



## Original Research Article

### Assessment of Groundwater Sources in Benin City, Edo State, Nigeria

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#### ABSTRACT

*As the population of Benin City continue to increase, human activities are also on the increase leading to increased anthropogenic activities within the city. This has resulted to easy and increased contamination of surface water due to its exposed nature. In this study, data on groundwater sources in Benin City were collected via questionnaire survey method and analysed using SPSS (Statistical Package for the Social Sciences) statistical software. About a hundred questionnaires were administered to residence in four local government areas (Ikpoba Okha, Oredo, Ovia North East and Egor Local government areas) in Benin City. Ninety- three (93) were completed and returned, while seven (7) were not returned. Hence, ninety-three (93) questionnaires were analysed. Results from statistical analysis showed that the groundwater sources within Benin City are boreholes, wells, springs, and infiltration galleries, having usage of 61.3%, 25.8%, 2.89% and 16.7% respectively. Results further revealed that boreholes are the predominant source of groundwater supply within Benin City.*

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## 1. INTRODUCTION

Water is a vital resource for human survival and it is essential for sustainable development. Portable water is crucial for the wellbeing of man; however, it is lacking in many societies (Udom et al., 2002). Although water from all source contains some form of impurities, but it is believed that surface water contains more impurities due to its exposed nature, thus groundwater has become a crucial source of water supply in many localities (Asrafuzzaman, 2011). Increased human activities within Benin City (as a result of population rise) has also increased anthropogenic activities within the city (Erah et al., 2002). These activities have increased the contamination of surface water source within the city and due to high cost of treatment of water from such sources, the populace has resulted to using groundwater as an alternative source of water supply for both domestic and industrial purposes within the city (Seghosime et al., 2018). This may probably be due to the fact that groundwater contains low level of impurities and as such requires less treatment (Akpoveta, 2011). Hence, it is referred to as a reserve of portable water (Akpode, 2012).

Water received on the surface of the earth from different sources becomes groundwater when it goes underground after infiltration through pores of permeable rocks. Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers. Groundwater supplies are replenished, or recharged, by rain and snow melt that seeps down into the cracks and crevices beneath the land's surface (Mukherji, 2006). Groundwater is recharged from the aquifer and eventually flows to the surface naturally and natural discharge often occurs as springs and seeps and can form oases or wetlands (Mukherji, 2006). Ground water is a vital natural resource that is used for many vital purposes such as public and domestic water supply system, irrigation and livestock watering, industrial, commercial and mining purposes (USEPA, 2002). About two third of the freshwater reserves of the world is made of groundwater (Chilton et al., 1992).

According to UNECA (1999), the provision of water supply in human settlements involves tapping the most suitable source of water, ensuring that the water is fit for domestic consumption and supplying it in adequate quantities so as to prevent or decrease the scarcity of clean fresh water. Thus, this study seeks to evaluate the sources of groundwater in Benin City, Edo State, Nigeria.

## **2. MATERIALS AND METHODS**

### **2.1. Study Area**

Benin City is the capital of Edo State, Nigeria and it is located in the south-south geopolitical zone of Nigeria. It is bounded by latitude  $6^{\circ} 34'N$  and longitude  $05^{\circ} 60'E$ . It is situated approximately 40 km north of the Benin River and 320 km east of Lagos (by road). The city falls within the rainforest zone of Nigeria with mean annual rainfall of about 2,012 mm (Klimatafel von Benin City / Nigeria, 2016) and mean monthly temperature in the range of  $25^{\circ}C$  to  $28^{\circ}C$  (Seghosime et al., 2018). Also, it has an estimated land area of 500 square kilometres (Erah et al., 2002). The Benin region is underlain by sedimentary formation of the South Sedimentary Basin (Ikhile, 2016). The geology is generally marked by top reddish earth, composed of ferruginized or literalized clay sand (Ikhile, 2016).

Benin City has two distinct seasons. These are the wet (rainy) season and the dry season. The rainy season occurs between the months of March and October with a short break in August. The dry season on the other hand lasts from November to February with dry harmattan winds between December and February. However, with the effect of global warming and climate change, rains have been observed to fall irregularly almost in every month of the year with double peak periods in July and September. At present the population of Benin City is estimated to be about 1.75 million (projected from 2015 population figures) and it comprises of few local government areas (LGAs), including Ikpoba Okha, Oredo, Ovia North East and Egor Local government areas among others (Balogun and Orimoogunje, 2015). The study covers these local government areas. Figure 1 shows the map of Edo State showing the study area (Benin City) and the LGAs Covered.

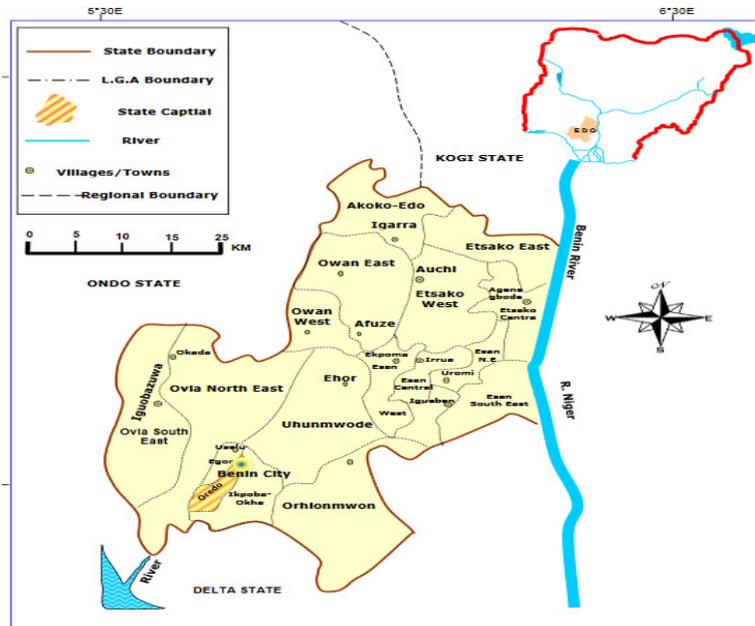


Figure 1: Map of Edo State Showing the Study Area (Benin City) and the LGAs Covered (Adapted from Emeribe et al., 2017).

## 2.2. Data Collection and Analysis

Data were collected via questionnaire survey method. The questionnaire was designed to extract data on the social demographic features of the residents within Benin City, groundwater treatment, quality of groundwater, frequency of groundwater treatment, occurrence of shortage of water supply from groundwater within the study area. A total of hundred (100) copies of questionnaires were distributed to individuals across four local government areas (Ikpoba Okha, Oredo, Ovia North East and Egor Local government areas) in Benin City. Ninety- three (93) copies were completed and returned, while seven (7) copies were not returned. Hence, Ninety- three (93) copies of the questionnaires were analysed.

SPSS (Statistical Package for the Social Sciences) statistical software, version 23.0, 2017 was used to analysed the data collected. A reliability test was also carried out using Cronbach's alpha statistics in order to ascertain if the questions in the questionnaires were relevant to the subject matter of the survey.

## 3. RESULTS AND DISCUSSION

The data collected and analysed are presented in Tables 1, 2 and 3. The response rate on the distributed questionnaires are present in Table 1, while Table 2 shows the summary of social demographic features of respondents and other information on groundwater in Benin City. Table 3 shows the result from the reliability test (Cronbach's alpha statistics).

Table 1: Response rate on distributed questionnaires

Options	Frequency	Percentage (%)
Returned	93	93
Unreturned	7	7
Total	100	100

Table 2: Summary of social demographic features of respondents and other information on groundwater in

Benin City		
Description	Number of Respondents	Percentage (%)
Sex		
Male	61	66
Female	32	34
Total	93	100
Occupation		
Civil servant	33	36
Self employed	45	48
Student	12	13
Others	3	3
Total	93	100
Resident in the area		
Yes	68	73
No	25	27
Total	93	100
Years of residence in the area		
1-5 Years	18	19
6-10 Years	23	25
11-15 Years	39	42
Above 15 Years	13	14
Total	93	100
Having source of ground water in homes		
Yes	81	87
No	12	13
Total	93	100
Currently using ground water in homes		
Yes	69	74
No	24	23
Total	93	100
Sources of ground water in Homes		
Borehole	57	61.30
Well	24	25.80
Spring	2	2.89
Others	12	16.70
Total	93	100.00
Use of ground water in Benin City		
Domestic	46	49.50
Industrial	14	15.10
Agricultural	27	29.00
Others	6	6.50
Total	93	100.00
Ground water treatment		
Yes	65	70.00
No	28	30.00
Total	93	100.00
Quality of ground water in homes		
Very good	43	46.23
Good	39	42.00

Bad	9	9.60
Very bad	2	2.10
Total	93	100.00
Frequency of ground water treatment		
Daily	4	4.30
Weekly	10	10.75
Twice weekly	12	12.90
Monthly	30	32.60
No planned time	37	40.21
Total	93	100.00
Occurrence of shortage of water supply (in homes) from ground water		
Yes	12	13.00
No	81	88.03
Total	93	100.00

Results from Table 1 indicated that Ninety- three (93) copies of questionnaire were completed and returned out of a total of Hundred (100) copies while seven (7) copies of questionnaires were not returned.

Results from Table 2 shows that 66% of the respondents were males, while 34% were females. Respondents were predominantly self-employed constituting 48% of the total respondents while 36% and 13% were civil servants and students respectively and 3% of the total respondent were having occupations not listed in the option. Furthermore, 73% of respondents reside in the local government area covered while 27% of respondents do not reside in the area. Out of the 73% of residence residing in the area, 19.4% have spent between 1-5 years, 24.73% have spent between 6-10 year, 32.50% have spent between 11-15 years while 14% have spent above 15 years in the area. About 87.1% of respondent have source of groundwater supply and 74.20% are currently using groundwater in their homes while 12.90% of respondent do not have source of groundwater and 26.67% are currently not using groundwater in their homes.

With respect to sources of groundwater in homes, 61.30% use borehole, 25.80% use well, 2.89% use spring while 16.70% use others not listed in the option. About 49.50% of respondent use groundwater for domestic purpose, 15.10% use groundwater for industrial purpose, 29.00% use groundwater for agricultural purpose while 6.50% use groundwater for other purposes not listed in the option. More so, 70% of respondents treat their water before use while 30% do not treat their water before use and out of these respondents that treat their water before use, 46.23%, 42%, 9.6% and 2.10% agreed to very good, good, bad, and very bad quality of water respectively. Also, about 4.30% respondents treat their water daily, 10.75% treats their water weekly, 12.90 treats their water twice a week, 32.60 treats their water monthly while 40.21 treats their water at any time. Finally, 13% of respondent agreed to occurrence of shortage of groundwater supply while 88.03 have not experience shortage of groundwater supply. Hence, there is rarely the occurrence of shortage of water supply from groundwater in Benin City.

From Table 2, results revealed that groundwater sources of water supply are predominantly used in Benin City and this is in accordance with the results obtained from studies conducted by Erah et al. (2002) and Akpoveta et al. (2011). Results from Table 2 further indicated that boreholes are the predominant and reliable source of groundwater in Benin City.

A reliability test was carried out in order to ascertain the relevance of the questions in the questionnaire to the subject matter of the survey. Table 3 show the result from the test. From Table 3, the statistics of more than 70% revealed by the Cronbach's Alpha Statistics suggested that the questions in the questionnaire are all similar and relevant to the subject matter of the survey.

Table 3: Cronbach's alpha statistics

Cronbach's Alpha	0.71
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#### 4. CONCLUSION

This study has shown that although groundwater sources such as springs, hand dug wells, boreholes are used in Benin City for domestic, industrial and agricultural purposes, boreholes are still the predominantly used and reliable source of groundwater in Benin City and they are mainly used for domestic water supply.

#### 5. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

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