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Water Supply Resources for Domestic Purposes in Auchi Metropolis of Edo State, Nigeria

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ABSTRACT

Water supply resources are critical problems in Edo state in general and Auchi metropolis in particular which, in no small measure has had negative impact on people's daily living in the area. Data for this study were collected through the direct interview with the river, boreholes and pure water vendors and through the physical survey of the study area including rainfall data collected from the metrological station of the area. Mathematical formulas were used to analyse the data. Results from this study show that the average volumes of water supply to the residents per month are 3118m^3. The highest volumes (18,934m^3) and the lowest volume (12,265 m^3) of water were supplied in the month of August and June respectively. Similarly, 2465 m^3 (79%) of monthly supply was realized from river sources and 146 m^3 (4.7%) realized from borehole sources. The estimated overall water supply resources for domestic purposes per head per day for each quarter (Usogun, Akpekpe,Iyekhei,Igbe and Aiboste) were 0.00172m^3, 0.00179 m^3, 0.00188m^3, 0.00180m^3 and 0.00176m^3 which are below the set minimum standard volumes of 0.02m^3(Table2) and total of 0.135 m^3 for water requirements for domestic purposes (Table3). The study recommends that there is need to construct reservoir of about 1000 hectares for rainfall harvesting among others in the study area.

Keywords: *Water supply. Auchi, sources, minimum water requirement, residents*

1. INTRODUCTION

Domestic water supply is water used for all useful domestic purposes including consumptions, bathing and food preparation. The need for domestic water supplies for basic health protection exceeds the minimum requirement for consumption (drinking and cooking). Additional volumes are required for maintaining food and personal hygiene through hand and food washing, bathing and laundry. Without water, people's health and livelihoods can be severely affected; the education of children (particularly girls) suffers as the daily tasks of survival take precedence overall other concerns. It is in light of this reality that the international community has set ambitious Millennium Development Goals (MDGs) to reduce by half the number of people without clean water by 2015 (United Nation,2000).

Brooks and Peters (1988) estimate that water use for food preparation in wealthy regions range from 10 to 50 litres per person per day, with a mean of 30 litres per person per day. In a study carried out on water provided for 1.2 million people in northern California, an average of 11.5 litres per person per day was used for cooking, with an additional 15 litres used for diswashing (East Bay Municipal Utilities District,1991). Kalbermatten et al (1982) suggested that the minimum water needed for adequate bathing should be on the other of 5 to 15 litres per person per day and that the required for showering be 15 to 25 litres per person per day. Other studies in both developed and developing countries (White et al, 1972, National Research Council, 1989, WHO, 1972 and Black, 1990) suggest that an average of 10 to 20 litres per person per day will meet basic needs. Gleick (1996) recommends that a basic water requirement of 25 litres per person per day of clean water for drinking and sanitation be provided by water agencies or governments. This amount is just above the lower end of the 20 to 40 litres per person per day target set by the U.S. Agency for international development, the World Bank, and the World Health Organization, each of which also exclude water for cooking and cleaning. It is also in line with the recommended standards of the United Nations International Drinking Water Supply and Sanitation Decade and agenda 21 of the Earth Summit. Falkenmark, considerers 100 litres per person per day to be necessary to provide for some minimum acceptable quality of life (falkenmark, personal communication, 1996). An estimate of total daily water requirements for a "reference" human were summarized in several reports by Vinograd, 1966, Roth, 1968, WHO,1971, white et al, 1972, USEPA, 1976, NAS, 1977 and Saunders and Warford, 1976.

The low priority given to water management in the mid 1900s was understandable as the water resources available then were more than adequate to meet the demands of the population (charania, 2005). According to Mara (1980), the general scarcity of water and high costs of development new water sources are the two major factors responsible for the increasing recognition of the need to conserve water resources by effluent reuse. Gray (1989) suggested the use of treated sewage effluent in areas where water is scarce. McFeter (1990) agreed claiming that comprehensive analysis of the microbiological quality of water treated by many reclamation systems demonstrated that the direct reuse of safe drinking water from waste water is technically feasible and economically competitive under certain circumstances. Water shortages, particularly during dry period of draught have necessitated sticker control measures, on the rate of water consumption and developing of alternative water sources (Asano, 1998). This situation is complex in Nigeria, and for the basis of this research study emphasis is based on Auchi metropolis of Etsako west local government area of Edo State.

Auchi has poor water supply and its inadequacy and scarcity is in alarming rate to the extent that water that are supposed to be human right are sold at the rate of thirty naira(#30 or 0.2$) per 25 litres of gallon. The water supply as well does not always meet up with the quantities demanded by the residents of the area on daily basis.

Although, there is an existing water works established for years ago in the area, but presently it is not working due to poor funding and maintenance of the systems. As a result majority of water supply in the area come from water vendors that do fetch water from streams and rivers and sell to the community at exorbitant price. The streams and rivers normally reduce in volumes during dry seasons; water from these sources are not treated and are prone to pollution as erosion often erode wastes into the various streams and rivers. The objective of this research was to determine the present domestic water supply situation including the sources and possible limitations towards provision of adequate water supply in Auchi metropolis in order to proffer solution for better water supply in the area.

2. DESCRIPTION OF STUDY AREA

The study is designed to cover Auchi metropolis as shown in Fig.1. Auchi is situated in the northern part of Edo state and is about 130 kilometers from Benin City the capital of Edo state. Auchi is an urban town in Edo state of Nigeria. It is situated approximately on latitude 7° 4^{1}N and longitude 6°4^{1}E. It is the administrative head quarters of the Etsako west local Government which shares common boundaries to North with Ikpe-Uzairue; while to the east is south Ibie, to south is aviele and to the west is Owan. The area has an average population of 65,000 (NPC, 2006) and they settled in low land region of the state which is rich in alluvium deposit.

Furthermore, Auchi is situated within the derived savannah. The annual rainfall ranges between 75mm-80mm and spreads over seven to eight months. The average temperature is about 70°F. The weather is very pleasant and the climate quite moderate. The nature of soil coupled with the fairly heavy rainfall contributes immensely to the menace of gully erosion in the town.

3. METHODOLOGY

Data for this study were collected by direct interview with river, borehole and pure water vendors. The rainfall data were supplied by Auchi meteorological station. Effort was made to ascertain the approximate volumes of water supply to every quarter (Fig.1) on daily basis from different water supply sources. An attempt was also made to seek information on the situation and sources of water supply by different agencies; limitations towards provision of adequate water supply in the area; the present and past efforts to manage water supply in the area and suggestions from the respondents on the practical ways of improving water supply in the area.

Furthermore, personal observations and experiences acquired from tours round the study area in search of information were invaluable assets utilized in rationalizing some of the study assumptions and conclusions. Various published and unpublished materials were used particularly on the review of relevant literature and comparative purposes, specifically that which pertained to the existing systems of water resources development and supply in transhara desert of other developing countries.

In order to measure the volumes of water supply to each quarter, the following formulae were adopted:

3.1 Water Supply from Rivers

$$V_r = \frac{T_q x V_{wt} x D_s}{1000 m^3}$$

Where,

V_r=vol. of water supply from rivers (L)
T_q=No. of tankers for that quarter
V_{wt}=Vol. of water that the tankers contain (L)
D_s=No. of days of water supply per month.

3.2 Water supply from Pure Water Vendors

$$V_P = \frac{V_{sd} x D}{1000 m^3}$$

Where,

V_P=Vol. of water supply from pure water industries (L)

V_{sd}=Vol. of water supply per day (L)
D_s=No. of days of water supply per month.

3.3 Water Supply from Boreholes

$$V_B = \frac{V_{dd} x Ds}{1000m^3}$$

Where,

V_B=Vol. of water supply from Boreholes (L)
V_{dd}=Vol. of water discharged per day.
D_s= as stated earlier.

3.4 Water Supply from Rainfall

$$V_{rf} = \frac{\sum P_1A_1+\sum P_2A_2+\sum P_3A_3+\ldots\ldots\ldots\ldots+\sum P_nA}{A_1+A_2+A_3+\ldots\ldots\ldots\ldots\ldots\ldots\ldots +A_n}$$

Where,

V_{rf} = Vol. of water supply from rainfall (m^3)
A= Area of rainfall data collection (m^2)
P= precipitation in the area (m)

3.5 Water Supply from all Sources

$$V_T=V_r+V_p+V_B+V_{rf}$$

Where,

V_T =Total volume of water supply from all sources (m^3)

3.6 Water Requirement for Domestic Purposes

$$V_{TCP} = V_{cp}/p/d$$

Where,

V_{TCP} = Total volumes of water used for domestic purposes per person per day.
V_{cp} = Volume of water supplied per month
P = Population (Person)
d = Day

Finally the total present population of study area were gotten from the general formula for solving growth rate in population. Bearing in mind that the total population of Auchi is 65,000 persons (NPC, 2006) and the growth rate in population on yearly basis is 3.2% as prescribed by National population commission and contained in the official Gazette of Federal Republic of Nigeria. Now the present population as at 2011 was calculated using:

$$P_{t+n}=P_t\ell^{r\,n}$$

Where,

P_{t+n}=Total population of the area as at 2011
P_t=Total population at instant (2006)
ℓ=Exponential growth modal=2.71
r =Growth rate (%)
n=No. of years (5 years)

4. RESULTS AND DISCUSSION

Table 1 shows the result of estimated average volume of water supply from all sources *to* Auchi metropolis for the period of the study (April- August, 2011). The summation of individual water supply sources indicate that rivers contributed highest with the volumes of 61620m^3, Boreholes being the least with the volumes of 3660m^3 as shown in Fig.2.

The data obtained also showed that 2464.80m^3 and 70.07% were the highest average volumes and percentage values of monthly water supply in the area from river sources; whereas boreholes recorded the least volumes of 146.40m^3 and 4.70%. The variations in the volumes and percentage of water supply at different quarters may be attributed to varying changes in population and water supply sources of the areas. The reason for highest water supply in the month of August, 2011 from river sources more than any other month may be based on the ground that the rainfall and water tables of boreholes are being affected by weather changes in that period of the year. The average volumes of water supplied to each quarter per month (April to August, 2011) from different sources was computed (not shown in the Table) and the values were 4,632m^3, 3,610m^3, 3,038m^3, 2,413m^3 and 1,892m^3 for Usogun, Akpekpe, Iyekhe, Igbe, and Aiboste respectively as represented in Fig.3.

The summation of volumes of water supplied in the area for five months of the study was observed to be 77930m^3. Furthermore, the total volumes of water supplied to the quarters in each month from April to August, 2011, irrespective of their sources were 15,298m^3, 17,358m^3, 12,262m^3, 14,073m^3 and 18,934m^3 as represented in Fig.4.

Going by the population of Auchi metropolis with total number of 291,200 persons at present (2011) as estimated from total number of 65,000 (NPC, 2006). The estimated overall water supply available for domestic consumptions per head per day in each quarter with respect to their individual population of 89,700, 67,200, 53,760, 44,800 and 35,840 for Usogun, Akpekpe, Iyekhe, Igbe and Aiboste are 0.00172m^3, 0.00179m^3, 0.00188m^3, 0.00180m^3 and 0.00176m^3 respectively.

With these volumes, it is evident that the volumes of water supply per head per day in the area is below the requirements when compared with the recommended total volumes of 0.020m^3 (Table 2) and 0.135 m^3(Table 3) including other water municipalities for domestic consumptions (bathing, drinking, washing, cooking e.t.c.) needed by an individual on daily uses

Table 1: Estimated Average Volumes of Water Supply From All Sources to Auchi Metropolis for the Period of Five Months

WATER SUPPLY SOURCES	Volumes of water supply to each Quarter per Month																									Summation(m^3)	Ave. vol.(m^3)	%vol. of water
	APRIL(m^3)					MAY(m^3)					JUNE(m^3)					JULY(m^3)					AUGUST(m^3)							
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E			
Rivers	3840	2880	2400	1902	1440	4080	3060	2550	2040	1530	2880	2160	1800	1440	1080	3360	2520	2100	1680	1260	4800	3600	3000	2400	1800	61620	2465	79
Pure water	500	450	357	250	225	520	468	390	260	234	440	396	330	220	198	480	432	360	240	216	540	486	405	270	243	8930	357	12
Rainfall	56	56	56	56	56	291	291	291	291	291	136	136	136	136	136	147	147	147	147	147	116	116	116	116	116	3720	149	4.8
Boreholes	192	168	144	120	96	208	182	156	130	104	176	154	132	110	88	184	161	138	115	92	216	189	162	135	108	3660	146	4.7
Sub-Total	4588	3554	2975	2364	1817	5099	4001	3387	2712	2159	3632	2846	2398	1884	1502	4171	3260	2745	2182	1715	5672	4391	3683	2921	2267	77930	3118	100
Total	15298					17358					12262					14073					18934							

Table 2: Minimum Amount of Water Required per Person per Day

Use	Amount (litres per person per day)	Amount (m^3 per person per day)
Drinking	3-4	0.003-0.004
Food preparation and clean up	2-3	0.002-0.003
Personal hygiene	6-7	0.006-0.007
Laundry	4-6	0.004-0.006
Total	15-20	0.015-0.020

Source: http//www.searo.who.int/linkFiles/list_of_Health_Emergency_Minimum_Water_quantity.pdf

Table 3: Water Requirements for Domestic Purposes

DESCRIPTION	AMOUNT(LITRES PER HEAD PER DAY)	AMOUNT (m^3 PER HEAD PER DAY)
Bathing	55	0.055
Washing of clothes	20	0.020
Flushing of W.C	30	0.030
Washing of house	10	0.010
Washing of utensils	10	0.010
Cooking	5	0.005
Drinking	5	0.005
Total	135litres	0.135 m^3

Source: Punmia et al, (1995)

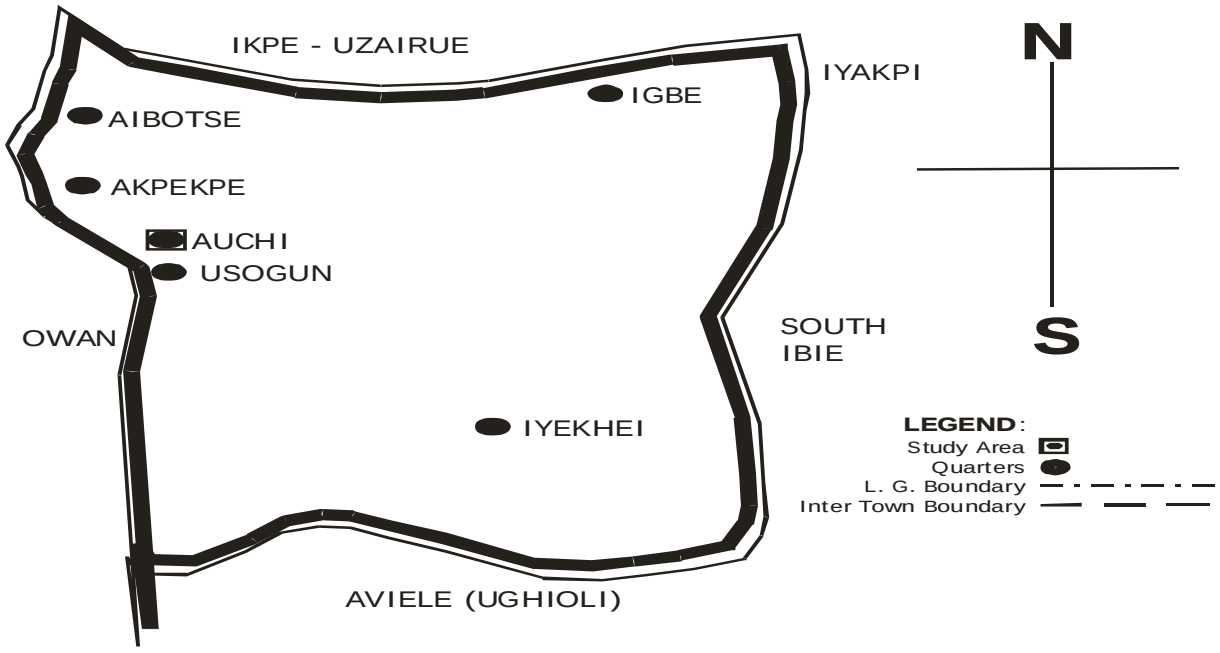

Fig. 1: Map of Auchi showing Study Area
Source: Harunah, (1990).

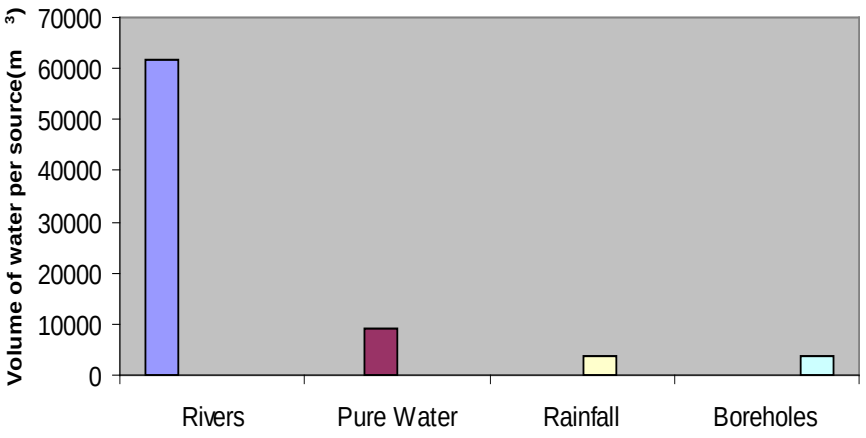

Fig.2:Summation of water supply from each source for the period of the study

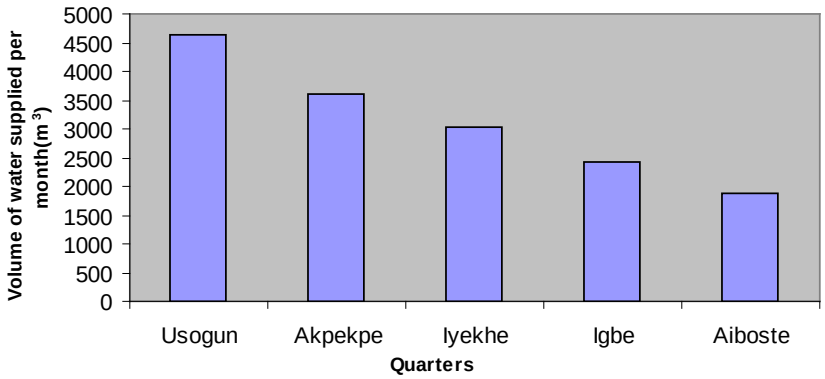

Fig.3: Average volume of water supplied to each Quarter per month(April-August,2011)

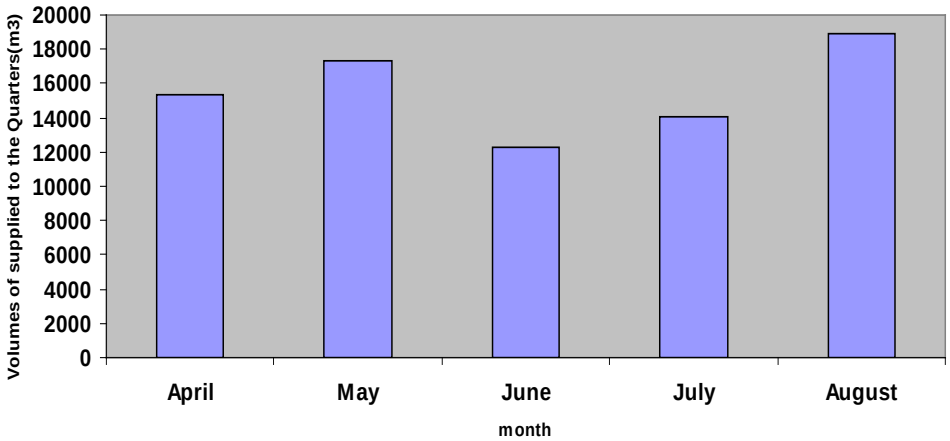

Fig.4:Volumes of water supplied to the Quarters per month(April-August,2011)

5. CONCLUSION AND RECOMMENDATIONS

It was observed from the research, that the water distribution to the people of Auchi metropolis on daily basis for domestic consumptions is below minimum amount required per person per day as recommended by World Health organization and other water municipal agencies. The various water sources are inadequate to meet up with the present demand of the residents of the area. This was attributed to poor water resources development in the area.

Based on the findings, the following recommendations are drawn:

- The Federal government of Nigeria on pursuit of Millennium Development Goals (MDGs) and vision 20:2020 will be a white elephant project without making water available to Auchi metropolis and across other water stressed communities in the country.

- The construction of water shed (reservoir) of about 1000 hectares for rainfall harvesting among others will help the residents of the area from their critical water struggle.

- More research work should be carried out on the other sources of water in the area to determine better alternative for water sustainability.

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