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Assessment of water quality of the Nossa Senhora das Dores-SE reservoir

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INTRODUCTION

Population growth, the search for high economic levels, and water wastage are the main factors of the emerging environmental impacts of society. They are also observed by the large number of dumps, contaminated rivers and social inequality.

The management of these socio-environmental disequilibrium vectors is the crucial point for sustainable development.

According to the National Water Agency - ANA (2011), significant amounts of inadequately treated sewage, industrial and agricultural effluents are being dumped daily in the world's waters. Rivers, lakes and ponds absorb the organic load of the entire watershed, in the form of pollution.

In view of this context, the present work was carried out in the municipality of Nossa Senhora da Dores-SE, with the objective of evaluating the physical-chemical and microbiological characteristics of public water, the main water course which cuts the municipality, among 2014 and 2016. Establish the grouping of the various variables in order to propose a preliminary water quality index, demonstrating the changes in water quality in the reservoir for different uses.

METHODOLOGICAL PROCEDURES

Study area

The studied reservoir is located in the municipality of Nossa Senhora das Dores, central region of the State of Sergipe - BRAZIL. It belongs to the sub-basin of the Siriri River, integrated to the Basin of the Japaratuba River, Figure 1.

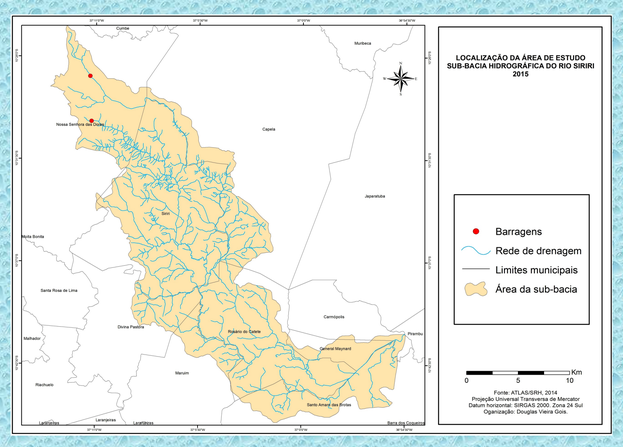

Figure 1. Location of the study area Sub-basin of the Siriri River.

Sampling Period

According to the climatic classification of Köppen, the municipality is partially inserted in the drought polygon, presents dry and sub-humid metamorphic climate, transition to semi-arid, average annual temperature of 24.6 °C, average annual rainfall of 1,056.4 mm and rainy season from March to August.

Sampling steps

To obtain good results it is necessary that the procedure in the field is well executed. The sample space is extremely important and should be as representative as possible for the area to be studied. Thus, for the reservoir, the samples were collected in three points distributed between the margins and the center. The collections started in January/2014 and completed in October/2016, totaling 10 campaigns.

The variables measured were Total Phosphorus (P_{total}), Total Nitrogen (N_{total}), Turbidity (Turb), Total Dissolved Solids (STD), Dissolved Oxygen (OD), pH, Electrical Conductivity (Cond), Thermotolerant Coliforms Chlorophyll (Cfila-a). The methodology adopted was the analysis of parameters according to the Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 20th ed. APHA (1998).

Statistical analyzes

For the statistical analysis, the data was worked by the methods of descriptive and bivariate statistics (Matrix of Correlation). The calculations of mean, standard deviation, maximum and minimum value were performed in the Excel™ worksheet. For the analysis of water quality variables, the R software for Windows correlation matrix was used. Through the analysis of basic statistics it is possible to identify the existing discrepancies between the data, for bivariate, the physical, chemical and microbiological variables can be grouped in common data.

RESULTS AND DISCUSSIONS

During the monitoring period of the water quality of the Municipality of Nossa Senhora das Dores, the maximum, minimum and mean values, as well as the standard deviation of the results of the physical and chemical and microbiological analyzes carried out on the samples collected are described in Table 1. In it we can observe that thermotolerant coliforms have the highest average and highest standard deviation, these organisms give an indication of water contamination by fecal material (human or animal), and therefore demonstrate the potentiality of water to transmit diseases.

Table 1 - Basic descriptive statistics of the variables studied during the period from February / 2014 to January / 2016.

Parameters	Mean	Stand. Dev.	Maximum	Minimum
Turbidity (NTU)	96.57	63.46	204.15	31.1
TDS ($mg.L^{-1}$)	170.95	112.82	358.00	48
DO ($mg.L^{-1}$)	7.40	1.19	8.38	4.84
N_{total} ($mg.L^{-1}$)	10.73	15.67	44.24	0.448
P_{total} ($mg.L^{-1}$)	0.071	0.051	0.109	0.003
TC ($NMP.100mL^{-1}$)	$2.86x10^{-4}$	$6.4 x10^{-4}$	$1.60 x10^{-7}$	$1.30 x10^{-3}$
EC / $\mu S.cm^{-1}$	462.06	138.26	730.00	312.00
Clo-a ($\mu g.L^{-1}$)	98.93	40.39	139.98	25.98
pH	7.78	0.79	8.84	6.91

In Table 2, the Pearson Correlation Matrix is described for the water quality variables in the municipality of Nossa Senhora das Dores. This method is used to measure the correlation between two variables through the Pearson Linear Correlation Coefficient, where ρ is the correlation coefficient for the bivariate normal population, and ranges from -1 to +1

Table 2 - Correlation matrix of water quality variables in the municipality of Nossa Senhora das Dores.

Variables	Clo-a	TC	EC	Ntotal	DO	pH	P_{tot}	TDS	Turb
Clo-a	1.000								
TC	-0.378	1.000							
EC	0.091	0.162	1.000						
N_{total}	-0.239	-0.080	0.133	1.000					
DO	-0.598	0.193	0.303	0.685	1.000				
pH	-0.569	-0.313	0.078	-0.200	0.238	1.000			
P_{tot}	0.921	-0.640	0.197	-0.042	-0.475	-0.352	1.000		
TDS	0.406	0.247	0.910	0.019	0.036	-0.294	0.394	1.000	
Turb	-0.120	0.766	-0.004	0.031	-0.208	-0.564	-0.315	0.193	1.000

In the results obtained by the correlation matrix, the value of ρ equal 0,921 between the total phosphorus and chlorophyll a, showed a strong correlation between the parameters. Specifically, chlorophyll a is an indicator of the presence of macronutrients such as phosphorus and nitrogen, whose growth is directly related to their increase, Aguiar Netto et al. (2013).

The grouping between total dissolved solids and electrical conductivity can also be observed with a considerable value of ρ equal to 0.91. The electrical conductivity is a very significant parameter, regarding the intrusion of ions in the water body.

In contrast, the variables P_{tot} and TC obtained the lowest value of ρ equal to -0.640, for the parameters of total phosphorus and thermotolerant coliforms.

CONCLUSION

Among the parameters studied here, the concentrations of chlorophyll a, total phosphorus, turbidity, electrical conductivity and thermotolerant coliforms are outside the limits established by the pertinent environmental legislation, suggesting that Nossa Senhora das Dores reservoir possesses considerable environmental changes, possibly originating of domestic effluents.

The grouped variables which presented values of ρ close to 1, such as chlorophyll a and total phosphorus, electrical conductivity and total dissolved solids, evidenced an eutrophic environment, allowing the construction of a water quality indicator for a more detailed analysis.

Acknowledgement: