Assessment Of Surface Water Quality For Domestic And Agricultural Purposes In Rural Communities Of Kogi East, Nigeria.

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Abstract
Water quality is very important in fish farming as poor quality water can affect the health and growth of the fishes. It is important that farmer pay attention to the water's chemical and physical factor. Surface Water Quality in rural communities in Olamaboro was assessed to determine the impact of human activities on the water quality. Water samples were collected from four sample sites (A-D) during the wet season and analysed using Phisiochemical and Biological Parameter. Results from the study shows that DO mean level of water sample site I is 7.0+02 and PH mean level 7.4+01 which are within the permissible range by WHO for drinking water. The mean value for colour variation 4.6+4.3, Odour 73.9+4.1 Turbidity9.6 +5.8 which indicate that the water is Biologically polluted. Physiochemicalaly the water sample from site II, III, and IV. Are polluted. The Author advocates Water catchment protection and Household point of use treatment among others.

Key Words: Water Quality, Water Parameter, Surface water.

INTRODUCTION

Background to the Study

The quality and quantity of drinking water supply to human population is a topical global issues. According to WHO and UNICEF report (2016), safe water which is a basic necessity is still a luxury for many poor developing countries of the world today. It has been estimated that over 1.1 billion people do not have access to drinking water from improved sources. Eighty percent of the unserved populations live in these three regions – Sub-Saharan Africa, Eastern Asia and Southern Asia. Eighty- four percent of these people are the rural dwellers (Howard et al., 2015). In sub-Saharan Africa and Oceania only 54% and 50% of their populations respectively are served with improved sources of drinking water in 2014. Whereas at the same period, the population that had access to water from improved sources is over 90% in the Caribbean, Northern Africa and Western Asia (Medd, 2019). Access to safe drinking water is required by all communities regardless of the area, average income, average level of education, geographical region or race, ethic or cultural background (Akpor & Muchie, 2011). For many rural communities in developing countries, unreliable access to safe drinking water remains a large and growing concern (Eva, 2015)

Safe (quality) drinking water is that which does not present any significant health risk over a life time consumption, including any sensitivities that may occur in different stages of life. It is water which is free from pathogenic microbes, hazardous chemicals/substance and aesthetically acceptable (i.e. pleasing to sight, odourless and good taste). It is important that this type of water should not only be available, but also be available in enough quantity all the time (Lidebaum, 2012)

Water quality is very important in fish farming as poor water quality can affect the heath and growth of the fish. It is important that farmer pay attention to the water's chemical and physical factors. Water quality is a critical factor when culturing any aquatic organism. Optimal water quality varies by species and must monitored to ensure growth and survival. The quality of the water in the production systems can significantly affect the organism health and the cost associated with getting a product to the market. Water quality parameters that are commonly monitored in the aquaculture industry include: temperature, PH, dissolve oxygen, alkalinity, hardness, ammonia and nitrites.

In assessing quality of drinking water, physical, chemical and bacteriological parameters must be considered. Although water from a source may not pose any health threat to consumers, they may abhor it due to its colour, odour, or taste

(Medd, 2019). Physical parameters include colour, smell, temperature, PH, turbidity etc. There are myriad of chemical substances which may be naturally present or introduced (even chemicals used for water treatment) into water; those that are naturally present seldom pose risk to health. However, chemicals released due to anthropogenic activities (fertilizer, pesticides, herbicides, industrial effluents and byproducts etc.) carry more health risk to consumers. Fortunately, whether chemical naturally present or introduced into water, there are maximum allowable concentration of most of them proposed by World Health Organization (WHO) which serves as guide. Some of the chemical substances include residual chlorine (RC), Iron (Fe), Fluoride (Fl), Nitrate/Nitrite, Lead (Pb), Mercury (Hg) etc. (Mafuta et al., 2011). Bacteriological (microbial) parameter is used to assess drinking water quality using the index /indicator concept as advocated by Waite (2011).

Every year unsafe water, coupled with poor basic sanitation, kills about 1.6 million children under 5years and most of this occur in poor /economically disadvantaged countries of the world. According to WHO, 80% of ill- health in developing countries can be traced to lack of access to safe drinking water and poor sanitation. About 37% of all diarrhea cases in the world occur in the Sub-Saharan Africa 2. Four million under 5 children die annually in developing nations from diarrheal diseases which place a heavy burden on the health services. Although diarrhea is less frequent in adult, it is also an important cause of mortality 3 most especially in the aged and immuno-compromised (Davis and Susan, 2014).

The type and severity of water contamination is often directly related to human activity, which can be quantified in terms of the intensity and type of land use in the catchment areas of a water body with growing human population, increasing urbanization, indusstrialisation, and environmental degradation. Lakes, streams and rivers are increasingly threatened from chemical and biological pollutant. Rural communities in developing countries still depend on surface water for their domestic uses.

The purpose of monitoring the faecal contamination in a water body is to indirectly quantify the risk people expose themselves to when using the water. This monitoring process demands the identification of an indicator, typically a bacterium that directly expresses the level of faecal contamination in the water sample and ideally also expresses the direct health risk to the exposed individual. However, monitoring of faecal pollution in a water body is usually carried out by a water engineer, who typically selects an indicator bacteria, according to tradition. Therefore, faecal pollution is today mostly monitored with the traditional bacterial indicators: total coliform and faecal coliforms, rather than considering alternative indicators. Chapter 3.2 will show that these indicators are not optimal in expressing the level of faecal pollution or the direct health risk of the water. The identification of the optimal indicator for faecal pollution is still an emerging field where no optimal solution has been found, especially not for field conditions in developing countries.

The identification of a proper indicator organism for the monitoring of faecal pollution in aquatic systems has been pursued for nearly a century. It all began with the discovery by Dr. Theodor Escherich, when in 1885 he isolated the *Bacterium coli commune* from infant faeces, later renamed after him as *Escherichia coli*. This bacterium now constitutes one of five species in the genus *Escherichia* under the family of *Enterobacteriaceae* (Sussman *et al.* 1985).

Since it was known from the beginning that *E. coli* is associated with human faeces, the idea was developed to use the *E. coli* as an indicator of faecal pollution. How-ever, until the 1930s it was not possible to quantify the numbers of *E. coli* bacteria in a sample, and before this problem was solved, *E. coli* could not be used as a quantitative indicator. Therefore, a new indicator was developed: the total coliform group, which, besides *E. coli*, includes the genera: *Citrobactor*, *Enterobactor*, *Serratia* and *Klebsiella* (Gleeson & Gray 1997).

However, the use of the total coliforms as an indicator for faecal pollution was not an optimal solution, as some of the genera in the group can also be isolated from the environment, and are therefore not necessarily associated with contamination of water with animal and human faeces. The problem of natural occuring environmental coliform bacteria was to a certain degree overcome by incubating the total coliforms at 44.5 ºC and testing their ability to ferment lactose with acid and gas production. By these procedures the genera included in the original total coliform group were reduced, and the faecal coliforms or thermo-tolerant coliforms indicator group was created (Bartram 1996). Today, the faecal coliform group are used widely as the indicator of faecal pollution in the water quality guidelines (WHO 1989 & 1993b). However, some species like the genera *Klebsiella* is also included in the faecal coliform group. *Klebsiella* are like *E. coli*, thermo-tolerant and can ferment lactose, but may also originate from the environment outside the intestinal tract (Cleseri *et al.* 1998, Gleeson & Gray 1997). Until the late 1980s the monitoring of *E. coli* was a slow procedure demanding 48 hours. Only after an 24 hour procedure to identify the total coliforms, followed by a second 24 hour incubation with a media containing 4-methy-umbellfieryl-β-D-glucoronide (MUG) could the *E. coli* be identified. However, since the beginning of the 1990s a variety of medias containing MUG or similar substrates that only allow growth of the target microbe, have allowed for a direct enumeration of *E. coli* thereby lowering the identification procedure to 18-24 hours (Edberg 2000, Cleseri *et al.* 1998).

The quality of water may be described in terms of the concentration and state (dissolved or particulate) of some or all of the organic and inorganic material present in the water, together with certain physical characteristics of the water. One purpose of a monitoring program is, therefore, to gather sufficient data (by means of regular or intensive sampling and analysis) to assess spatial and/or temporal variations in water quality. Water quality index which was first developed by Horton in 1965 has been successfully applied in water quality assessment studies in various region of the world under various names such as weighted Arithmetic water Quality index (WAWOI), National Sanitation Foundation Water Quality index (NSFWQI), Canadian Council of Ministry of the Environment Water Quality Index (CCMEWQI), Oregon Water Quality Index (OWQI). (Cute, 2001, Chaturvedi & Bassin, 2010, Sing et al., 2013a, Fadai and Gafari, 2015). The uniqueness of the use of the water quality index is that it provides the composite influences of individual water quality parameter in the overall quality of water (Sing et al, 2013). Accordingly, water with a quality index range of 90-100 is classed I and is its quality is described as excellent, 70-90 is classed II and its quality is described as good. 50-70 is classed III and its quality described as median 25-50is classed IV and its quality is described as bad and 0-25 is classed and its quality described very bad. (Deepika & Sind, 2015). Information on the quality of surface water using Physiochemical and Biological parameter in most streams and rivers in Nigeria is scanty, hence the need for this research.

Material and Methods

Study Area

Olamaboro is located Kogi state, Nigeria on latitude 6°50’0N, 7°30’0N of the equator and longitude 7°20’0, 7°40’0 E of the Greenwich meridian (Fig 1).

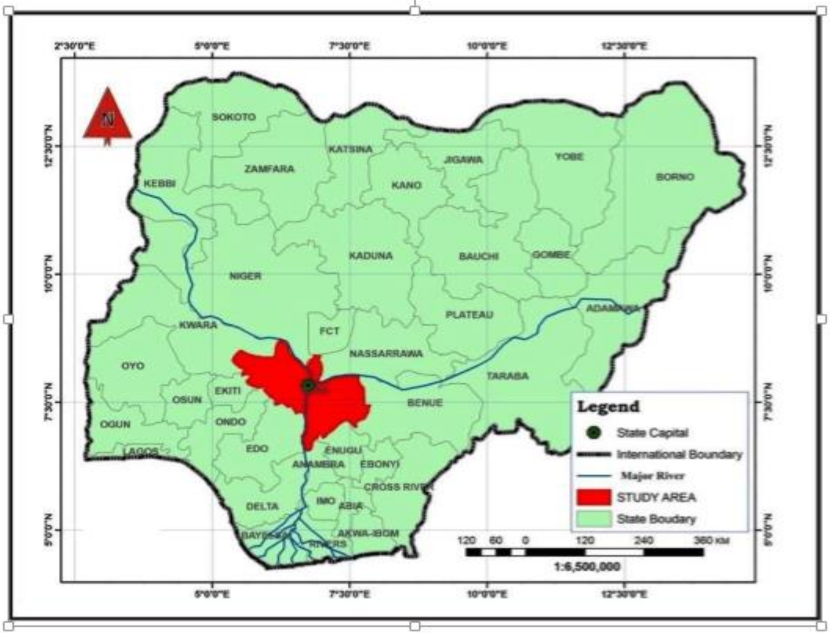

Figure 1.1: Kogi State within Nigeria Nigeria contex.
Source: Department of Geography, Kogi state University,Nigeria

Figure 1.1.: Olamaboro region within the context of Kogi State
Source: Google map**.**

Sampling design and Methods of data collection

Water samples were collected from four sampling points label I (odo-eto okpo), II (Ogugu), III (ikeja-Igah), IV (Agala-Igah) Table 1 and 2. Were purposefully selected to assess the variation in physicho-chemical and bacteriological characteristics and classify the water quality of the rural communities use for domestic ad agricultural purposes using water quality index. Samples were collected in sterile bottles and sent to an accredited laboratory for analysis. Physical parameters (turpidity, TDS), six chemical parameters (Chloride, nitrogen, Dissolved oxygen, Biochemical oxygen demand and PH) were analise while biological parameter (,echoli cell) were also analise by standard methods of APHA (1995) for their physical, chemical and Biological characteristics.

Samples were collected at the onset of the raining season in May and analyse using Hannah conductivity meter H19813-6 and Flame photometer. All sapling locations were geo-located using GARMIN 76 hand held GPS equipment (Fig1.1). Results obtained from physical, chemical and microbiological parameters were transferred to a weighting curve/ chart from which numerical values were obtained

RESULTS AND DISCUSION

Table 1.Result of Water sample site 1. Odo-eto okpo

Parameters	**Mean ± SD**
Temperature (C)	24.2±0.4
Dissolved Oxygen (mg/l)	7.0±0.2
Conductivity (µcm)	86.8±4.0
pH	7.4±0.1
Turbidity (mg/l)	9.6±5.8
Color variation (mg/l)	4.6±4.3
Odor (mg/l)	73.9±4.1

Source: Field survey, 2022

Result of the physiochemical characteristics of the rural communities in Odo-eto, okpo were presented in the table 1 above. 100 ml result of the individual parameter shows that Dissolve Oxygen (DO) level of 7.0± 0.2 were within the acceptable range of 3.0-7.0mg/1 for drinking water by NIS, 2007, WHO, 2011) and agrees with those of Ogamba and Ebere (2017). The observed Hydrogen ions concentration (PH) level of 7.4 ±0.1 were within the recommended range of 6.5- 8.5mg/1 for drinking water (NIS, 2007, WHO, 2011) were found to be similar to those of (Inengite et al., 2010 and Aghoghohiwia and Ohimain, 2014). Result concerning turbidity level showed a mean 95.8 with Standard Deviation of 5.8 NTU was rejected because, the observed value were above the permissible value (NIS, 2007 and WHO, 2011). Permissible value of 5.00 NTU. Color variation level showed mean value of 4.6 which is within the recommended value (UN, 1990, UN, 1993) permissible value 5.0mg/1

Table 2. Result of water sample site II, III, IV surface water'

Parameters/Sample ID	Ogugu	Ikeja-Igah	Agala-Igah
pH	5.80	5.20	7.10
EC (µS/cm)	0.01	0.00	0.00
TDS (mg/1)	12.00	6.00	20.00
Concentration in mg/1			
Na^{2+}	7.00	5.80	5.60
K^{2+}	3.10	1.10	3.70
Ca^{2+}	16.60	16.00	16.40

Source: Author's field work 2022

Result of the mean Physiochemical and Biological characteristics of water sampled in site II, III, IV Were presented in Table 2 above. Result of the individual Parameter showed that the observed Hydrogen ion PH for water sampled site II is 5. 8 while that of sampled site III is 5.20 which were below the recommended range of 6.5- 8.5 for drinking water (NIS, 2007, WHO, 2011). Sampled site IV has PH value of 7.10 which is within the permissible range of 6.5 – 8.5 for drinking water (NIS, 2007, WHO, 2011). The observed value for Total Dissolved Solids result were 1200, 600, and 2000 for water sampled site II, III, IV respectively were not within the recommended value of (500 Mg/1) by the National Guideline and Standard for Water Quality in Nigeria and the WHO (NIS, 2007, WHO,2011). Concentration of calcium in the water sampled site II, III, IV is above the recommended value of 7, 5 mg/1 by the (UN, 1990, UN, 1993), Urban Water resources water management. The findings could suggest pollutants from Agricultural activities such as fertilizer which could increase the concentration of Calcium in the water body. Similarly, water sample from site II indicates the presence of faecal pollutant in the water body which may be unhygienic for human consumption.

CONCLUSION AND RECOMMENDATIONS

The paper examine Surface Water Quality among rural communities in Qlamaboro Local Government Area of Kogi State using Physiochemical and Bacteriological parameters. Findings reveals that most of the water sampled are acidic, hard and polluted. Water Safety Plan is very crucial in protecting surface water from contamination. Catchment protection aims to decrease the amount of contamination that enters the water resource thereby reducing the amount of treatment that is required to supply safe and clean water. Hazard in the catchment may arise from both human and natural factors, it is important that the influence of all factor is understood before effective control measures including treatment are considered.

Policies may be required to cover the basic components of source protection, minimum treatment requirement using the multiple barrier principle and distribution management. The capacity of water users to shape the Government's water policy is multidimensional. As citizens, they may state water policy through the way they use their vote. These are critical component in ensuring that water supplies continue to provide high quality drinking water

Recommendations

The study recommends that

1. Public private partnership in water services should be sought as strategies in financing water infrastructure
2. It is necessary to educate the community on the need to protect water body from contamination and to have a sense of ownership of water body.
3. Household intervention. On point of use water treatment and improve water storage practice reduce the bacteriological contamination of water held in the home.

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