Hydrology for Disaster Management

Special Publication of the Nigerian Association of Hydrological Sciences, 2012

Water Quality Evaluation of Spring Waters in Nsukka, Nigeria

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Abstract

Water samples were collected and analyzed from five different spring water sources in Nsukka (Asho, Iyi-Nsukka, Ajie and Ikwoka-Obimo springs) to ascertain their portability for drinking, since they are consumed directly without treatment. Reports from hospitals in Nsukka metropolis indicate rampant cases of water borne diseases like typhoid fever. After analyzing the samples, it was found that most of the water parameters tested for was within WHO/NIS standard except in biological tests of coliforms, which have high concentration levels especially at Ajie and Iyi - Nsukka springs with 150MPN and 280MPN per 100ml. The springs also have E. coli of 3MPN/100ml each while Asho and Ikwoka- Obimo springs have <3MPN/100ml

Key words: Spring waters, Water quality, E coli, Coliform, Portable water.

Introduction

Water is vital to the existence of all living organisms, but this valued resource is increasingly being threatened as human populations grow and demand more water of high quality for domestic purposes and economic activities. Spring water is collected directly from an underground formation from, which water flows naturally to the surface or from a bored hole that taps the source of the spring. Although spring water requires minimal treatment before it is bottled, it must retain the same physical properties and composition as the natural spring water (Mehta et al., 1999). Water abstraction for domestic use, agricultural production, mining, industrial production, power generation, and forestry practices can lead to deterioration in water quality and quantity that impact not only the aquatic ecosystem, but also the availability of safe water for human consumption.

The quality of any body of surface or ground water is a function of either or both natural influences and human activities. Without human influences, water quality would be determined by the weathering of bedrock minerals, atmospheric processes of evapo-transpiration, and the deposition of dust and salt by wind. Others include, the natural leaching of organic matter and nutrients from soil, hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water (UNEP, 2006).

Water quality and quantity are intimately linked although not often measured simultaneously. Water quantity is often measured by means of remote hydrological monitoring stations, which record water level, discharge, and velocity. Monitoring of water quantity can be undertaken, to a certain degree, with a minimal amount of human intervention, once a monitoring station has been set up. In contrast, water quality is usually determined by analyzing samples of water collected by teams of personnel visiting monitoring stations at regular intervals. Typically, water quality is determined by comparing the physical and chemical characteristics of a water sample with water quality guidelines or

standards. Drinking water quality guidelines and standards are designed to enable the provision of clean and safe water for human consumption, thereby protecting human health as well as the environment. The guidelines are usually based on scientifically assessed acceptable levels of toxicity to either humans or aquatic organisms.

Water quality is neither a static condition of a system, nor can it be defined by the measurement of only one parameter. Rather, it is variable in both time and space and requires routine monitoring to detect spatial patterns and changes over time. There is a range of chemical, physical, and biological components that affect water quality and hundreds of variables could be examined and measured. Some variables provide a general indication of water pollution, whereas others enable the direct tracking of pollution sources. Contaminants that may be in untreated water include microorganisms such as viruses and bacteria; inorganic contaminants such as salts and metals; organic chemical contaminants from industrial processes and petroleum use, pesticides and herbicides, and radioactive contaminants. Water quality depends on the local geology and ecosystem, as well as human uses such as sewage dispersion, industrial pollution, use of water bodies as a heat sink, and overuse. Therefore, the activities on land use around the water sources, can increase the level and number of contaminants if not properly used.

Study Area

Nsukka is located on longitude $7^0$22'E and latitude $5^0$50'N in the South Eastern part of Nigeria (Ezenne et al., 2010). It is in the humid tropical climatic region and is characterized by two distinct wet and dry seasons (Figures 1 and 2), show the map of the study area.

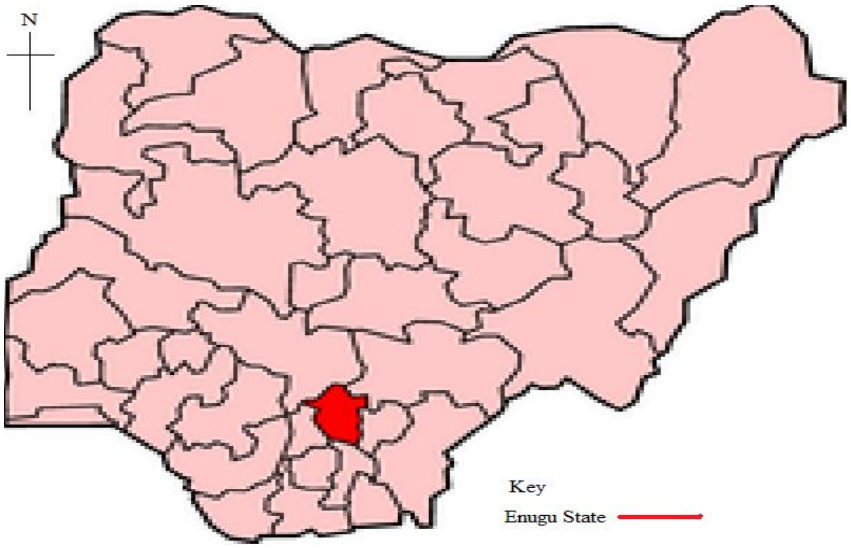

Figure 1: Map of Nigeria showing Enugu State, Nigeria (Okechukwu, 2011)

Figure 2: Map of Enugu State showing Nsukka (Okechukwu, 2011)

The Spring Sources

The spring water sources are located at different areas within Nsukka. The springs are of different features. The common features among them are that they are all located at the foot of the hills and run non-stop for 24 hours throughout the year.

Asho Spring

Asho spring is located at the foot of the hills at Onuiyi layout area of Nsukka, with the hills as the source of the water. The Asho spring water is well built and channeled to concrete reservoirs, where outlets were made through taps for collection as shown in (Figure 3). The water is only seen at the outlets because it runs underground but with very poor or no maintenance at all. The spring is a major source of water for the people of Onuiyi, especially during the dry season. Sanitary inspections of the surroundings revealed human defeacation at the upper part of the hills, which is a source of biological pollutant. There are also land developments since the top of the hill is a table land.

Figure 3: Water collection at the Asho spring, Nsukka, Nigeria

Ajie Spring

Ajie spring source has almost the same features as Asho with a refuse dump site at the entrance of the spring source. It is located at Odenigbo area of Nsukka, behind Erina Hotels. Like Asho spring, it a major source of water supply for the inhabitants of Odenigbo. Ajie spring is also well built but the reservoirs are dilapidated and are out of use. The spring water is collected at the point where the reservoir pipe is broken as shown below in Figure 4.

Figure 4: Ajie spring in Odenigbo, Nsukka, Nigeria.

Iyi-Nsukka Spring

Iyi-Nsukka spring is located at the foot of the hills behind the timber shade in Nsukka. The spring is not well built but drains from the stone and ponds in a small open earthen depression from where water is scooped with a cup or bowl as seen in (Figure 5).

Figure 5: Iyi-Nsukka spring, Nsukka, Nigeria

Ikwoka-Obimo Spring

Ikwoka-Obimo spring is located at Ikwoka village, Obimo in Nsukka. It is located in the village but, its source is at the foot of a hill few kilometers away. The spring is well built and channeled to the center of the village for domestic purposes as shown in (Figure 6).

Figure 6: Ikwoka-Obimo spring, Obimo, Nsukka, Nigeria

Materials and Methods

Water samples were collected during the rainy season, in the month of May 2012. All the water sources were located at the foot of hills where waters were being discharged as underground water seepage all year round. There are sparse activities of agriculture and land development at the top of the hills. The spring areas are also characterized by thick and tall forests, which protect the areas from direct sunlight and excessive evaporation. These springs are major sources of water supply within their host communities especially during the dry season. The samples were collected and sent to the laboratory for analysis on the same day. Physical tests like colour, odour and taste and the physico-chemical parameters of temperature, pH, and dissolved oxygen were analyzed for in-situ.

In Nsukka, spring waters are seen as clean and safe water, but this study evaluated the quality of four springs namely: Asho, Iyi-Nsukka, Ajie, and Ikwoka-Obimo springs. The results were compared with the World Health Organization and Nigerian Industrial Standards to ascertain conformity with the national and international guidelines

Results and Discussion

From the Table 1, the results show that most parameters tested were within both the international (WHO) and national (NIS) standards except for the biological tests, which exhibit high levels of contamination. The contamination can be attributed to the indiscriminate dumping of refuse and faeces around the water sources, which can be washed down from the upstream by runoff to contaminate the springs. There are also high concentrations of calcium in Asho and Ajie springs of 26.65mg/l and 24.04mg/l respectively, but there is no stated health implication by WHO/NIS. Magnesium has high concentration levels in all the assessed springs, which has 0.2mg/l as maximum permitted level for NIS with Ikwoka- Obimo springs having the highest level with 48.64mg/l. The health implication of magnesium is only consumer acceptability.(NIS, 2007). Iyi-Nsukka and Ajie springs has higher levels of phosphate but still within the permitted level and there is no guidline by WHO/NIS.

Table 2: Water quality parameters of four springs in Nsukka, Nigeria

S/N	Parameters	WHO/NIS (Guidelines)	Asho Springs	Ajie Springs	Iyi-Nsukka Springs	Ikwoka-Obimo Springs
1	pH	6.5-8.5	6.8	5	7.4	6.9
2	Dissolved O_2 (mg/l)	None	5	6.8	7.8	5.2
3	Temperature (^oC)	None	21^oC	22^oC	21^oC	20^oC
4	Calcium(mg/l)	None	25.65	24.05	4	3.2
5	Magnesuim (mg/l)	0.2	4.86	14.59	14.59	48.64
6	Biocarbonates (mg/l)	No guideline	10	10	6	12
7	Chloride(mg/l)	250	3.9	21.99	8.99	3.99
8	Nitrate (mg/l)	50mg	0.064	0.038	0.2	0.03
9	Iron (mg/l)	0.3	0.05	0.03	Nil	0.02
10	Aluminium(mg/l)	0.2	0	0	0	0
11	Flouride(mg/l)	1.5	0.08	0.04	0.02	0.06
12	Coliform (MPN)	Zero	7 MPN/100ml	150 MPN/100ml	280MPN/100ml	9 MPN/100ml
13	E. Coli	Zero	<3	3	3	<3
14	Phosphate (mg/l)		0.61	0.67	1.06	0.08
15	Ammonia (mg/l)	No guideline	0.23	0.2	0.28	0.21

NB: NIS = Nigerian Industrial Standard; - = No trace; MPN/100ml = Most Probable Number per 100ml of water

Conclusion

From the study, it is observed that the water quality of the four springs; Asho, Ajie, Iyi- Nsukka and Ikwoka-Obimo are below the accepted physical and chemical pollutants ranges relative to the WHO/NIS standards. The springs therefore, need no further physical or chemical treatment but, require biological treatment because of the contaminants from the dirty and untidy surroundings. This indicates that the water is not safe for drinking. The paper therefore recommends that the biological or bacteriological treatment be provided for the four springs before consumption. The surrounding environment should be kept clean and tidy to avoid or reduce contaminations from the dirt around the springs. Continuous monitoring should be provided to determine any change in the level of pollution at the sources.

References

Elemide O. A., (2010, Water Quality of Ala River and some wells and impact on Agriculture in Akure, Ondo State, Nigeria, BLWOIS-2010 Ohrid, Republic of Macedonia, pp1-6.

Ezenne, G.I., Mbajiorgu, C.C. and Okechukwu, M.E., (2010), Managing Floods in Nsukka Urban with Climate Change, Proceedings of Nigerian Union of Planetry and Radio Sciences (NURPS), Lagos 2010, In press

Mehta, A.R., Lemly, A.T., and Schwartz, J.J., (1999), Drinking Water Alternatives, Cornell Cooperative Extension, College of Human Ecology, Facts Sheet 11, pp 1-5.

NIS, (2007) Nigerian Industrial Standards NIS 554: 2007, Nigerian Standard for Drinking Water, Approved by Standard Organization Nigeria (SON), ICS 13.060.20 pp1-30.

Okechukwu, M.E., (2011), Design, Construction and Testing of a Drainage Lysimeter, Unpublished M. Eng. report submitted to the Dept of Agric. and Bio-resources Engineering, University of Nigeria, Nsukka, Nigeria.

UNEP, (2006) Water Quality for Ecosystem and Human Health, United Nations Environment Program/ Global Environment Monitoring System (UNEP/GEMS) Program 2006, pp 1-132.