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Effects of Water Pollution on Lower Usuma Reservoir and Ushafa Downstream Community, Bwari Area, Abuja, Nigeria

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----------ABSTRACT----------
The inadequate and improper disposal of wastes generated from domestic, agricultural and industrial processes have resulted in the pollution/contamination of our surface and ground water sources from physical, chemical and microbial pollutants.The impact of water pollution of Usuma reservoirand Ushafa downstream user community was studied using standard method to ascertain the level of microbial pollution/contamination of the reservoir water at upstream, middle and downstream and borehole water samples was studied. The fecal coliform, total coliform and E – coli levels in terms of most probable number per 100cm^{3}studiedwere all found to be > 16MPN/100cm^3 in the reservoir water. While all water samples from boreholes were found below WHO Standard of < 2.2 MPN/100cm^3. The incidences of waterborne/water related diseases like malaria, diarrhea, typhoid fever and skin diseases recorded from ushafa community local health center indicated a total of 1382, 319, 1325 and 1363, 318, 1291 and 452 cases were prevalent in 2016/2017 respectively. Malaria and typhoid fever are the most prevalent cases of waterborne and water related diseases recorded in the months of July and August annually. Adequate water treatment and the provision of sanitation facilities are recommended to improve the reservoir and ground water quality that willimprove the health standard in the entire watershed and Ushafa community.

KEY WORDS: *Pollution, Reservoir, boreholes, feacal coliform, waterborne/water related diseases.*

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I. INTRODUCTION

A dam is a reservoir constructed for storage and impounding water for domestic, agricultural and industrial uses by people living in a community or environment. Dams are also constructed to prevent floods, to supply drinking and domestic water, to generate energy and for irrigation purposes. The idea of dam construction or water storage structure or a reservoir is intended for all year round water supply for domestic, irrigation and industrial uses and other recreational activities like fishing, swimming and navigational purposes [1].

Pollution of water body occurs when addition of large amount of materials are introduced into the water body making it unfit for any intended use, such water is considered polluted. Notably, two forms of water pollution exist; point and non-point source. Point source of pollution occurs when harmful substances are directly emitted into the body of water. This includes sewage effluent waters from treatment works, and effluents from factories.While non-point source of water pollution are pollution indirectly through environmental changes. For example the application of herbicides, fertilizers that is often carried to streams, rivers and dams in the form of run- off are example of non-point sources of pollution which end up mixing the pollutants and creating a conducive atmosphere for breading of microorganisms responsible for encouraging the spread of waterborne diseases.

According to [2], water pollution from non-pointsources are much more difficult to control and these pollution type account for majority of contaminants in dams, streams and lakes.Pollutants characteristics can also be in the form of physical, chemical and biological origin.Whatever form of the source of pollution, there is always an attendant positive and negative impact on the downstream resident communities and its immediate environment. A research work to quantify the pollutants and source of pollution will be highly commendable in any given environment.

Danazumi and Bichi, [3] reported a strong correlation between high cases of malaria in settlements located at Sharada, Chalawa and Bompai industrial estates in Kano State in Nigeriaand they attributed it to the presence of polluted water which provided a breeding ground for mosquitoes and other insects.

Water quality and quantity of available water have implication on the health status of a community. According to USAID, [4],Herschy, [5], and Nwidu [6],over 50,000 people die daily due to water borne

diseasesand the mortality rate in children under five years due to water related diseases annually was estimated to be about 4 million in developing countries. WHO, [7] also reported that 2.3 billion people worldwide have mortality and morbidity associated with water related ailments.

Water pollution which could emanate from domestic, industrial and agricultural sources that are mostly discharged into rivers, lake, dams or perennial streamsmight harbor microbial pollutantswhich could be responsible for the prevalence of water borne/water related diseases proliferation particularly on the downstream user community like Ushafa.Therefore this study seek to determine the effect of reservoir water and borehole water pollution on Ushafa downstream communitiesfrom microbial contamination of the reservoir water and the prevalence of waterborne diseases around the residential areas of Ushafa community.

II. MATERIALS AND METHODS

Study Area

Ushafa community is located between the latitude 10° 38"N and longitude 4° 55"E and it covers a land mass of 190km^2. The major occupation of the inhabitants is farming and hunting. The area comprised of Clinton village, Ushafa kasa, Ushafa Sama and Ushafa new extension, while the entire community was made up of Cogo, Jugo, Bambara, PAYE and Usuma dam. Usuma dam reservoir was constructed in 1984 with a maximum capacity of 1000 m^{3}for water supply and other water requirements for the entire area (Fig 1).

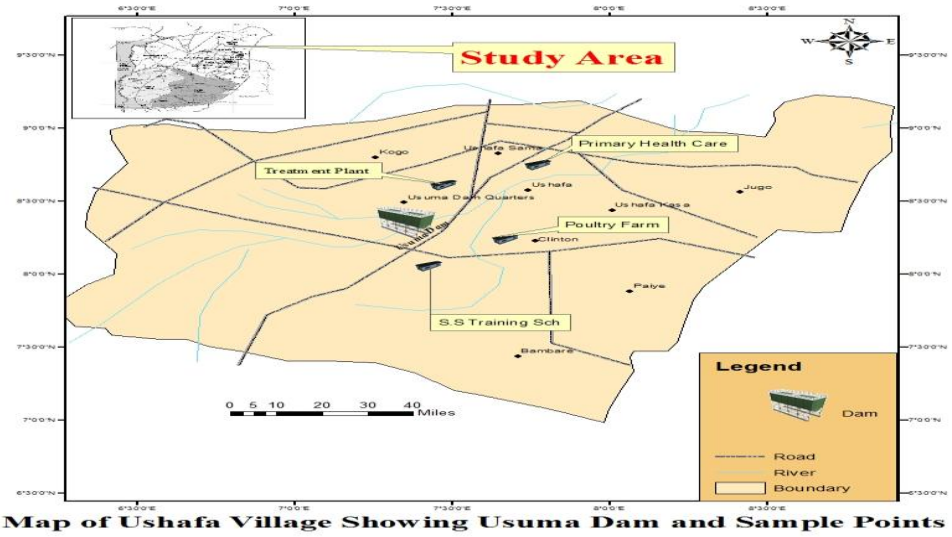

Figure 1: Map of Ushafa village showing Usuma Dam and water sampling points

Method of data collection

The main source of data for this research was collected through primary and secondary sources. The primary data source covers water sampling at three selected location of Usuma dam and water from boreholes within Ushafa Community, while the secondary data source was obtained from epidemiological and the prevalence of waterborne/water related diseases records from Ushafa community health center covering a period of two years (2016 to 2017).

Water Sampling

Water samples were collected at upstream, middle and downstream of the reservoirin triplicate using one liter pre - cleaned and sterilized sampling bottles which were stored at a temperature of 4°C in a portable freezer.Grab sampling technique was adopted and were immediately transported to water quality monitoring laboratory of Usuma dam for further analysis. Water samples were also collected from three boreholes randomly spread across Ushafa community using the same procedure, technique and treatmentas outlined above for reservoir water.All the water samples were immediately taken to laboratory for analysis using standard method. Total and feacal coliforms were determined in the water samples using the multiple fermentation techniques where the samples were inoculated in series of bottles containing lactose broth at 35°C for 24 hours after which the bottles were checked for gas production and further incubation using Eosin Methylene Blue media. Total

and feacal coliform populations present in the water samples were estimated using multiple counting techniques and presented in Table 1.

Data on the prevalence of water borne/water related diseases recorded within the study period (2016/2017)

Monthly information on the prevalence of water borne/water related diseases like malaria, diarrhea, typhoid fever, cholera and skin diseases experienced in Ushafa community was sourced from Medical records from Ushafa Community Health Center located at Ushafa Kasa spanning for a period of two years (2016/2017) were analyzed and presented in Figures 1and 2**.**

Data Analysis

Simple descriptive statistics, percentages and bar charts were used to analyze the data collected using Microsoft Excel software and WHO Standard were used to make comparism as presented Table and Figures below:

III. RESULTSAND DISCUSSION

Table 1: Bacteriological Quality of Usuma Dam and Borehole waters of Ushafa Community

Locations	Water Source	TC MPN/100cm^3	FC MPN/100cm	E – Coli MPN/100cm	WHO STD	Remarks
Upstream	Reservoir	> 16	> 16	Present	<2.2	Highly Contaminated
Middle	Reservoir	> 16	> 16	Present	<2.2	Highly contaminated
Downstream	Reservoir	> 16	> 16	Present	<2.2	Highly contaminated
Ushafa Kasa	Borehole	< 2.2	< 2.2	Present	<2.2	Safe for human consumption
„	Borehole	< 2.2	< 2.2	Present	<2.2	Safe for human consumption
UshafaSama	Borehole	< 2.2	< 2.2	Present	<2.2	Safe for human consumption

WHO Standard (2008), TC= Total coliform, FC = Feacal coliform, EC = Escherichia coli

The results of bacteriological quality of Usuma dam and borehole waters sampled at three different segments located in Ushafa community are presented in Table 1.

Total Coliform

The total coliform concentration as assessed in Usuma dam reservoir and borehole waters in Ushafa community were presented in Table 1. The results showed that the total coliforms were all found to be greater than 16/MPN/100cm^3. The recorded concentration value of total coliforms in this study were far greater than (WHO, 2008) standard by almost 8 timeshigher than the maximum allowable limit for safe human consumption of water at the upstream, middle and downstream sampling points of the dam. The results indicated high level of water contamination for safe human consumption which could be attributed to open defecation, application of chemical fertilizers around the dam reservoir especially at the upstream side where runoff could possibly find their way into dam reservoir from the entire watershed and dam reservoir catchment area. The result of total coliforms as assessed in borehole water samples taken from Ushafa Sama and Ushafa kasa indicated that all the samples were below the allowable standard of < 2.2 MPN/100cm^{3}indicating that the groundwater from boreholes were safe for human consumption in Usahafa Community.

Feacal Coliform

The feacal coliform levels of Usuma Dam and borehole water as assessed from Ushafa Community also revealed that the concentration level of feacal coliformin dam reservoir water had higher values > 16MPN/100cm^3 at the upstream, middle and downstream section of the dam. Borehole water samples taken from the selected areas of the same community indicated a feacal coliform level below < 2.2 MPN/100cm^3. The study revealed that groundwater samples from boreholeswere not contaminated by feacal coliform and was however safe for human consumption based on the results. The presence of feacal coliform in the dam reservoir could be as a result of domestic and anthropogenic wastes disposed into water ways from FCT alongside with runoffs. Domestic waters from whatever source should be free from any agent that can cause health hazard. To

promote hygiene, treatment plants should adequately remove all pathogen to an acceptable level to ensure public safety.

Escherichia coliform (E – coli)

The E – coli concentration levels of Usuma dam and borehole waters in Ushafa Community indicated that all the water sources be it surface or ground water contained E – coli. The presence of E – coli in raw water indicate some level of contamination of the water for human consumption. The World Health Organization (WHO) specified that water for human consumption should be free or should contain no coliform bacteria at all. The presence of E – coli could be from bad attitude of open defecation by human being around the area and poor disposal of human waste especially from homes which finally find their way into the dam reservoir from the upstream side thereby polluting the water in the dam reservoir. This finding strongly agrees with the finding reported in [9].

The prevalence of water based/water related diseases in Ushafa Community

The prevalence of water based/water related diseases experienced in 2016 by resident of Ushafa community is presented in (Fig 1). The monthly record of malaria fever, diarrhea, typhoid fever and skin diseases indicated a total of 1382, 319, 1325 and 484 cases of malaria fever, diarrhea, typhoid fever and skin diseases recorded within a period of one year. The incidences of malaria ranged from (97 -149) having the lower value recorded in the month of January and February, while the most prevalent cases were recorded in the month of July in theYear 2016. Recorded cases of diarrhea ranged from (17 – 41). The prevalence of typhoid fever cases as recorded revealed from the data collected ranged from (99 - 118). The higher value of typhoid fever was recorded in the month of October in the year 2016. The recorded cases of skin diseases ranged from (20 – 70).Higher prevalence of malaria and typhoid fever were recorded in the months of July and August with a total of 149, 139 and 112, 122 cases and graphically presented byFig 1.

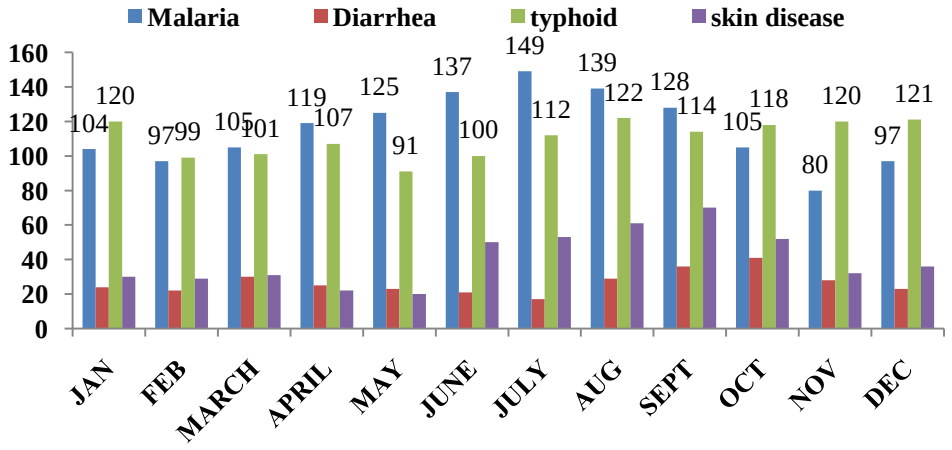

Figure 1: Recorded Monthly Prevalence of Water related/water based diseases in Ushafa community in 2016

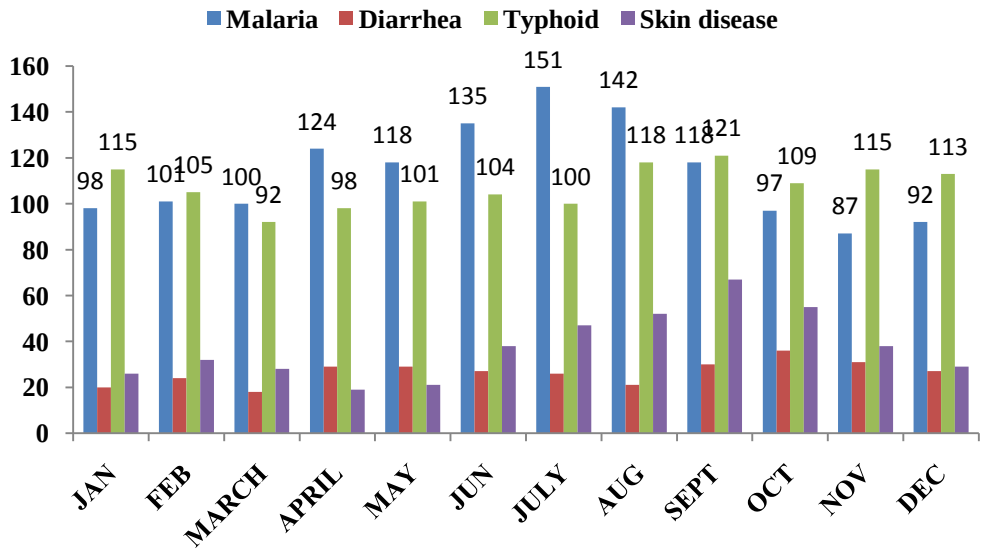

Figure 2: Recorded Monthly Prevalence of Water related/water based diseases in Ushafa community in 2017

Similarly, the year 2017 (Fig 2) total monthly prevalent cases of malaria feverwas 1363, diarrhea 318, typhoid fever 1291 and 452 for skin diseases were recorded from the month of January to December in the year 2017 indicating that malaria and typhoid feverswere the most prevalent cases with higher values of 151,142 and 118 and 121 in the months of July, August, August and September respectively (Fig 2). The monthly recorded cases of malaria fever ranged from (92 – 151) with the least case in December and the highest in the month of July of the year 2017. Incidences of typhoid fever ranged from (92 – 121) occurring between the months of March and September of 2017. The cases of diarrhea ranged from (18 – 36), while skin diseases ranged from (19 – 67) as shownFig 2. Higher incidences of malaria and typhoid fever were prevalent, while skin diseases and diarrhea were observed as the least prevalent cases of water related/water borne diseases as evidenced from the collected data.However, the prevalence of water borne diseases by [6] indicated 2, 4, 9 and 7, 12 and 12 incidences of diarrhea and typhoid in 2005 to 2007 recorded in General Hospital Amasoma in Niger Delta of Nigeria. The higher incidences of water borne diseases recorded in our study could be attributed to higher population of people and concentrated industrial areas in the capital city of Abuja and hence the generation of liquid waste into the environment. The results obtained in this study is in line with the findings reported by [8] who studied water quality parameters of river Rupsha of Khulna Region of Bangladesh. The prevalent cases of waterborne diseases reported in this study also concur with [10] where a total of 25 and 121 cases of typhoid and diarrhea were experienced due to water pollution in Uzere, Ivorogbo, Kwale, Ibrede, Iselegu insouthern Nigeria.

It is evident from this study that the diagnosed cases of malaria and typhoid fever were predominantly experienced between the months of July and September where pick malaria and typhoid fever cases were recorded. This could be linked to the fact that raining season reached its peak period around July thus making condition favorable for mosquitoes breeding and other vectors around the entire community and water shed of the dam reservoir and hence the high prevalence of malaria fever. The recorded cases of higherprevalence of malaria, typhoid fever, diarrhea and skin diseases as evidenced in this study is a serious concernwhich also is an indication that the dam reservoir water cannot serve for recreational activities as swimmers, fishermen and other water users are may be at riskof contracting skin diseases.

IV. CONCLUSION

The microbial contamination of Usuma reservoir and borehole water samples of Ushafa community as well as the prevalence of waterborne and water related diseases recorded within the period of 2016 to 2017 was studied. The levels of total coliform, feacal coliform and E – coli were found to be above WHO (2008) Standard indicating high level of microbial pollution of the water sources. The water samples from borehole were found to be within safe limit for human consumption. Higher cases of malaria and typhoid fever are predominantly experienced in the months of July and September for the two years studied which could be linked to rainy season making condition favorable for mosquitoes and other insect vectors around Ushafa Community. Adequate management of the entire watershed and the provision of drainage systems and sanitation facilities are hereby recommended in other to control the contamination of water sources and to properly dispose of contaminated water that create favorable breeding environment for diseases causing agents.

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