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RESEARCH ARTICLE

DISPARITIES IN ACCESS TO PUBLIC WATER SUPPLY IN GREATER YOLA, ADAMAWA STATE NIGERIA: IMPLICATIONS FOR URBAN DEVELOPMENT

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ABSTRACT

This paper aimed at investigating factors determining disparities in sustainable water supply in the greater Yola region of Adamawa State Nigeria with the view to suggesting physical planning recommendations that will enhance sustainable water supply. The study employed a two staged sampling procedure for the investigation. First, the study area was divided into three clusters based on physical planning characteristics with three residential areas selected randomly from each of the three clusters. Secondly, a systematic random sampling procedure was employed to administer 312 questionnaires, amounting to 7 percent, to the households in the selected residential districts. Chi square analysis revealed significant variations in terms of the sources of water supply (x^2- 189.6188, P- 0.000).Only those residing in the formal private residential areas are able to consume the recommended WHO standard which is 70 liters per capita per day. The government owner occupier (53.6l/c/d) and the peri-urban areas (38.7 l /c /d) fall short of recommended standards. Analysis of variance also shows differences in quantity of water consumed (F=3.658, P=0.41). However, 85% percent of the population lives within the prescribed limits of proximity to water supply sources. The study recommended that physical planning authorities work in conjunction with the water board corporations in adopting physical planning standards to ensure communities are supplied with potable water, within accessible distances, to promote public health, and designing of masterplans that will incorporate, within the limits of physical planning, the water supply needs of urban dwellers to sustainable public water supply.

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INTRODUCTION

The problem of community water supply is common to most developing countries around the world including Nigeria, despite its importance in meeting the needs for cooking, washing, bathing among others. According to Ezenwaji*et al* (2014), even with increase in water supply to both urban and rural areas in Nigeria over the years, it is doubtful that the country will meet the millennium development goals target of ensuring that half the population of Nigeria have access to improved water sources. While there is improvement in water supply,records have it that up to 63 million Nigerian still lack access to improved water supply (Obinna, 2014). As a result, many Nigerians are still exposed to high rates of water related diseases such as cholera, diarrheal, dysentery and other such diseases arising from the consumption of unsafe drinking water (Mohammed, 2007; Obeta, 2003). In absolute terms therefore, residential water supply scarcity is a problem facing many urban areas in Nigeria. The percentage of people without access to this vital resource has been on the increase in recent times. However, the nature and magnitude of shortages are not felt uniformly within residential districts in urban areas.It appears from reports (Ezenwaji, 2014; Musa, 2009) that there is disparity in the distribution of water supply between regions, within regions and within urban areas in Nigeria. The National Water Supply Policy for Nigeria (2004) has also affirmed that there is temporal and spatial variation in water availability in Nigeria. In line with this lop-sidedness in access to water supply in many countries including Nigeria, the National water supply for Nigeria (2004) adopted as one of its guiding principles, the assessment, development, appointment and management of water resources in such a manner as to enable all users to have equitable access, taking into account the sustainability of the resource. Also, the United Nations General Assembly and the Human Rights Council (2010) recognized access to water supply as a human right, and urged governments to ensure that water is made available, accessible, safe, acceptable and affordable to all without discrimination. Ghermai *et al*. (2012), note that the concept of access to water

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supply refers to the quantity, quality and availability of water, and in close proximity to consumers. It connotes physical availability and lays credence to the extent to which factors like distance, time and cost have decayed (Adeyemo, 1989). Without access, there is no survival. Access to water supply is therefore a strong index of development. Thus access to water supply has been defined as the number of people who have reasonable means of obtaining sufficient amount of clean water that is safe for drinking, cooking, washing and other important household activities (World Bank, 2002), and the ability of individuals, households, communities to obtain water for domestic, agricultural, industrial and landscape purposes (Ishaku, 2012). One important aspect of access to water supply however is the question of the type of access because access can either be improved or unimproved. Improved access to water supply can be achieved when individuals have household connection or have access to a public water stand pipe, borehole, protected well, spring or rain water collection facility, capable of providing 70 liters of water per capita per day at a distance of not more than 1000 meters World Health Organization (2013; O'Hara *et al*., 2008).

An unimproved source is taken to mean any unprotected well or spring, vendor provided water, tanker truck provision of water, surface water(river, lake, dam, pond, stream, canal, irrigation cannels)and bottled water (W.H.O/U.N.C.E.F 2010). Table 2.0 further illustrates this.This concept is used for international comparison and reporting based on water security, quality, proximity, quantity and type of technology (United Nations Development Programme, 2006).When access to improved water sources is not achieved, unimproved sources are used. Unimproved sources endanger health and welfare of the society which consequently lead to low productivity, increase national health cost, poverty and death.
While access to water improves health, it also has a number of development goals (Figure 1). According to Kosoe and Osumanu (2015), problems of poverty are inexplicably linked with those of water-its availability, proximity, quantity and quality-and as such improving access to water could also make a major contribution towards achieving the eradication of poverty.

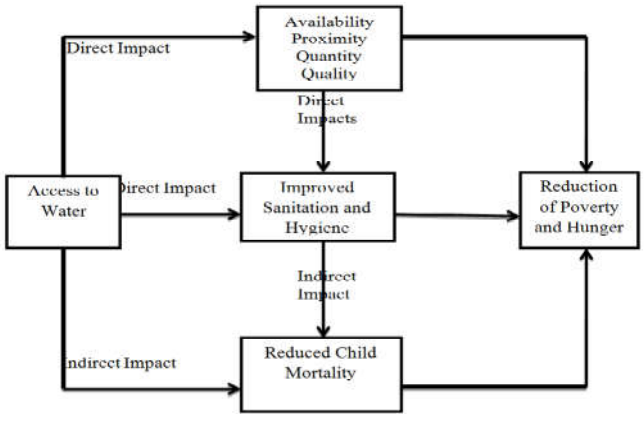

Figure 1. Impact of Access to water Supply Source: Kosoe and Osumanu (2015)

Therefore, while it becomes imperative to acknowledge that water supply in Nigeria urban areas is inadequate, it is important to focus on investigating intra urban access to water supply so as to make recommendations on equitable distribution. Yola is blessed with abundant water resourcesof both ground and surface water. Its location in close proximity to the river Benue is a case in point. In spite of its potentials for good water resources, there appears to be incessant water shortage in the metropolis. Specifically, preliminary investigations in Yola show that there is disparity in publicwater supply. From preliminary visits, areas such as Karewa, and Dogireihave adequate and regular water supply while worst hit areas include Luggere, Limawa and Rumde . This poor supply and distribution of water usually results in useof water from unsafe sources which leads to high chances of contacting water borne disease, and also leads to large amount of income spent on accessing water from water vendors.Yola presents a good basis for studying disparities in domestic water supply in the residential areas to understand the factors that limit access to water supply in some areas and factors that present opportunities for water supply in some areas. The study is imperative because providing optimum water supply to urban dwellers improves quality of life, health and liveability. Therefore, it is within the purview of urban planning and control regulations to ensure supportive planning policies are deployed for sustainable development.

Study Area and Methodology

Yola is the capital of Adamawa State of Nigeria, located on the River Benue. Yola is split into two parts. The old town of Yola where the Monarch (Lamido) resides is the traditional city but the new city of Jimeta (about 5 km North West) is the administrative and commercial centre. Generally the term Yola is now used to mean both. Yola is located on latitude9°14″ N and longitude 12°28′ E.It has total land coverage of 662.47 square kilometers and apopulation of 395,871 persons (Adamawa State Ministry of Water Resources, 2015). 2012 projection gives the population as 410,598 persons (Abdulrahaman, 2013). The study area comprises twenty two (22) administrative wards from three (3) localgovernment areas (Yola North, Yola South, and Girei).Yola has a tropical climate marked by rainy and dry seasons. The maximum temperature can be as high as 40^{o}C, particularly in April, while minimum temperature can be as low as 18oC between December and January. The mean annual rainfall is less than 1,000 mm (Adebayo, Tukur, 1999). A two staged sampling technique was employed for questionnaire administration. The first stage was the selection of the residential districts. Thus, the residential districts in greater Yola were divided into three core zones. The first zone is the formal private residential areas with good housing and infrastructure.The second is the government owner occupier residential districts while the third was theperi-urban areas, characterized by slum conditions. From each of these clusters, one residential district was randomly selected. The second stage includes the selection of the households in which the questionnaires were administered. A total of 312 households amounting to 7 percent of the households were administered through a systematic random sampling procedure, as described in Table 1.

Table 1. Summary Description of the sub-areas

Description of area	SelectedResidential District	Number of Household	Sample Taken
Formal Private	Dogirei	485	34
Owner Occupier	Shagari Housing Estate	1400	98
Peri-urban	Vunoklang	2573	180
Total		4458	312

The conceptual and theoretical framework for the research was built from a search of published and unpublished literature on

related issues that provided information on water supply policies and on standards for water supply in urban areas. These materials contained information on what had already been done on the subject matter. Information on existing water supply distribution network in Yola was, in addition to information gathered from Adamawa State Water board Yola Branch, obtained from the multi state water supply project, Adamawa State sub-project feasibility study (1996). Data collected from the questionnaire were entered into the Statistical Package for Social Sciences (S.P.S.S) Version 22 spread sheet for the statistical analysis.Chi-square test was used to test if an association exists between the categorical data. The chi-square test is a statistical test that can be used to determine whether there is a statistically significant difference between the observed frequencies and expected frequencies. As in other statistical tests, the chi square test states a null hypothesis (H_0: there is no significant difference between observed and expected frequencies) and an alternative hypothesis (H_1: there is a significant difference). Based on the outcome of the chi-square test we will either reject or fail to reject the null hypothesis. Chi-square tests enable us to compare observed and expected frequencies objectively, since it is not always possible to tell just by looking at them whether they are "different enough" to be considered statistically significant. The chi square is calculated by the formula:

$$x^2 = \sum \frac{(O - E)^2}{E}$$

Where,

O= Observed frequency

E= Expected frequency

∑= Summation

X^2= Chi Square

The differences in mean liters per capita per day (l/c/d) have been tested using one--way analysis of variance technique. The one-way ANOVA is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups. Specifically, it tests the null hypothesis:

$$H_0: \mu_1 = \mu_2 = \mu_3 = \cdots = \mu_k$$

Where μ = group mean and k = number of groups. If, however, the one-way ANOVA returns a statistically significant result, we accept the alternative hypothesis (H_A), which is that there are at least two group means that are statistically significantly different from each other.

RESULTS AND DISCUSSION

Differences in sources of water supply between the residential districts

Table 2 describes the variation in sources of water used between the three residential districts using Chi-square test. The test shows a significant difference in sources of water used between the three residential districts (x^2- 189.6188, P- 0.000).

Table 2. Percentage Distribution of Source of Water across the Residential Districts

Sources of Water Supply	Formal private %	Owner-occupier %	Peri-urban %	Total %
Protected Well	0.00	26.32	72.68	100
Unprotected Well	0.00	75.00	25.00	100
Water Vendor	0.000	42.96	57.04	100
Private Water Supply	53.13	28.13	18.75	100
Public Water Supply	0.00	77.78	22.22	100
Public Borehole	0.00	5.00	95.00	100
Surface Water	-	-	-	-
Others	0.00	25.00	75.00	100
Chi-Squared Value	189.6188			
Degree of freedom	12			
P-value	0.000*			

* Significant at 5% level

Differences in quantity of water supply between residential districts in Yola

The concept of access refers to the quantity, quality and availability of water in the closeproximity. The current quantity of water supply in Greater Yola disproportionately distributed. Dataon average per capita water consumption shows that only the formal private areas attain the per capita water supply requirements (70-100 liters) recommended by the Indian water supply standards (2010) and World Health Organization (2013).The owner occupier and medium income areas in Yola are not able to meet this requirement (Table 3). The low and medium income parts of the metropolis are less served with public water supply.

Table 3. Estimated mean daily amount of water used per household (Liters)

	Mean Monthly Household Income(₦)	Mean Family Size	Mean Daily Household Consumption	Mean Daily water used(Liters)
Formal Private	74,821.5	4.7	342.63	72.9
Owner Occupier	54,822.2	5.5	294.8	53.6
Peri-Urban	32,812.08	6.2	239.94	38.7

Source: Field Survey (2017)

From Table 4, the analysis of variance confirms that there is a significant difference in water use between the settlements (F=3.658, P=0.41).

Table 4. A comparison on quantity of water supply between districts using ANOVA

	Sumof Squares	df	Mean Square	F	Sig.
Between Groups	1424.333	2	712.167	3.658	.041*
Within Groups	2920.167	15	194.678		
Total	4344.500	17			

* Significant at 5% level

Relationship between Distances covered and sources of water used between the residential districts

From table 5, about 5.9 % of those living in high income residents' access water from outside their houses. All residents in the high income areas access water within a recommended 500 meters radius for accessing waterin the middle income estates, 66.7 % of the residents' access water outside of their houses and they access water within a 500 meter radius while 11.5 % travel beyond 500 meter radius for water supply.

Majority of the residents rely on water from private commercial sources. In the low income unplanned area, up to 69.6 % of the residents travel up to 500 meters to access water while 26.9 % reported that they do not travel any meaningful distances to access water. Only 3.5 % of respondents in low income areas are however located outside a 500 meter service radius of water. This is possibly due to the higher number of boreholes (especially public boreholes) in the low income areas as compared to those in the middle income planned areas.

Table 5. Distance from main water source in the different areas

Type of settlement	<100mt	100-500	>500mt	Total
Formal Private	32(94.1%)	2(5.9%)	-	34
Owner occupier	66(66.7%)	21(21.8%)	11(11.5%)	98
Peri-urban	48(69.6%)	126(69.6%)	6 (3.5%)	180
Total				312

Source: Field Survey (2017)

ANOVA test (Table 6) made between the settlements shows significant differencesin distance to water sources (F-test=1.485 and P-value = 0.253).

Table6.Analysis of variance comparing distance to the water supply between districts

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1323.524	2	661.762	1.485	.253
Within Groups	8023.143	18	445.730		
Total	9346.667	20			

* Significant at 5% level

Conclusion and Recommendations

The existing source of water supply in the city is the River Benue, treated and distributed through network and underground water source from industrial boreholes. However the sources lack reliability, accessibility and equity. The geographic distribution of the service is found inequitable between different settlements of the city. Particularly, areas settled by lower income groups are not served properly, the water in use of lower quantity. Also, large proportions of those in lower income areas depend on water vendors during interruption, while they pay large proportion of their income to water vendors and consume less in quantity. There are a number of lessons learnt from this study. First, physical planning authorities must in conjunction with the water board corporations adopt planning standards in terms of distance access for water supply on the basis of physical planning standards. Secondly, the minimum standard should allow for pipelines to be provided even in areas like Vunoklang that are not formally planned. Third, a robust policy must be adopted to curtail and control private borehole construction in favor of low income areas that should have water heavily subsidized or given for free. Finally in designing future masterplans, physical planners must make provisions for and develop new estimates of water requirements which will enhance access tosustainable public water supply.

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