

Review Article

The Quality and Effect of Borehole Water Proliferation in Benin City, Nigeria and its Public Health Significance

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Abstract

Water is life, essential for human existence, and its importance for individual health as well as the well-being of a nation and access to good quality water cannot be overemphasized. Water makes up about 70% of the earth's surface and about 97% of this volume of earth's surface water is contained in the oceans, only about 0.3-0.8% makes up underground water. Ground water is the water beneath the surface where all the voids in the rocks and soil are filled. It is a source of water for wells, boreholes and springs. A borehole is a hydraulic structure which when properly designed and constructed, permits the economic withdrawal of water from an aquifer. It is a narrow well drilled with machine. Due to the poor investments of the Nigerian government in water supply, many have resulted in construction of boreholes as an alternative source of portable water. Benin City is located in Edo State, southern Nigeria with a growing population. There is a high degree of borehole proliferation as housing development projects are on the increase. There is hardly any residential house, office or business building that does not have a constructed borehole in Benin City. As the population of Benin City continues to rise, human activities including soil fertility remediation, indiscriminate refuse and waste disposal, and the use of septic tanks, soak-away pits and pit latrines are on the increase. These activities are capable of producing leachates into the groundwater formation that serve as source of water to the inhabitants in the City.

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Proliferation and Contamination of groundwater can pose a serious public health risk and as well as a long term environmental hazard. It is therefore recommended the Edo State government look urgently at this issue and provide solutions to safeguard the health of the citizens and the environment. It is drawn conclusively stated that the proliferation of boreholes in Benin City, may lead to a long term environmental hazard and as well as pose a potential serious public health concern. The objective of this study is to elucidate the effect of the proliferation of boreholes in Benin City and public health significance.

Introduction

Water is essential for human existence, and its importance for individual health as well as the well-being of a nation cannot be overemphasized. Fresh water represents the main sources of safe water for household use, sustainable development, and human survival [1]. It occupies about 70% of the earth's surface. About 97% of this volume of earth's surface water is contained in the oceans, 21% in polar ice and glaciers, 0.3-0.8% underground, 0.009% in inland freshwaters such as lakes, while 0.00009% is contained in rivers [2]. Water has been regarded as a universal solvent that can dissolve many chemicals which may or not be beneficial to man and its environment [3]. It is however essential to all living things and its environment [4]. Due to the poor investments of the Nigerian government in water supply, it been estimated that over 52% of its citizens have no access to potable water [5]. The fresh water sources available to the local inhabitants are either unsafe or difficult to obtain. In some instances women and children need to walk for hours to fetch ordinary drinking water, these have led to proliferation of groundwater in many parts of Nigeria. Ground water is the water beneath the surface where all the voids in the rocks and soil are filled. It is a source of water for wells, boreholes and springs. A borehole is a hydraulic structure which when properly designed and constructed, permits the economic withdrawal of water from an aquifer. It is a narrow well drilled with machine [6]. The quality of groundwater is a function of natural processes as well as anthropogenic activities [7]. As the population of Benin City continues to rise, human activities including soil fertility remediation, indiscriminate refuse and waste disposal, and the use of septic tanks, soak-away pits and pit latrines are on the increase. These activities are capable of producing leachates into the groundwater formation that serve as source of water to the inhabitants in the City [8]. Borehole can be contaminated via soil erosion from underground leachate seepage from contaminated dumpsites and the leaching of chemicals from human activities. The degree of this contaminations can be as a results of the precipitation pattern, depth of the water table, rate of percolation, and structures of the top soil such as textural properties [9,10]. This review is to x-ray the quality of boreholes in Benin City and contribute to knowledge as to the public health implications of consuming water from such boreholes and in other to recommend possible adaptation measures and solutions.

Borehole Proliferation in Benin City

Benin City is located in Edo State, southern Nigeria with a growing population. Borehole drilling are continuously carried out in Benin City as far as housing development projects are carried out because; every house owner needs water supply. There is a constructed borehole in almost every house, office or business establishments within Benin City. The development of borehole projects are mainly carried out by private drillers for private ownership from the time public water supply systems in the state failed functioning. Benin City has shallow water table which makes it less cost intensive to construct boreholes and hand dug wells within so many places as the need arises. The quantity and quality of groundwater reserve can be seriously affected by proliferation of drilled bore holes and hand dug wells by introduction of intensive pressure arising from heavy abstraction of water as a highly vulnerable resource. WHO [11], specified that depletion of groundwater is usually because of over exploitation of groundwater resources with little or no intensive recharge system especially in areas of low rainfall that can cause a natural recharge process. WHO and UNICEF [12], also stated that the formation of preferential flow from strong hydraulic gradients result from abstraction of groundwater which causes reduction in attenuation process but increases groundwater contaminants concentration. Due to the financial benefits arising from water well development projects, numerous non environmental and non- hydrogeological experts now go into borehole and hand dug well development thereby establishing site location of these water well projects close to waste dump sites, pit toilets, soak away pits, and septic tanks. This non expertise act, induces contaminant transport into groundwater sources because, these pollution sources are very close to the water wells. In that case, attenuation becomes difficult since microbial survival becomes certain within the short travel time that will be taken by the microorganisms to travel from a certain short distance from pollution site to groundwater source [13]. United Kingdom groundwater forum [14], specified that the continuous pressure on the borehole causes a corresponding decrease in water level to such a point that a depressed cone is formed because, the water level has reduced thereby allowing influx of water into the borehole from different directions which is response to pumping. The influx of water could come from any source of surrounding water bodies including saline water.

Effect of Proliferation of Boreholes

As much as boreholes provide fast and cost effective access to portable water, the effect of its proliferation can be devastating such as.

Lack of standards in drilling boreholes

Many borehole drillers are artisans who learnt the skill of drilling boreholes, they have no formal knowledge of it neither do they follow any standard and as a result of this, groundwater may be seriously contaminated and may pose health challenges for the consumers. The report of UNICEF [15], shows that for over sixty water samples from boreholes within Owerri Zone, Imo State, Southern-east Nigeria shows that the PH of water samples is 6.0 to 6.5 on the average. It means the water around the area is slightly acidic which is not good for drinking. It is unfortunate that despite the above listed consequences of having many boreholes concentrated in a place the government whose job it is to provide potable water for the citizens is not taking immediate measures to address the problem and discourage this trend.

Ground water level reduction

The effect of pumping out ground water from much water borehole point will lead to a reduction in the level of ground water. This means that people have to drill farther down to get enough water to sustain pumping. Those that have shallow wells will no longer get water unless they go deep into the aquifer. It will therefore cost more in future to drill to a realistic sustainable depth in the aquifer if one desires to have a borehole in other words recharge will be low [11,12,16].

Reduction of flow

When borehole is randomly drilled and water is collected from so many points at any time, it leads to reduction in the net flow of underground water which consequently can have significant effect on the water cycle [16].

Saline intrusion risk

Proliferation of boreholes can also mounted pressure on underground water through continuous water withdrawal and that gives way to salt water intrusion [13], especially if the area in question is located close to the coast of the sea or ocean. It also means that something has to go in there to take its place otherwise in the future the area may run the risk of having landslides etc. which may consequently reach the surface and affect structures and infrastructures around the site. These holes may in the future develop into cracks which may lead to faults in the earth [16].

Pollution and contamination

Proliferation of boreholes leads to the spread of pollution and contamination. Due to lack of planning and adoption of profession procedures, Government allows indiscriminate springing up of mechanic villages workshops and waste collection and disposal sites all over the town especially in elevated topography. Some of their wastes have heavy metals and other harmful substances. These substances dissolve with rain and seeps through the layers of the soil to shallow aquifers. The rains will definitely wash these pollutants that are injurious to health into water bodies and also to various low land areas of the city inhabited by many people who ignorantly drill water boreholes that have likelihood of being polluted. There are industries whose wastes are dumped indiscriminately and yet boreholes are all around such areas. Boreholes stand the chance of being polluted by seepage from septic tanks around the borehole. Other domestic wastes are also sources of pollution of boreholes [12,16].

Effect on vegetation

When water is constantly drawn from many boreholes, groundwater recedes, and this will bring about a shift in the level of saturation of moisture. As a result of this recession, it is most likely that water at the upper soil layer will remain only at the capillary level which may not be very available to the plants and other soil organisms. This Draw Down effect will affect soil moisture availability adversely and consequently vegetation will be affected adversely [16].

Borehole Contaminants and Public Health Effect on Consumers

Physiochemical parameters

A study on water quality of boreholes in Benin City by Ogbeifun et al., [17], physiochemical analysis of the water samples was carried out.

It was reported that all the parameters tested were within the acceptable WHO recommended standards except the pH values recorded from the samples which were well below the WHO recommended standards. The analyzed borehole water samples were slightly too acidic for human consumption. Acidic water may occur naturally as a result of mixture of volcanic gases, gaseous emanations in geothermal areas or due to alteration of groundwater as stated by [18]. A similar report of UNICEF [15] on groundwater in Owerri, Imo State, Nigeria showed that the water had slightly acidic pH. Usage of such water may result in serious health complications such as irritation in the eyes, skin and mucous membrane [19].

Chemical contaminants

The report of Erah et al., [8] on the quality of ground water in Benin City, showed that there was an abnormally high level of inorganic chemicals (Pb, Cr, Zn and Cd) in the groundwater. Generally, toxic chemicals in drinking water may cause either acute or chronic health effects. Acute effects such as nausea, lung irritation, skin rash, vomiting, dizziness, and, in the extreme, death usually follow large doses of chemicals and occur almost immediately. Chronic effects, like cancer, birth defects, organ damage, disorders of the nervous system, and damage to the immune system, are usually more common [20]. The report of Enuneku et al., [21], on trace metals in borehole water in Benin City, showed concentrations of the trace metals (Mn, Zn and Cu) in the various borehole sites. The study highlighted that level of toxicity of trace metals to humans depends upon their daily intake rate. Similarly, Olorunfemi et al., [22], reported the presence of heavy metals from boreholes in southern Nigeria.

Microbial contaminants

The presence of certain microorganisms is often undesirable in any drinking water. When microorganisms are present in water, cycles of growth and decay of the cellular materials of the microorganisms may result in the production of by-products which may adversely affect the quality of the water supply. This is also true regarding the growth cycles of other non-pathogenic bacteria and harmless microorganisms [20]. Drinking waters from the boreholes most places in Benin City are unlikely to be treated in any way before they are ingested. Thus the presence of pathogenic microorganisms (aerobic bacteria, coliform, faecal Streptococci) and fungi in the boreholes is a major concern for consumers because of the effect of the microorganisms on the health of consumers. Coliform are a group of bacteria with common characteristics used to indicate unacceptable water quality. Within the total coliform group, the *E. coli* bacteria are specifically used to indicate faecal contamination. Boreholes and open wells are sited indiscriminately in Districts in Benin City without proper geological surveys. Indiscriminate refuse and waste disposal and location of septic tanks, soak-away pits and pit-latrines in living surroundings are common. These activities could account for the presence of faecal bacteria in the borehole waters [8]. The report of Erah et al., [8] on the quality of ground water in Benin City, detected the presence of microbial contaminants such as *E. coli*, aerobic bacteria, fungi, faecal streptococci and presumptive coliforms in samples. Similar reports of Eno et al., [23] showed that borehole water samples in Akwalbom State, Southern Nigeria, showed the presence of *E. coli*. The presence of *E. coli* in some samples is of great concern and implies faecal contamination of such samples. It is recommended by the WHO that no microbial organisms should be found in 100ml of drinking water.

The greatest risk from microbes in water is associated with consumption of potable water that is contaminated with human excreta, although other sources of exposure are significant [24]. Also Olorunfemi et al., [22] reported elevated levels of coliform counts and heterotrophic bacteria, some of which could produce toxins from boreholes in southern Nigeria. Consumption of such water can pose serious health challenges.

Conclusion and Recommendation

Water is life and access to good quality water cannot be overemphasized. However, the proliferation of boreholes especially in Benin City, may lead to a long term environmental hazard. Increased human activities in Benin City, particularly the indiscriminate location of septic tanks, soak-away pits and pit-latrines, disposal of refuse and waste, and other materials that can leach into the groundwater constitute a major health concern. Majority of the inhabitants of the City continue to consume water from boreholes and wells without adequate and proper treatment. It is recommended that the government of Edo state should regulate the construction of boreholes so as to ensure it is constructed to standard by professionals. Government should also look into supply of portable water so as to discourage people from constructing boreholes as an alternative source of water. It is also recommended that borehole owners should analyse the quality of water, government must ensure that professionals analyse already existing boreholes and enforce corrective measures so as to safeguard the public health of the citizens of the state and prevent contamination of the aquifer.

A future prospect to improve water quality is for the government of Edo state to privatise water supply to private companies who will meet the needs of consumers in both supplying portable water and collect wastewater for treatment in adherence to the Nigerian regulations of water quality. The private companies will be expected to abstract water from mainly from rivers and then from the aquifer then treat it and pump it to customers. They will also collect the waste water, treat it and discharge it back into the rivers. Edo state environmental agency will control discharges of waste water to ensure they are properly stored for collection to be treated and recycled and discourage indiscriminate discharge of waste water. The government environmental agency will also ensure all existing boreholes are stopped, allowing only the private sectors to supply water. This will not only stop the indiscriminate drilling of boreholes by individuals but also safe the quality of the aquifer by avoiding anthropological disturbance, prevent possible environmental hazard and provide clean portable water for consumers there by safe guarding the health of the people.

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