Effect of Anthropogenic Activities on Surface and Ground Water in Ogwuama Community of Ahiazu, IMO State, Nigeria

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ABSTRACT

Human activities have become a major source of environmental pollution especially on the issue of water pollution which includes surface and ground water. This research was aimed at studying the effect of human activities such as indiscriminate defecation, fermentation of cassava tubers etc on the water quality of Onuakpaka stream and selected ground water in Ogwuama community of Ahiazu, Imo State, Nigeria. Water samples were collected in triplicates each with sterile containers from upstream, downstream and ground water. All the samples were analyzed using standard method. The result showed that the pH of samples collected from the upstream and downstream were more acidic (5.70 and 5.90 respectively) than the ground water (6.06). Also, the upstream and downstream have high turbidity of 14.76 and 15.40 respectively. More also, dissolved oxygen in the stream samples were below the World Health Organization and Federal Ministry of Environment standards while the ground water samples were within the standard. Also there were presence of feacal counts and *Escherichia coli* in all the samples collected (8.00 in ground water, 13.00 in the upstream and 23.00 downstream) this may be due to indiscriminate defecation. Furthermore, the temperature, conductivity, total dissolved oxygen etc were within the standard in all the samples collected. Conclusively, the presence of feacal contaminant and *Escherichia coli* signifies that the water is highly polluted and unfit for drinking and domestic work. This posses a great danger to human health in this community.

Keywords: contamination, anthropogenic, upstream, downstream, ground water.

1   Introduction

Water is very important in our day to day activities. Sources of water in Ogwuama community are stream and ground water. Water is a scarce and fading resource and its management can have an impact on the flow and the biological quality of rivers and streams. The quality of water source is influenced majorly by anthropogenic activities. Such as cassava fermentation and intensive agricultural practice, washing of cloths, bathing, defecation and discharge of massive amount of waste around the

water source. The impact of these anthropgenic activities has been so extensive that the water bodies have lost their significant capacity to a large extent.

The quality of water is determined by monitoring microbial load especially feacal coliform and physico-chemical parameters like pH, Dissolved oxygen, Biochemical oxygen demand etc. The problem of ground water contamination include outbreaks of water-borne diseases , as well as unsuitability of water for both agricultural and domestic uses. Low water tables may cause low infiltration rates.

2   Materials and Method

2.1 Study Area

Ogwuama in Ahiazu Mbaise, Imo State of Nigeria is located within 7° 14' 348'' to 7° 18' 44'' E and 5° 31' 006'' to 5° 35' 56'' N. The climate of the area is humid tropical and typifies the rain forest zone of the equatorial region. Mean ambient temperature is 28^{0}C. Wet season last between April to November with a short dry season lasting the rest of year.

2.2 Sample Collection

Water samples were randomly collected from Onuakpaka stream using 500ml sterile containers at three different points on the upstream and downstream and from three different public groundwater using standard method.

2.3 2.3 Determination of Physico-Chemical Parameters

The pH, temperature, conductivity, total dissolved solid and dissolved oxygen were determined in-situ using jenway(Hanna 1910) multipurpose tester in each sampling point while the BOD was determined using a winkler method for a period of five days at 20^{0}C.

Also, the turbidity was determined by photometric method using HACH DR/2010 spectrometer at a wavelength of 860nm.

More also, Argentometric method described by APHA (2005) was used to determine the chloride content.

EDTA titrimetric method was used to determine total hardness.

Nitrate was determine by cadmium reduction method using H183200 multiparameter bench photometer at a wavelength of 525nm.

2.4 Microbial Analysis of Samples

Samples were serially diluted and aliquots of 0.1ml of each water sample was used to inoculated on plate, Eosin methylene blue agar and potato dextrose agar nutrient were added by spread plate method. These plates were then incubated at 37°C for 24hrs for bacteria Colonies and 25°C, 78hrs–120hrs for fungi Colonies. After incubation, colonies were identified, counted and recorded.

3   Results and Discussion

3.1 Results

A total of 9 samples were collected (three samples each from the upstream, downstream and ground water).

Table 1: The physico-chemical and microbial analysis results of well water.

Parameter	FMEMV Standard	WHO Standard (2008)	Ground water 1	Ground water 2	Ground water 3	Mean value
pH	6.5 – 8.5	6.5 – 9.5	6.06	6.07	6.05	6.06
Temp (^{o}C)	20 – 30	N/A	26	28	27	27
Conductivity (Us/cm)	100	100	109	111	107	109
Turbidity (NTU)	10	5	0.00	0.00	0.00	0.00
DO (mg/l)	>4	4	4.18	4.20	4.22	4.20
BOD (Mg/l)	10	6	1.8	2.1	2.1	2.0
Total Dissolved solid(mg/l)	250	250	70.87	70.85	70.83	70.85
Total Chloride(mg/l)	250	250	-	145.08	145.10	145.08
Total Hardness(mg/l)	200	200	145.06	2.1	2.4	2.3
Nitrate(mg/l)	40	45	22.88	22.93	22.89	22.90
Total faecal count (cfu)	0	N/A	9	11	10	10
Total E-Coli Count(cfu)	0	N/A	9	9	6	8

N/A   =   Not Available

Table 2: The physico-chemical and microbial analysis results of Upstream.

Parameter	FMEMV Standard	WHO Standard (2008)	Upstream 1	Upstream 2	Upstream 3	Mean value
pH	6.5 - 8.5	6.5 – 9.5	5.71	6.69	5.70	5.70
Temp (ºC)	20 – 30	N/A	27	27	27.3	27.1
Conductivity (Us/cm)	100	100	8	10	12	10
Turbidity (NTU)	10	5	14.65	14.30	15.33	14.76
DO (mg/l)	>4	4	3.57	3.55	3.68	3.60
BOD (Mg/l)	10	6	2.4	2.0	1.99	2.1
Total Dissolved solid(mg/l)	250	250	6.00	6.40	7.10	6.50
Total Chloride(mg/l)	250	250	65.9	70.0	82.81	72.9
Total Hardness(mg/l)	200	200	0.5	0.6	0.7	0.6
Nitrate(mg/l)	40	45	10.97	10.90	10.83	10.90
Total faecal count (cfu)	0	N/A	22	22	22	22
Total E-Coli Count(cfu)	0	N/A	9	12	18	13

N/A=Not Available

Table 3: The physico-chemical and microbial analysis results of downstream.

Parameter	FMEMV Standard	WHO Standard (2008)	Down-stream 1	Down-stream 2	Down-stream 3	Mean value
pH	6.5 - 8.5	6.5 – 9.5	5.80	5.90	6.00	5.90
Temp (ºC)	20 – 30	N/A	27.1	27.3	27.5	27.3
Conductivity (Us/cm)	100	100	11	11	14	12
Turbidity (NTU)	10	5	15.48	15.60	16.14	15.74
DO (mg/l)	>4	4	3.57	3.80	3.85	3.80
BOD (Mg/l)	10	6	0.79	0.70	0.61	0.70
Total Dissolved solid(mg/l)	250	250	7.10	7.60	8.70	7.80
Total Chloride(mg/l)	250	250	150	172.6	224	182.2
Total Hardness(mg/l)	200	200	0.65	0.70	0.75	0.70
Nitrate(mg/l)	40	45	0.36	0.28	0.26	0.30
Total faecal count (cfu)	0	N/A	28	40	52	40
Total E-Coli Count(cfu)	0	N/A	20	22	27	23

N/A=Not Available

Table 4: The mean standard deviation of the water samples

Parameters	FMENV Std	Well water	Up stream	Down stream
pH	6.5-8.5	6.06±0.01	5.70±0.01	5.90±0.10
Temp (°C)	20-30	27.00±1.00 [a]	27.10±0.17 [a]	27.30±0.20 [a]
Conductivity (Us/cm)	100	109.00±2.00[b]	10.00±2.00 [b]	12.00±1.73 [b]
Turbidity (NTU)	10	0.00±0.00	14.76±0.52	15.74±0.35
DO (mg/l)	>4	4.20±0.02	3.60±0.07	3.80±0.05
BOD (Mg/l)	10	2.00±0.17	2.13±0.23	0.70±0.09
Total Dissolved solid(mg/l)	250	70.85±0.02[c]	6.50±0.56 [c]	7.80±0.82 [c]
Total Chloride(mg/l)	250	145.08±0.02[d]	72.90±8.82 [d]	182.20±3.02 [d]
Total Hardness(mg/l)	200	2.30±0.17	0.60±0.10	0.70±0.05
Nitrate(mg/l)	40	22.90±0.03[e]	10.90±0.07 [e]	0.30±0.05 [e]
Total faecal count (cfu)	0	10.00±1.00[f]	22.00±0.00 [f]	40.00±5.00 [f]
Total E-Coli Count(cfu)	0	8.00±1.73[g]	13.00±4.58 [h]	23.00±2.65 [g h]

Values are mean±Standard deviation of triplicate determinations values bearing the same superscript "a,b,c,d,e,f,g,h" across the same row are significantly different ($p<0.05$).

3.2 Discussion

The mean pH values recorded showed that ground water, upstream and downstream waters are slightly acidic and below the lower permissible limit recommended by WHO and FMENV. This may be due to the organic contamination which may come from natural leachates, atmospheric droplets and human contamination during fermentation of cassava in the water. Also caustic soda from soap and detergent during washing of cloths and bathing in the stream may be the cause of low pH as recorded in Ekhaise and Anyasi (2005).

The mean temperature of the water samples collected was within the permissible limit. Also Ekhaise and Anyasi (2005) reported that change in temperature difference of any aquatic habitat is affected by weather, the extent of shade from direct exposure to sunlight or biodegradation of organic matter that enter the water.

The mean values of conductivities of ground water is a little bit higher than WHO/FMENV limits while that of upstream and downstream waters are lower, though the waters can be suitable for domestic uses. The high conductivity value in the ground water may be due to high total dissolved solid as found in Akubugwu and Duru (2011).

Turbidity in drinking water is caused by particulate matter that may be present from water source as a consequence of inadequate filtration. From the mean values of turbidity of the waters, ground water is below the permissible limits while that of upstream and downstream waters were above the permissible limits and can shield the pathogenic organisms. Therefore, the higher the turbidity, the more energy and chemicals required for water treatment (Obasi *et al.*, 2004).

The mean value of Dissolved Oxygen (DO) of ground water was within the limit of FMENV and a little bit higher than the WHO while that of upstream and downstream water are a little bit below the limit values recommended by WHO/FMENV and therefore can support aquatic life (Njoku-Tony *et al*., 2016). Though, Ukaga and Onyeka (2002) stated that the desirable range of dissolved oxygen for normal fish growth is between 5.5 to 7.8mg/L.

The total dissolved solid is indicative of material carried in solid form and this falls within the WHO/FMENV standards.

In Tables 1, 2 and 3 the mean chloride are 145.8mg/L, 72.9mg/L and 182.2mg/L which are quite lower than the WHO/FMENV limit of 250mg/L, the chloride of the upstream water was relatively higher than that of the ground water and downstream water which do not pose any health risk (WHO, 2011).

The water samples foam easily with soap. Comparatively, the upstream water sample had the lowest value of 0.6mg/L and will produce lather with soap easier than the downstream and ground water. The direct effect of hardness on human health is yet to be proven scientifically (Sharma and Chandel, 2004). Hardness is not a health concern but can cause mineral build-up in plumbing fixtures and poor foaming of soap and detergents (WHO, 2011).

From the mean values of Nitrate in Table 4 recorded lower compared with WHO and FMENV limits. This means that the nitrate levels of the three water samples do not pose any health threat. High concentration of nitrate in both surface and shallow groundwater can be probably due to poor sanitation and latrine construction, fertilizer and other agrochemical use and causes methemoglobinemia in children (Margaret *et al*., 2012).

The BOD values fall within the WHO standard. According to Moore and Moore (1976), BOD values of 1-2 mg/L was classified as clean water, 2-3 mg/L as fairly clean water, 4-5 mg/L as fairly polluted water and 10mg/L as bad and polluted water. Therefore, the ground water and upstream can be classified as fairly clean water while the downstream can be classified as clean water.

Results of the heterotrophic bacterial count showed that the ground water had the lowest load. This is simply a measure of the number of live bacteria present in water and does not necessarily indicate health threats. Faecal coliform bacteria were detected in all the waters but were a bit much in the downstream water. According to FMENV standards, drinking water should have zero faecal coliform bacterial count in 100ml of the water. It is most likely that faecal contamination arises from human activities. The mean values of *E. coli* detected (0.8×10^1Cfu/ml) in the ground water, (1.3×10^1cfu/ml) in the upstream water and (2.3×10^1cfu/ml) in the downstream water. *E. coli* is normally a harmless commensal in the alimentary canal of a man and other animals. However, some sero-types frequently cause gastroenteritis characterized by severe diarrhea with mucus or blood and with dehydration but usually without fever. Children, especially the newborn are usually affected but increasing cases of adult diarrhea caused by *E. coli* are also being noted (Okafor, 1985). Therefore, the presence of *E. coli* in the waters makes it potential health risk to its consumers.

4   Conclusion

Due to the heavy bacterial load, the water sampled were not good drinking and for other domestic activities. There is need to reduce most anthropogenic activities around the water source especially

those that have negative impact on the water body such as defecation (both humans and animals), fermentation etc. This will help to improve the sanitization of water for domestic use since the stream and ground water are the major source of water in this area. Furthermore, sinking of shallow borehole should be discouraged.

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