now been split into Anambra, Enugu and Ebonyi States, it has 21 Local Government Areas (Fig. 1.) and about 177 Communities (ANSG, 2000). Its State capital, Awka is an emergent urban area which is about 440kms from Abuja, the Federal Capital in central part of Nigeria and about 65kms to Enugu the old Eastern Nigerian regional capital. According to the National Population Commission (2010), the State has a population of 2,796,475 in 1991, but rose to 4,182,032 in 2006 and 4,461,942 in 2011.

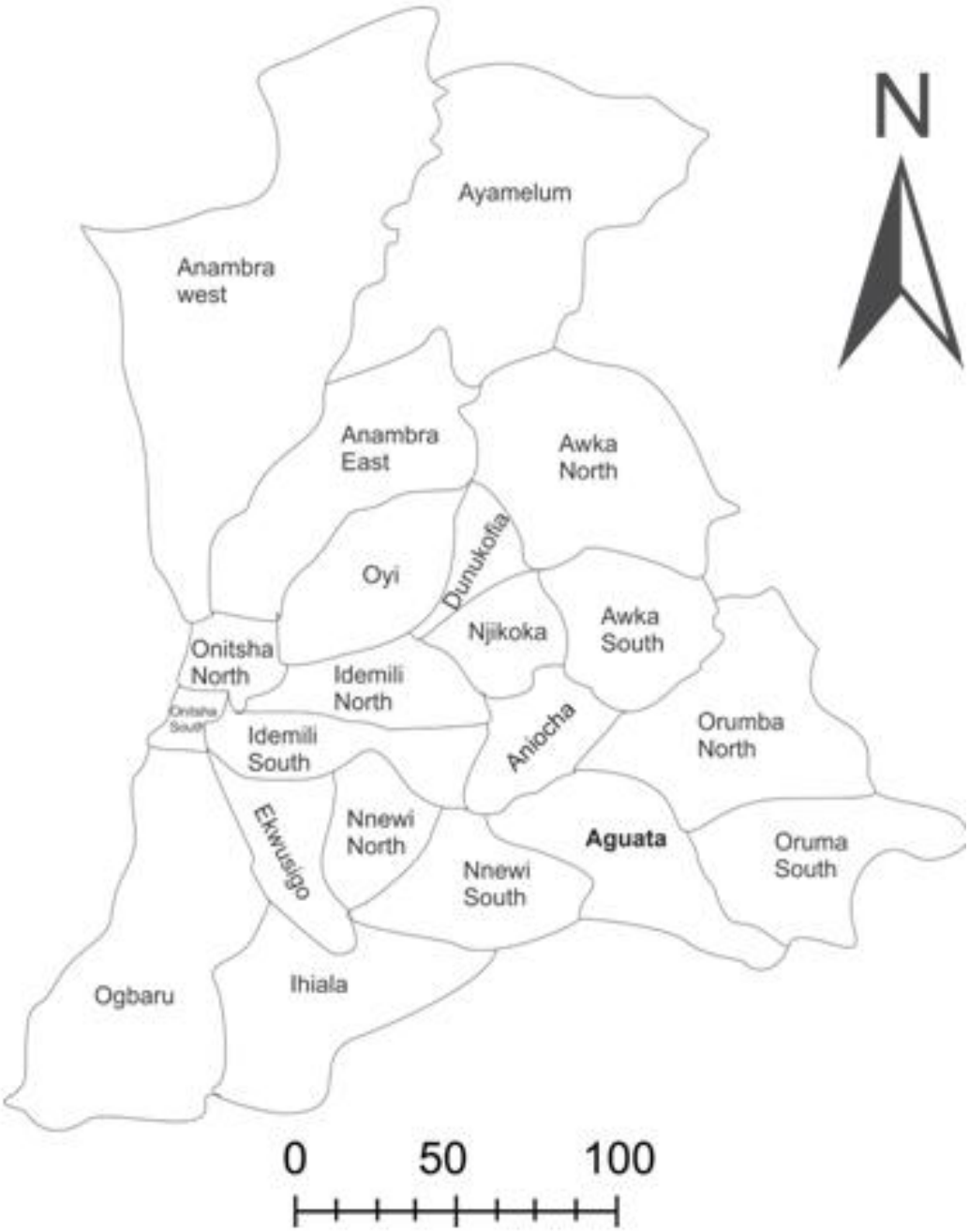

Fig. 1: Map of Anambra State, Nigeria showing 21 Local Government Areas

Anambra State is traversed by many rivers of national and regional importance which include: the river Niger, Anambra, Mamu, Idemili etc. The climate shows that annual mean minimum temperature is about 23°C while the annual mean maximum temperature is about 32°C. The annual mean rainfall is about 1750mm. while the mean annual Relative Humidity is about 68% (NBS, 2009).

The geology is made up of alluvium deposits which is found close to the major rivers of Niger and Anambra. Other major formations are Imo clay shales, Bende-Ameki and Nanka sands formations. This geological composition which is associated with varying water bearing potentials is one of the reasons for differences in water supply situations between areas in the State. The vegetation is rainforest, but has been largely disturbed by various human activities thus leaving a residue of trees and grasses.

III. Data Collection

This study was carried out for 3 months (June – August 2012) when interviews and field observations which formed the sources of primary data were conducted, while we sourced secondary data from publications containing five water access parameters in the 21 Local Government Areas (LGAs) from the Anambra State Ministry of Public Utilities, Water Resources and Community Development. Water access is defined according to the European Union support Water Programme (2005) to mean that households do not have to spend a disproportionate part of their day in fetching water for the family. The parameters were, however, described and recorded in Table 1.

Table 1: Residential Water Supply Access Parameters used in the Analysis

S/N	VARIABLE CODE	VARIABLE DESCRIPTION
1	INHA	Water available inside the house
2	COMP	Water available within the compound
3	WITH	Water source within 200m from the house
4	ABOV	Water source is above 200m from the house
5	MORE	Water source is more than 500m from the house

Table 2 however presents the field data of water supply access parameters in the 21 LGAs of the State.

Table 2: Field Data of Water Supply Access in the 21 LGAs of Anambra State

LGA	CODE	INHA	COMP	WITH	ABOV	MORE
Aguata	1	54	280	212	61	229
Anambra East	2	14	100	59	184	148
Anambra West	3	21	69	81	149	302
Anaocha	4	56	166	240	416	39
Awka North	5	24	83	114	163	180
Awka South	6	212	200	218	69	40
Ayamelum	7	18	46	184	110	139
Dunukofia	8	61	180	152	90	28
Ekwusigo	9	40	140	123	64	93
Idemili North	10	103	109	182	49	60
Idemili South	11	37	138	141	58	70
Ihiala	12	28	110	188	40	122
Njikoka	13	54	128	101	74	60
Nnewi North	14	202	188	146	39	11
Nnewi South	15	48	111	108	47	53
Ogbaru	16	30	129	141	58	33
Onitsha North	17	529	602	439	78	91
Onitsha South	18	544	563	592	29	70
Orumba North	19	49	30	110	101	162
Orumba South	20	40	68	102	144	187
Oyi	21	32	92	41	130	113

Source: Field Work (2012)

IV. Data Analysis

The analytic technique adopted in the work is the cluster analysis which according to Friedman (1967) is a multivariate technique for detecting regional groupings with the basic objective of reducing data. The model requires that data should be standardised if they were collected in different measuring units but our variables are homogenous and, therefore, did not need standardization. The clustering of the 21 Local Government areas based on their relative water supply access was done using the similarities approach which employs the single linkage or the nearest neighbour method. The use of nearest neighbour method to form clusters was to enable us define that the distances between different clusters represent the smallest distance between the cases. For this study, the amalgamation steps leading to the formation of clusters for the 21 Local Government areas is shown in Table 4. All calculations were, however, performed with the aid of MINITAB version 16 statistical package.

Table 4: Amalgamation Steps Leading to the Clustering of 21 Local Government Areas

Step	Numbers of clusters	Similarity level	Distance level	Clusters joined	New clusters	Number of observation in new clusters
1	20	99.89	902	9,11	9	2
2	19	99.88	1035	5,20	5	2
3	18	99.86	1152	13,15	13	2
4	17	99.82	1499	9,16	9	3
5	16	99.76	2013	9,13	9	5
6	15	99.52	4063	5,19	5	3
7	14	99.44	4732	8,9	8	6
8	13	99.43	4853	2,21	2	2
9	12	99.27	4879	2,5	2	5
10	11	99.67	6102	8,10	8	7
11	10	99.15	7059	8,12	8	8
12	9	99.13	7169	6,14	6	2
13	8	99.89	7303	2,7	2	6
14	7	98.89	9801	2,8	2	14
15	6	98.34	14053	2,6	2	16
16	5	97.66	19839	2,3	2	17
17	4	96.69	27997	17,18	17	2
18	3	95.03	42042	1,2	1	18
19	2	87.65	104586	1,4	1	19
20	1	62.97	313618	1,17	1	21

Source: (Author's calculation).

Whit the data on Table 3, the cluster distances were plotted with the use of the statistical package and the display of this plot in which the horizontal lines show joined clusters is commonly called dendograms (Fig. 2.). The position of the line on the scale indicates the distance at which clusters join and these distances are usually rescaled by the computer to fall into a reduced range of invisible actual distances.

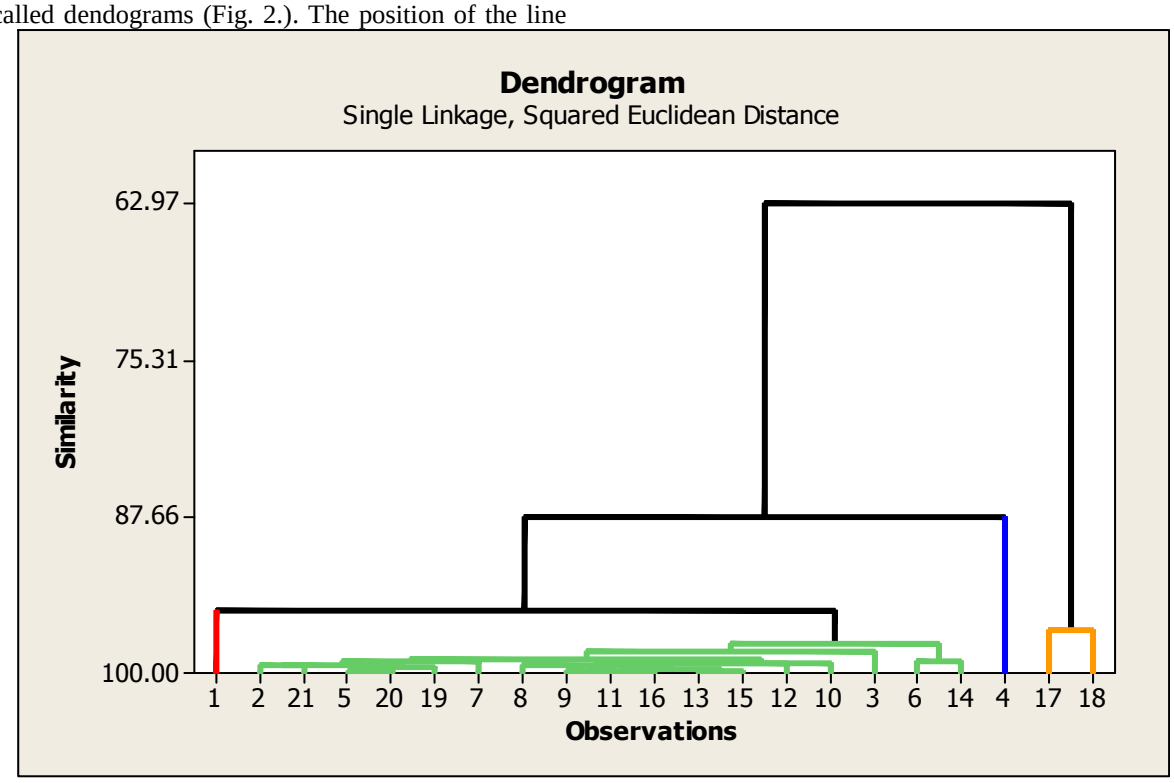

Fig. 2: Dendogram of the study area

V. RESULTS AND DISCUSSION

Results

Table 3 and Figs 2 and 3 show the result of the clustering of the 21 Local Government Areas in Anambra State in terms of water accessibility. Table 3 indicates that the first hook achieved in the amalgamation process are those of 9 (Ekwusigo) and 11 (Idemili South) with the highest similarity index of 99.89 with all others and the accompanied distance level of only 902. Conversely the last two Local Government areas that were clustered by the model are those of 1 (Aguata) and 17 (Onitsha North). Observe that as the distances increased between the LGAs to the maximum of 313618 in case of these two Local Government areas, the algorithm comes to the end as all the Local Governments are merged into one cluster (see the last column on Table 3). It was in this process that a dendogram with 4 clusters was produced.

Table 4: Local Government Area Groupings According to Water Supply Accessibility Level

Group	Local Government Areas	Water supply accessibility level
1	4 (Anaocha)	Very high
2	17 (Onitsha North), 18 (Onitsha South)	High
3	1 (Aguata)	Low
4	2 (Anambra East), 21 (Oyi), 5 (Awka North), 20 (Orumba South), 9 (Ekwusigo), 11 (Idemili North), 8 (Dunukofia), 9 (Ekwusigo), 11 (Idemili South), 16 (Ogbaru), 13 (Njikoka), 15 (Nnewi South), 12 (Ihiala), 10 (Idemili North), 3 (Anambra West), 6 (Awka South) and 14 (Nnewi North).	Very low

Source: Field work (2012).

The spatial representation of the grouping in Table 4 is shown in Fig. 3.

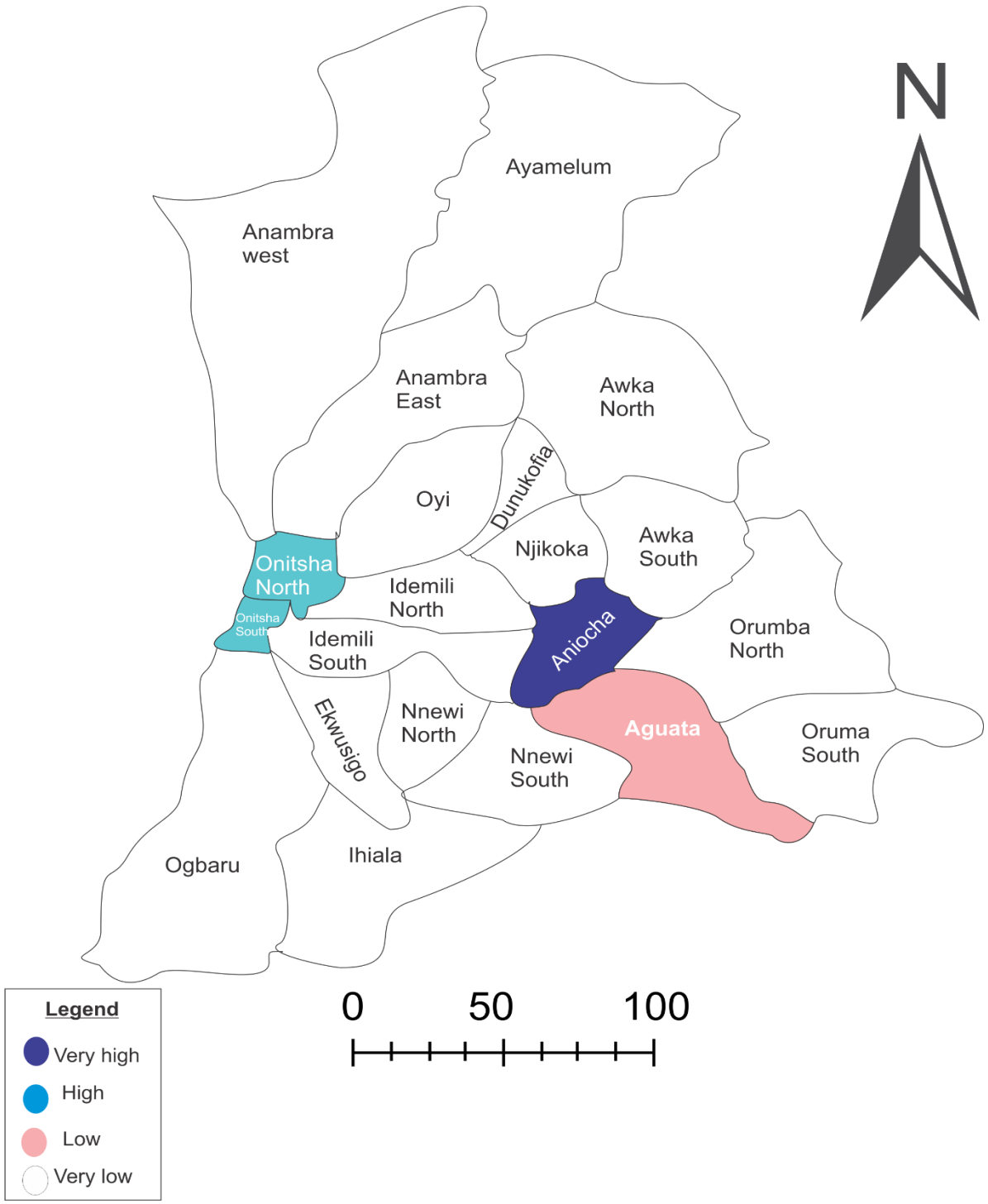

Fig. 3: Map of Anambra State showing spatial distribution of Dendogram grouping of the Local Government Area.

Discussion

Table 4 shows that the residential water supply accessibility was clustered into four in Anambra State ranging from those Local Government with very high water accessibility to those with very low accessibility levels to water sources. These groups are discussed as follows:

In group 1, is Anaocha which is the only Local Government Area in this group. The high level achieved by this Local Government Area is somehow surprising because as a rural Local Government Area, one would expect that it would have a low water accessibility level. However, a very close

investigation revealed that because the entire area lack surface water supply, there has been consistent increasing effort by the State Government to supply water through numerous boreholes which were recently constructed in the area with the assistance of such donor support agencies as the European Union, World Bank and the likes. Although it has the highest average number of households that fetch water above 400m, from the source but with a considerable high level of households (240) who source their water within the compound (see Table 3). The table also revealed that few households fetch water from sources that were above 500m (i.e. ½km) from their houses. Recently especially since 2008, the State Government has constructed so many groundwater sources, many of which had been connected to consumers in their houses.

Group 2 is made up of Onitsha North and South Local Government Areas which together constitute the legal city of Onitsha. This group has the second highest accessibility level of residential water supply in the State. They have the highest number of households who have water connected inside their houses with Onitsha South having the highest (544) while Onitsha North, had (529). Again they ranked highest in the State in terms of households who have water connected in their compounds with Onitsha North (602) having the highest number in the State followed by Onitsha South with 563. They also rank very high on households that source water within 200m, again with Onitsha South (592) having the highest in the State followed by Onitsha North with 439. The reason for the high achievement accorded in these two LGAs could be attributed to the contributions of individuals, companies and churches to close the gap created by the failure of the State government to provide water to the teaming urban population of the town. These private concerns run what may be regarded as micro water schemes which could be found in over 200 locations in the town. These schemes usually comprise a borehole or group of boreholes or shallow Wells fitted with submersible pumps that lift water to overhead tank(s) usually erected to form small water reservoir from where multiple public standpipes constructed in open spaces are usually connected. Consumers from the neighbourhood usually fetch water on payment of small tariff from such stand pipes. Households that require water connected inside their houses also pay some money to individuals or companies providing the service. This is the primary reason why the two Local Governments rank high on the number of consumers who have water inside their houses, those in their compounds and so on. Additionally, the number of those micro water schemes may not have been enough for the urban area, but the density of existing number of these schemes tend to serve the town because of high population and housing density observed in most parts of the town in which one scheme can serve many households located close by. This is in line with the observation of Presat (2006) that whenever a water supply source is located anywhere in congested neighbourhood, the distance people need to cover to the source is usually short.

Group 3 like group 1 has Aguata as the only Local Government Area and that only this Local Government Area was isolated as a separate group is not easy to understand. Suffice it to say that although it has high number of households that fetch water from sources that are more than 500m from the house, it achieved low (61) on those households that obtained their water from sources which are not more than 200m. The great strides recorded in this Local Government Area in the supply of water to the rural communities is remarkable. With the current effort by the State Government to boast the Obizi water scheme to serve communities in the area water supply situation will be improved further. Also there are many individual efforts at improving the residential water supply in this area and all these contributed to the current success recorded in the water sector of the area.

In group 4 are the rest of 17 Local Government Areas in the State. This is a group with very low level of water supply accessibility. They are mainly rural Local Government areas, although, Awka South, the State capital and Nnewi North the industrial hub of the State are strangely included in them. This group is generally characterised by households who travel more than 200m from their houses to fetch water from the nearest source of water. The situation presents a very gloomy water supply picture of the State because as high as 17 out of 21 LGAs in the State belong to this group. This thus means that a great deal of work awaits the government to ensure that a larger percentage of the State population who are currently denied the opportunity to be served with adequate water are served. A study conducted on the problem of water supply in some of the Local Government Areas that fell under this group by Kalma Hydro Consultants, an Israeli water company found that two water borne diseases namely cholera and diarrhoea were prevalent in the area (Kalma, 2010). Quite recently, diarrhoea has made a new outbreak in Ayamelum and other parts of old Anambra Local Government Area. The efforts of the State Government to combat these diseases has been much considering the cost of drugs used in fighting them.

In Awka and Nnewi towns, the situation is still parlous as the two urban areas are yet to enjoy public piped water supply. The orchestrated efforts of the State Government at supplying water to these two towns has not been translated to concrete results. The only ready source of water by households in these urban areas has been shallow wells the quality of which is highly doubtful. The State and Federal Governments should form a synergy in this regard as a strategy to tackle the perennial water supply in these two towns. Some rural communities in this group, which have used the community institutions such as the age grades, women and town unions to provide water supply are no longer the case as the government took over these functions, but has unfortunately been able to perform it. This made Elokaibe (2009) to comment that the low water supply conditions found in most of the Local Government Areas under this group is as a result of the fact that the social structure that helped them to provide water to their people suddenly broke down immediately after the Nigerian Civil War making them incapable of shouldering the responsibility. The successive Local or State Governments that took over this responsibility was found to be most corrupt, leading to cumulative denial of water services to the people.

VI. POLICY IMPLICATIONS OF THE STUDY

The result of this study has revealed a clear spatial disposition of water supply accessibility in Anambra State. Based on this finding, some policy measures are suggested to deal with these observed regional imbalances in the water supply levels in various parts of the State. These policy measures are outlined as follows:

a) Need for an Institutional Reform

The present institutional framework for water supply in the State has become obsolete and unable to meet the present challenges of the sector. The institution for the delivery of water supply in the State has been the Anambra State Water Corporation, which has been moribund. The Corporation's structure is such that there are six zonal offices in various parts of the State. The purpose of the zonal offices was to ensure that the decisions and policies of the Corporation were implemented locally. Again, it was the responsibility of the zonal offices to make sure that there was an efficient water delivery at the local level. However, this structural arrangement did not properly address the water supply problems in different parts of the State because of the following reasons;

i. Various zonal managers had varying performance levels. Although this is expected as no two zonal managers would deliver the same way, but the fact that the Corporation's performance during its days in zones could be said to be satisfactory but in others it was below the expected level. This may have resulted in the clear regional imbalances in water supply accessibility levels observed.

ii. The zonal offices were only an extension of the State offices and the inherent problem of the office often filter down to these zonal offices, through the established administrative chain of command. Such problems included wanton corruption, which was generating rivalry among management staff, the politicization of the Corporation by the State Government and lack of clear roles between the Ministry of Public utilities and the Corporation. As a result of these, there is every need for a policy shift in the institutional arrangement. We recommend the establishment of Local Government Water Service Boards (LGWSB) in each Local Government, while water commitees should be established in the component communities that make up the Local Government Area. Such bodies may be called the Community Water Supply Committess (CWSCs). These institutions will be responsible for the implementation of the government policies in the sector as may be initiated and published from time to time by the Ministry of Public Utilities, Water Resources and Community Development. By this, the central role of the Corporation regarding ownership and management of water will now be devolved to lowest possible level of government. Furthermore, the State should establish Water Service Regulatory Commission (WSRC) with authority to plan, licence, regulate and supervise the Local Government Water Service Boards and Community Water Supply Committee. The regulatory board has the right to sanction any nonperforming Board or committee.

Financing Water Services

Part of the problem of very poor performance in the sector is lack of funds. The present arrangement where budgetary provisions for the sector are rarely released, is part of the reason why as many as 17 Local Government areas of the State including the State capital are in severe water poverty. There must be a shift in both the administrative and operational management of funds

in the sector. On this we recommend the Ethiopian model where a Water Resources Development Fund (WRDF) was established. The main function of this fund when established will be to pool government and donor resources and channel them in line with the overall sector policy and budgetary provisions. This will remove the main line ministry from interfering in the finances of the sector. The fund will be accessed by the Local Government Water Service Boards under clearly stipulated conditions. This arrangement will no doubt streamline the present funding and expenditure structure of the sector.

The involvement of the Private Sector

The private sector has recently been seen as the central agent for the revitalization of nonperforming infrastructural institutions in Africa. However, in some areas they are manifestly rejected because of their high economic interests as against their protection of social issues of water supply. The above consumer's reaction was chiefly directed to the multinational companies with supra national interest. This is not the type of private sectors being recommended rather we are concerned with the proper integration of the local private water companies into the Local Government water supply scheme. The Local Government can engage them on PSP basis and allow them to handle low services such as reading of the metres, revenue collection and repair of the infrastructure. This will undoubtedly ensure the sustainability of the system.

From the foregoing, the following summaries could be made

(i). Anaocha Local Government area has the highest water supply access in the State.
(ii). Onitsha urban area which consists of Onitsha North and South Local Government areas has a high level of water access in the State.
(iii). Aguata Local Government area like Anaocha stands alone as the Local Government area with low water supply access.
(iv). The rest of the seventeen Local Government areas are classified under very low water supply accessibility level.

VII. CONCLUSION

This study reveals that water accessibility in various parts of the State presents a distinct spatial pattern that can be used in the water supply planning of the State. The grouping of as many as 17 out of 21 Local Government areas in the State into very low level of water accessibility category, indeed calls for urgent practical action to overcome the present arrangement where the construction of water infrastructure is only consigned to areas that are politically favoured.

The continuation of their practice will escalate the already wide imbalanced in the water resources development observed in the State. Presently, various water borne diseases such as diarrhoea, cholera and dysentery are ravaging some parts of the State and the social and economic consequences of such affliction on the populace cannot be ignored. This is why we call for an urgent implementation of key policy measures which we have suggested. The new policy represents a clear departure from the present arrangement which has performed abysmally low. It will no doubt help in giving quality governance to the sector which will ensure efficient and effective management of the available resources for sustainable water service provision to all parts of the State.

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