Quality of Hand-dug Wells in Selected Locations in Lagos Coastal Aquifer, Nigeria

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ABSTRACT: Thirty water samples where collected from hand dug wells in Six different locations in the study areas. These include: Ikeja, Lagos Island, Ajah, Victoria Island, Eti- Osa and Yaba. The chloride concentrations of all the samples were acquired and then compared with the World Health Organisation (WHO) standards for chloride content in drinking water. We selected hand dug well because it is a common source of drinking water in the area under consideration. Results show that the the average chloride concentrations in all the samples collected in all the six locations are above the WHO value of 250mg/l (value recommended for safe drinking water) with Ajah having the highest Chloride concentration of 606.68mg/l and Ikeja with the least value of 255.37mg/l. This indicates that the water in the considered areas are not safe for drinking. Chloride concentration in the Lagos coastal aquifer may become equal to that at the source at some infinitestimal time and this portends a great danger to the use of groundwater for domestic purposes. [Report and Opinion. 2010;2(3):51-54]. (ISSN: 1553-9873).

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INTRODUCTION

Freshwater quality and availability is one of the most critical environmental and sustainability issues of the twenty-first century (UNEP, 2002). Of all sources of freshwater on the Earth, groundwater constitutes over 90% of the world's readily available freshwater resources (Boswinkel, 2000) with remaining 10% in lakes, reservoirs, rivers and wetlands.

Groundwater is also widely used, for instance, for drinking water supply and irrigation in food production (Zekster and Everett, 2004). However, groundwater is not only a valuable resource for water supply, but also a vital component of the global water cycle and the environment. As such, groundwater provides water to rivers, lakes, ponds and wetlands helping to maintain water levels and sustain dependent ecosystems.

Moreover, some field investigations indicate groundwater as a surprisingly important source of water and solute input to coastal waters (Lewis, 1987; Moore, 1996; Kim et al., 2003). According to Church (1996), these scientific findings challenge our understanding of coastal and oceanic chemical mass balance and ecosystem functioning.

Coastal zones contain some of the most densely populated areas in the world as they generally present the best conditions for productivity. However, these regions face

many hydrological problems like flooding due to cyclones and wave surge, and drinking fresh water scarcity due to problem of salt water intrusion (C. P. Kumar).

Almost two thirds of the world's population (4 billion) lives within 400 km (250 miles) of the ocean shoreline; just over half (3.2 billion) live within 200 km (125 miles), an area only taking up 10% of the earths surface. Most of these coastal regions that rely on groundwater as their main source of fresh water for drinking, continues to grow at an alarming rate, fresh water supplies are constantly being depleted, bringing with it issues such as saltwater intrusion and increasing the importance of groundwater monitoring and management.

Saltwater intrusion is a major concern commonly found in coastal aquifers around the world. Saltwater intrusion is the induced flow of seawater into freshwater aquifers caused by groundwater development near the coast. Where groundwater is being pumped from aquifers that are in hydraulic connection with the sea, inducedgradients may cause the migration of salt water from the sea toward a well.

The key to controlling saltwater intrusion is to maintain the proper balance between water being pumped from the aquifer and the amount of water recharging it. Constant monitoring of the salt-water interface is necessary in determining the proper management technique.

HYDROGEOLOGY OF LAGOS METROPOLIS

According to (Oduwole, 1999), a study of groundwater resources and aquifers underlying lagos metropolis has been made. This is based on well-logs, pumping tests, well production as well as water quality data.

The sub-surface geology indicates a complex lithogy of alternating sequence of sand and clay deposits. Three aquifer horizons were delieanated. The first, a water table aquifer (average thickness of 10 -25 and 10 – 35m respectively), are harnessed through boreholes.

Average values of transmissivity T and storage coefficient(s) are 3.53 x 10^{-3} m^2s^{-1} and 2.95 x 10^{-4} respectively for the first and second and 17.44 x $10^{-3}m^2s^{-1}$and 3.29 for the third.

The range of transmissivity, the storage coefficient and also the permeability indicate considerable inhomogenity in the aquifers.

Lagos state lies between latitude 8^o 15^1 and 8^o 45^1 and longitude 2^o 30^1 and 4^o 30^1. Two major climate seasons are recognized; the dry season which is between November and march, and the wet season which starts in April and then end in october with a short break in mid- August.

The average annual precipitation is above 1700mm and serves as a major source of groundwater replenishment. The temperature range from 32°C to 37°C.

The surface geology is made up of the Benin formation (Miocene to recent) and the recent littoral alluvial deposits. The Benin formation consists of thick bodies of yellowish(ferruginous) and white sands (Jones and Hockey, 1964). It friable, poorl sorted with intercalation of shale, clay lenses and sandy clay with lignite. The formation attains a thickness of about 200m elsewhere(Short and Stauble, 1969) and is overlain in many places by considerable thickness of red earth compose of iron- stained regolith formed by weathering and ferruginization of rock (Onyeagocha,1980).

Lagos metropolis is located within the Western Nigeria coastal zone; a zone of coastal creek and lagoons (Pugh, 1945). The metropolis is the area of land around the only inlet of the sea into the extensive lagoon system. It includes such areas as the Islands (Lagos, Ikoyi, Victoria Island).

MATERIAL AND METHOD

The methods employed for this study are field investigation/sampling and laboratory analysis .Thirty water samples from hand dug-wells were collected in 6 different locations in Lagos state namely Ajah,Victoria Island, Lagos Island, Yaba, Ikeja and Eti- Osa.

A detailed field sampling exercise was carried out, while laboratory analysis of the water samples were carried out afterwards at Danas water laboratory, Ibadan.

A noticeable increase in chloride content would indicate intrusion from the coast with increased rise of water level attributed to global warming. It would be logical to expect an imbalance between freshwater and seawater with saltwater gaining more prominence by moving inland.

RESULT AND DISCUSSION

The pH of all the samples taken range between 9.88 – 7.07. This shows that all the samples taken in all the locations are alkaline. The highest value is at Ajah. The average pH for Victoria Island, Eti Osa and Ajah are 8.636, 7.902 and 7.968 respectively. For Ikeja, Lagos Island andYaba, the average pH values are 8.426, 7.826, and 8.595 respectively.

With the exception of the pH of Samples from Victoria Island and that of Yaba that exceed the WHO value of 8.5, the pH values for all other samples are within the acceptable range.

Table 1 shows chloride concentration of each of the thirty samples samples collected from the five locations in Lagos. The highest value for the chloride concentration was observed in one of the samples collected from Ajah. This may be due to its proximity to the Lagoon. The least value was obtained in one of the samples from Ikeja. The average chloride concentration of all samples collected is shown in Table 2.

Figure 1 is a bar chart showing the variation of chloride concentration of the sampled water.

It can be deduced from the tables that there is very high chloride content in the samples analysed Eti - Osa. The average chloride content here is 530.87 mg/l

Six water samples were collected at Ajah, 4km from the Atlantic Ocean and the average chloride concentration observed is 608.68 mg/l

Five water samples were also collected at Ikeja and the average chloride concentration is 255.37 mg/l.

Ikeja is about 30 km from the Atlantic Ocean.

At Lagos Island which is about 18km from the Atlantic Ocean, the average chloride concentration is 322.95 mg/l. At Victoria Island, the five samples collected give an average chloride concentration of 344.53 mg/l.

The four samples collected at Yaba, give an average chloride concentration of 271.36 mg/l.

The average chloride concentrations in all the samples in all the six locations are above the WHO value of 250mg/l (value recommended for safe drinking water) with Ajah having the highest average Chloride concentration of 606.68mg/l and Ikeja with the least average value of 255.37 mg/l.

Since all these values exceed 250 mg/l, the water in all the six locations namely Victoria Island, Eti-Osa, Ajah, Ikeja, Lagos Island andYaba are therefore not safe as drinking water.

It is also observed that the chloride concentrations decreases as we move away from the coast.

Table 1: Chloride concentration of all the thirty Water samples collected from five selected locations from Lagos, Nigeria.

S/No	P.H	Cl^-	Location
1	8.40	312.35	V.Island
2	9.20	369.04	V.Island
3	9.44	307.54	V.Island
4	7.81	477.32	V.Island
5	8.33	256.42	V.Island
6	8.39	548.24	E. osa
7	7.92	590.12	E. osa
8	7.89	642.34	E. osa
10	7.84	272.43	E. osa
11	9.38	561.31	Ajah
12	7.82	679.61	Ajah
13	8.08	592.24	Ajah
14	7.08	654.92	Ajah
15	7.69	594.32	Ajah
16	7.76	569.64	Ajah
17	7.10	261.12	Ikeja
18	9.32	230.52	Ikeja
19	8.08	260.74	Ikeja
20	8.56	300.04	Ikeja
21	9.07	224.42	Ikeja
22	7.23	361.26	L Island
23	8.01	301.75	L Island
24	7.80	294.33	L Island
25	8.33	401.11	L Island
26	7.76	256.33	L.Island
27	8.66	250.42	Yaba
28	9.01	301.33	Yaba
29	8.59	261.12	Yaba
30	8.12	272.61	Yaba

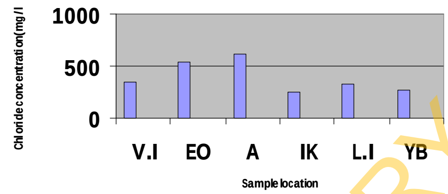

Figure 1: Variations of average Chloride Concentration in the Sampled Water

Table 2: Average Chloride concentration in water sample from selected hand dug Wells

Location	V.I	E.O	A	Ik	L.I	Yb
Chloride Concentration (mg/l)	344.53	530.35	608.68	255.37	322.96	271.36

NOTE:V.I – Victoria Island; EO – Eti Osa, A – Ajah, IK – Ikeja , L.I – Lagos Island, YB - Yaba

CONCLUSION

This work has shown that the average chloride concentration of hand dug well in the Lagos coastal region is well over the recommended 250 mg/l by the word Health Organisation.

It was also noticed that with progressive movement of water inland from the coast, chloride concentrations were found to be decreasing with increasing distance from the coast. We also observed that if concrete measures are not taken to reduce the seawater intrusion, the chloride concentration in some unknown time may become equal to that at the source and this will portend a great danger and hindrance to the use of grounwater for both domestic and industrial uses.

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