Evaluation of Nitrites, Nitrates and Phosphate from Surface Water of the Conakry City: Case of Lake Sonfonia

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Abstract: Conakry town, the economic hub of Guinea, suffers from a huge problem of water as well in quantity as in quality, just like in most of African countries. Although they are available, surface waters are poorly exploited. With a view to knowing the condition of surface waters so as to integrate them at best into the management of their environment and the public health of the populations the study has been focused on the concentration of nitrites, nitrates and phosphates of the waters of Lake Sonfonia as well as on the physicochemical parameters such as: the temperature, the pH, the conductivity, the chemical need in oxygen, the turbidity and the suspended matter. The samples have been taken during the low flow end and 5 areas of sampling have been selected randomly according to the direction of the water flow. The results obtained allow to conclude that the waters of Lake Sonfonia offer no danger to drinking water production and as far as the aquatic flora and fauna is concerned.

Key words: Surface water, physicochemical, nitrate, nitrite, phosphate, lake

INTRODUCTION

Conakry is experiencing a rapid population growth. In 1996, it had about 1 million inhabitants and in 2009, it was estimated at nearly 2 million people which means an increase of almost 100% over 12 years that is to say 6270 inhabitants km^2 so, it alone has 17% of the Guinean population. At the central part of the city and in the new suburban areas, the water supply is still non-existent or inadequate.

It is estimated about 58% the number of people who have access to safe water and 70.8% of households in the lower Guinea get their water from traditional springs, according to the Survey of Guinea Demographic Health published in 1999.

The supply of people with drinking water is provided primarily by improved wells and boreholes which implementation costs are high and out of reach of the communities and populations (Diallo, 2006).

However, the potential groundwaters are poorly known and we can expect shortages of groundwaters due to the recurrent effects of climatic variability (NAPA, 2007). Unfortunately, although surface waters are available and can be used to supply drinking water to people (NAPA, 2007) and to fight poverty (through better

environmental management), they are poorly exploited (Diallo, 2006). The insufficient urbanization, sanitation facilities and refuse dumps are almost nonexistent, wild piles of garbage, sewage stagnating in the gutters and the dispersion of human and animal excreta potentiate the pollution of surface waters; in fact, only 36% of the populations have access to latrines.

The uncontrolled development of surface waters in such an environment without regard to the standards and the morphological characteristic may cause pollution. Thus, high concentrations of nitrites, nitrates and phosphates can lead to eutrophication (Idrissi, 2006) and methemoglobin, respectively (Stanbury, 1983) renal insufficiency and osteoporosis which therefore, represent a danger to the environment and the public health of populations.

The present study aims to determine the status of surface waters in view of their better integration in the management of the environment and the health public of populations.

MATERIALS AND METHODS

Presentation of the application area: The application area chosen for the study is the urban district of Ratoma

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Fig. 1: Lake Sonfonia

located at 9.583°North latitude and 13.658°West longitude. It is located in the Northwestern part of the peninsula of urban district Kaloum and covers an area of 62 km². It is bounded on the East by the urban district of Matoto, on the West by the Atlantic ocean, South by the urban district of Dixinn and North by the Atlantic ocean and the prefecture of Kaloum (Consultants, 2007).

The urban district of Ratoma is drenched with an average rainfall of 4000 mm per year; the climate is tropical and characterized by the alternation of 2 seasons: the dry season and the rainy season with an average annual temperature of 27°C (Consultants, 2007). The current water supply is insufficient and very old. Some lines are several years old and have certainly experienced a number of damage.

The main sources of water are surface waters (Lake Sonfonia) and groundwaters (traditional wells, springs). Lake Sonfonia is located in the urban district of Ratoma. It is an artificial lake approximately 1 mile wide which was built in the 1970s to irrigate vegetable crops and vegetables in the plains. Its geographical coordinates are: North (9°41'0.52"N); South (9°40'20.46"N); East (13° 34'22.15"W) and West (13°35'2.79'O).

Lake Sonfonia has no planning. It is bordered by dilapidated homes, fields of growing vegetables, garbage deposits and at some parts of cinder block factory, laundry automobile. It is the main point of water (laundry, household, etc.) for the lakeside residents who suffer from a lack of drinking water supply.

Selection of sampling areas: In order to control the receiving environment, 5 areas have been randomly selected, taking into account the direction of the current which is North-East to the North-West (Fig. 1) that is to say, 3 in the center of the lake, 1 upstream and 1 downstream noted: zone 1-5. The composition of the surface waters is more or less variable from days, months and seasons. It has been difficult to satisfactorily perform a sampling technique and we have resorted to the instant sampling which has the advantage of reducing the risk of precipitation, absorption, concentration or evaporation. All samples have been taken during the low flow end in September 1998.

Water samples were collected in polyethylene bottles that were washed with hydrochloric acid in half and rinsed with deionized water and stored at 4°C above and then transported to the laboratory within a period not exceeding 4 h.

Analysis of nitrites, nitrates, phosphates, chemical oxygen demand and suspended solids was carried out using a spectrometer (DR/2000) which principle is based on the molecular absorption law. The determination of the pH, the temperature, the conductivity and the turbidity was performed, respectively using a pHmeter (Metrohm pH Lab 827 Ù), conductimeter (conductimeter Iniko CTM) and a turbidimeter (Hach 2100P turbidimeter). The methods used for the various tests are those approved by the Environmental Protection Agency (EPA-USA) and the French Association of Normalization (AFNOR). Analyses were determined in triplicate and statistical analyses of results were performed with ANOVA.

RESULTS AND DISCUSSION

The physicochemical study performed on different waters taken enable to describe many things:

Table 1: Physico-chemical parameters of the waters of Lake Sonfonia

Settings	Harvesting areas					
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Average weekly±standard deviation
Temperature (°C)	26.55	27.70	27.15	27.45	26.93	27.16±0.45
pH	6.35	7.09	7.52	7.60	8.09	7.33±0.65
Conductivity ($\mu s\ cm^{-1}$)	19.17	10.33	5.33	2.50	1.33	7.73±7.37
COD (mg L^{-1})	0.00	3.50	6.00	6.83	1.67	3.60±2.87
Turbidity (NTU)	3.40	4.70	3.80	3.88	3.53	3.86±0.25
TSS (mg L^{-1})	1.67	4.17	4.00	3.50	4.33	3.53±1.09
Nitrites (mg L^{-1})	0.04	0.04	0.06	0.05	0.05	0.05±0.01
Nitrates (mg L^{-1})	9.94	10.74	11.38	8.69	11.71	10.49±1.21
Phosphates (mg L^{-1})	0.27	0.19	0.18	0.22	0.27	0.23±0.04

Impact of discharges on the physicochemical quality of the lake waters: Statistical analysis of the results (Table 1) of the temperature, the chemical oxygen demand, the turbidity, the suspended matter, the nitrites, the nitrates and the phosphates of the Lake Sonfonia have not proved to be significant at the threshold (5%). This apparent difference between the averages obtained is due to the precision of the equipment used during the determination and the random sampling.

Nevertheless, the results indicate significant differences for the pH (between zone 1, zone 3, 4, 5 and between zones 2, 5) and the conductivity (zone 1 between zone 2, 3, 4, 5 and between zone 2 and zones 4, 5). This pH variation is explained by the fact that the acidity of the water is caused by the dissolution of the atmospheric CO_2 in relation to the photosynthesis. This acidity increases with the presence of sulfur dioxide (SO_2) and the oxides of Nitrogen (NO_x) which are air pollutant, resulting mainly from the burning fossil fuels. As for the variation of the conductivity, it is due to the mineralization of the emissions released by human activities and the increases in temperature that cause the concentration of dissolved minerals in water evaporation.

Assessment of the degree of the contamination of the lake: The comparison of the different contents obtained for the analyzed waters compared with the maximum acceptable values set by the World Health Organization (WHO) and the European Union and other U.S. and Canadian standards permits to conclude that the temperature of Lake Sonfonia value is not conformed to the standard of the European Union for water intended for human consumption. As for the environmental quality, it is acceptable and it gives the water a potential to significantly reduce the number of taxa polluo-sensitive with a satisfactory diversity.

The pH, the conductivity, the chemical oxygen demand and the turbidity are respectively conformed to the French standards and Canada (NPHIQ, 2003) for the water intended for human consumption. As to the environment it is very good, it gives the waters a potential to host a large number of taxa polluo-sensitive with a

satisfactory diversity. The suspended solids, the concentrations of nitrite and phosphate levels are respectively in accordance with French norm (Mission Inter Water), U.S. (WHO, 2002), the European Union (French Government, 1989) and WHO (2000) for water intended for human consumption. As to the environment it is good, it gives the water a potential to cause the disappearance of certain taxa polluo-sensitive with a good diversity.

The nitrate levels are conformed to the U.S. standards (WHO, 2002) and the European Union (French Government, 1989) for water intended for human consumption. As to the environment it is fair, it gives the water a potential to significantly reduce the number of taxa polluo-sensitive with a satisfactory diversity.

CONCLUSION

The results obtained show that the quality of the lake waters is a fairly good with some heterogeneity in their composition. The lake still suffers from the bad influence of waste in the city. The comparison of the results obtained in different areas of distinct samples shows the direct impact of discharged waters on the physicochemical quality of the lake to the occurrence of the pH and the conductivity. In fact, the organic charges and inorganic provide by used water of household and runoff tend to be too important to be degraded by natural self-purification. This study shows that the waters of Lake Sonfonia are suited to producing drinking water although, it is true that Lake Sonfonia suffers from the bad influences of various discharges. The waterfront development and sewerage would very probably improve the quality of these waters.

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