APPLICATION OF THE WATER QUALITY INDEX IN A STRETCH OF THE SAMPÁIO RIVER BASIN

José Antonio Rodrigues de Souza¹
Débora Astoni Moreira²
Ellen Lemes Silva³
Soraya Carmelita Novaes Thomazini⁴
Nelson Donizete Ferreira⁵
Helaine Cavalcanti Mello⁶

ABSTRACT

Purpose: Study the interference of anthropic activities in the quality of water located in the urban perimeter of the municipality of Pires do Rio - GO.

Method/design/approach: The literature review demonstrates that the Water Quality Index can be used for comparative studies between stretches of the river and/or river basins.

Results and conclusion: The values of the IQA indicated that the collected samples have “good” quality, except the points that are part of the ETE, which has “poor” quality. When considering, however, the results obtained from microbiological analyses, the values of thermotolerant coliforms, show a high contamination of fecal origin, making the consumption “in natura”.

Research implications: It is recommended that it be reconciled urbanization and preservation, through environmental zoning, as well as investments in public sanitation, especially with regard to the treatment of collected effluents.

Originality/value: This study determines the Water Quality Index of Sampaio river that has great relevance for the region of the municipality of Pires do Rio.

Keywords: Water Resources, Monitoring, Water Management, Hidrography.

APLICAÇÃO DO ÍNDICE DE QUALIDADE DE ÁGUA EM UM TRECHO DA BACIA DO RIBEIRÃO SAMPÁIO

RESUMO

Objetivo: Estudar a interferência das atividades antrópicas na qualidade das águas localizadas no perímetro urbano do município de Pires do Rio - GO

¹ Instituto Federal Goiano Campus Urutai, Urutai, Goiás, Brazil. E-mail: joseantonio@ifgoiano.edu.br
Orcid: https://orcid.org/0000-0003-3024-9424
² Instituto Federal Goiano Campus Urutai, Urutai, Goiás, Brazil. E-mail: debora.astoni@ifgoiano.edu.br
Orcid: https://orcid.org/0000-0002-8658-1269
³ Universidade Estadual do Oeste do Paraná (UNIOESTE) Campus Cascavel, Cascavel, Paraná, Brazil. E-mail: ellen.1910s@gmail.com Orcid: https://orcid.org/0000-0001-5649-5055
⁴ Instituto Federal Goiano Campus Urutai, Urutai, Goiás, Brazil. E-mail: sorayathomazini@yahoo.com.br
Orcid: https://orcid.org/0000-0002-7443-1052
⁵ Instituto Federal Goiano Campus Urutai, Urutai, Goiás, Brazil. E-mail: nelson.ferreira@ifgoiano.edu.br
Orcid: https://orcid.org/0000-0001-5123-9116
⁶ Instituto Federal Goiano Campus Urutai, Urutai, Goiás, Brazil. E-mail: helainemelloppdr@hotmail.com
Orcid: https://orcid.org/0009-0008-2723-6183
Referencial teórico: A revisão bibliográfica demonstra que o Índice de Qualidade de Água pode ser utilizada para estudos comparativos entre trechos do rio e/ou de bacias hidrográficas, bem como indicar a qualidade da água.

Método: O estudo foi conduzido em um trecho urbano da microbacia do ribeirão Sampaio, pertencente à bacia do Rio Paranaíba. Amostras de água foram coletadas no período seco e de chuva, determinando-se o Índice de Qualidade de Água

Resultados e conclusão: Os valores do IQA indicaram que as amostras coletadas apresentam “boa” qualidade, exceto os pontos que fazem parte da ETE, que apresenta qualidade “pésima”. Ao considerar, entretanto, os resultados obtidos das análises microbiológicas, os valores de coliformes termotolerantes, evidenciam uma alta contaminação de origem fecal, inviabilizando o consumo “in natura”.

Implicações da pesquisa: Recomenda-se que seja conciliado urbanização e preservação, por meio do zoneamento ambiental, bem como investimentos no saneamento público, sobretudo no que se refere ao tratamento dos efluentes coletados.

Originalidade/valor: Este estudo determina o Índice de Qualidade de água do ribeirão Sampaio que apresenta grande relevância para a região do município de Pires do Rio.

Palavras-chave: Recurso Hídrico, Monitoramento, Manejo, Hidrografia.

**APLICACIÓN DEL ÍNDICE DE CALIDAD DEL ÁGUA A UN TRAMO DE LA CUENCA DEL RÍO SAMPAIO**

**RESUMEN**

Objetivo: Estudiar la interferencia de las actividades antrópicas en la calidad de las águas localizadas en el perímetro urbano del municipio de Pires do Rio – GO.

Marco Teórico: La revisión bibliográfica demuestra que el Índice de Calidad del Agua puede ser utilizada para estudios comparativos entre tramos del río y/o de cuencas hidrográficas, así como indicar la calidad del agua.

Método: El estudio fue realizado en un tramo urbano de la microbacia del Ribeirão Sampaio, perteneciente a la cuenca del Río Paranaíba. Muestras de agua fueron recogidas en el período seco y de lluvia, determinándose el Índice de Calidad del Agua.

Resultados y conclusión: Los valores del ICA indicaron que las muestras recolectadas presentan "buena" calidad, excepto los puntos que forman parte de la ETE, que presenta calidad "pésima". Al considerar, sin embargo, los resultados obtenidos de los análisis microbiológicos, los valores de coliformes termotolerantes, evidencian una alta contaminación de origen fecal, inviabilizando el consumo "in natura".

Implicaciones de la investigación: Se recomienda que sea conciliado urbanización y preservación, por medio de la zonificación ambiental, así como inversiones en el saneamiento público, sobre todo en lo que se refiere al tratamiento de los efluentes recolectados.

Originalidad/valor: Este estudio determina el Índice de Calidad del agua del Ribeirão Sampaio que presenta gran relevancia para la región del municipio de Pires do Rio.

Palabras clave: Recursos Hídricos, Monitoreo, Manejo, Hidrografía.

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1 INTRODUCTION

The movement and transformation of water in nature, called the hydrological cycle, occurs by means of different physical, chemical and biological processes. Anthropic actions inevitably enter these processes producing significant alterations, modifying this cycle and consequently bring with them relevant impacts for man and the environment, that is, it generates scarcity in terms of quantity and quality of water (MENEZES et al., 2009).

The growth of cities results in increased demand for energy and food production. In the past, when cities were smaller, the needs were also reduced, and consequently the environmental impact was also reduced (VASILIEV; BOLGOV, 2008). According to Santos (2007), the way in which the occupation of the space is done has caused successive and numerous environmental problems, such as degradation of the plant cover, loss of biodiversity, obstruction and alteration of the drainage network, transmission of diseases of water circulation, contamination and pollution of the air, water, soil, loss of productive land, triggering of erosive processes, among others.

It should be noted that the process of urbanization of Brazilian cities has been contributing to the distance between these and the watercourses, resulting in the loss of rivers as a landscaping, historical and cultural reference element, besides resolving their connectivity with the urban environment.

The UN (United Nations) has set seventeen sustainable development goals to meet the needs of the present generation and ensure the quality of life of future generations on an equal basis. Ensuring the availability and sustainable management of water and sanitation for all, aims to improve water quality by reducing pollution, eliminating dumping and minimizing the release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and increasing recycling and safe reuse worldwide.

In the present work, it was sought to carry out a survey of the situation of the micro basin of the Sampaio stream in Pires do Rio -GO, in terms of water quality, use and land occupation, generating data that serve as a diagnosis to subsidize management, research and future uses, characterizing the quality of the water of the micro basin with the use of a Water Quality Index (AQI).
2 THEORETICAL FRAME

Water is essential for the survival of all life forms due to its presence in various physical, chemical and biological processes, besides being necessary for multiple anthropic activities, such as supply, agro-industrial uses, electricity generation, tourism, leisure, fishing, among others (COSTA, 2022). Despite this, it is also one of the main forms of pathogen diffusion (SAAD et al., 2007), due to unbalanced and unsustainable use caused by agricultural, livestock and urbanization activities, which have as a consequence the degradation of water resources and aquatic habitat, the increase of water pollution and the decrease of its biodiversity, compromising the guarantee of the use of water resources for the present and future generations (SOARES; FERREIRA, 2017).

Water quality is closely linked to its physical, chemical and biological characteristics, and its condition is a function of the different uses for which it is intended (ABREU; CUNHA, 2015). The changes that occur in the characteristics of the river basin and that somehow alter the balance and dynamics of the bodies of water are associated with the pollution existing in the territory (POLETO, 2014).

Water potability is assessed by means of analyzes corresponding to physico-chemical tests (color, turbidity, electrical conductivity, temperature, pH, alkalinity, total hardness, etc.) and microbiological methods (coliforms and thermotolerants, and aerobic mesophilic bacteria) in accordance with the resolutions of the National Environment Council (CONAMA). The various uses of water place it as a fundamental good for the development of human activities, whether for domestic, commercial, public or agro-industrial consumption (HELLES, 2010), CONAMA 430/2011 (BRAZIL, 2011) 396/2008 (BRAZIL, 2008) and CONAMA 357/2005 (BRAZIL, 2005), and also according to Ordinance GM/MS No 88888888, Health (MS) (BRAZIL, 2021).

An important existing tool for addressing the water quality of the most varied water bodies is the Water Quality Index (AQI), which is used as an integrating methodology for converting various information into a single numerical result (CECCONELO; CENTENO E GUEDES, 2018), facilitating comprehension, and allowing for relative comparison between water systems (SILVEIRA et al., 2014; CUNHA et al., 2013).

The AQI was proposed by the National Sanitation Foundation (NSF), in the United States, in the year 1970. In Brazil, it has been used by several environmental bodies, which started to use it as a tool for environmental monitoring and decision support (SUN et al., 2016). The AQI takes into account the characteristics specific to each source (MORETTO et al., 2012)
and, in this way, each variable that makes up the index receives a weight according to its degree of importance (SUN et al., 2016).

Water resources play an important role in maintaining human life, ecosystems and population development (OLIVEIRA, 2017). This is justified by the fact that they are widely used for consumption by the population, food production, energy generation, among so many uses, and therefore have relevance for health, quality of life and the development of nations (ASSIS, 2017).

Thus, with this work the objective was to determine the AQI in a stretch of the Sampaio stream, located in the municipality of Pires do Rio - GO

3 METHOD

The study was conducted in an urban stretch of the micro-basin of the Sampaio stream, belonging to the Paranaíba River basin (Figure 1), which is used as one of the borders of urban and rural areas, as well as is responsible for the drainage of an area of 169.3 km², which corresponds to 15.77% of the area of the municipality of Pires do Rio - GO (DIAS, 2008). This is the source that supplies water to various rural properties, and receives raw sewage.

The climate of the region, according to the Köppen classification, is Cwa type, characterized as tropical humid, with dry winter and rainy summer, and presents rainfall and average annual temperature of 2000 mm and 28 °C, respectively (SOUZA et al., 2023). The predominant soil is Latossolo Vermelho, which occupies 87.37% of the total micro-basin (DIAS, 2008) and the mapping of the use and occupation of the land indicated a predominance of farming activities in 70% of the total area (LEMES, 2021).
The points chosen for monitoring water quality (Figure 2) were those that presented moderate access difficulties and separated rural and urban areas (Points A, B, H and I). Also, it was sought to monitor the efficiency of the effluent treatment system (ETE) and its impact on the watercourse, being delimited the sewage intake (Point C), effluents from the anaerobic ponds (Point D) and optional (Point E), as well as points at a distance of 100 m upstream (Point F) and downstream (Point G) of the treated sewage release point.
Figure 2

Location of monitored collection points in the Sampaio stream microbasin.

Source: Adapted from Google Earth.

In these samples, nitrate (SMEWW 4500 NO3 E - Cadm), phosphorus (SMEWW 4500-PE - Ascorbic Acid Method), total solids (ST) (SMEWW 2540 C - Total Dissolved Solids Dried at 180°C), dissolved oxygen (OD) (SMEWW 4500-O C - Azide Modification), biochemical oxygen demand (DBO) (SMEWW 5 were determined 10 B - 5 Days BOD Test), hydrogenionic potential (pH) (SMEWW 4500-H+ - Electrometric MethodTM), turbidity (SMEWW W 2130 - TurbityCE), electrical conductivity (CE) (SMEWW 2510 - Laboratory Method), total coliforms (Colif. Totals) and thermotolerants (Colif. Term) (SMEWW 9223 A, B - Enzyme Substrate Coliform Test10 according to the methodology described in APHA (2017).

From the collected data, the water quality index (AQI) was determined by means of the production of the nine parameters determined, according to Equation 1, according to Cetesb (2017):

\[ \prod_{i=1}^{n} q_i^{w_i} \]  

Equation 1

Of which:

- AQI = Water Quality Index (ranges from 0 to 100); qi = quality of the i-th parameter, obtained by means of the mean curve of the quality change of each parameter, as a function of the value obtained; wi = weight assigned to the i-th Parameter as a function of its relevance; n = thenumber of parameters (n = 9).
For discussion purposes, the parameters analyzed had their values compared to Resolution CONAMA 357/2005 (BRAZIL, 2005) for class II freshwater.

In Figure 3, images are presented of the points monitored during the dry and rainy period.

**Figure 3**

*Images of water collection points*
4 RESULTS AND DISCUSSIONS

Temperature is one of the standards, or organoleptic characteristics, of the quality of the waters coupled with the sensitivity of the living organisms, which make water attractive or not for consumption. When the temperature change of a water body is significant to the point of altering its quality, it is characterized as thermal pollution (Souza et al., 2015).

Table 1 shows the results of the physical characteristics of the nine points monitored in the micro-basin of the Sampaio stream.

Table 1

<table>
<thead>
<tr>
<th>Points</th>
<th>T (°C)</th>
<th>Turbidity (UNT)</th>
<th>ST (mg L⁻¹)</th>
<th>EC (µS cm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>24</td>
<td>22</td>
<td>49.8</td>
<td>12.60</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
<td>22</td>
<td>47.9</td>
<td>15.20</td>
</tr>
<tr>
<td>C</td>
<td>24</td>
<td>24</td>
<td>213</td>
<td>284.00</td>
</tr>
<tr>
<td>D</td>
<td>24</td>
<td>24</td>
<td>428</td>
<td>331.00</td>
</tr>
<tr>
<td>AND</td>
<td>24</td>
<td>24</td>
<td>167</td>
<td>70.80</td>
</tr>
<tr>
<td>F</td>
<td>24</td>
<td>22</td>
<td>67.3</td>
<td>13.30</td>
</tr>
<tr>
<td>G</td>
<td>24</td>
<td>22</td>
<td>70.7</td>
<td>16.20</td>
</tr>
<tr>
<td>H</td>
<td>24</td>
<td>22</td>
<td>64.6</td>
<td>16.00</td>
</tr>
<tr>
<td>I</td>
<td>24</td>
<td>22</td>
<td>46.4</td>
<td>14.50</td>
</tr>
</tbody>
</table>

Chuv. = rainy; Est. = dry; T = temperature; ST = total solids; EC = electrical conductivity.

It is observed, in Table 1, that the observed temperatures (22ºC - 24ºC) for both seasons of the year, and even downstream of the launch of the ETE, reflected only changes in their levels due to the increase in air temperature throughout the collections, since the municipality presents humid tropical climate, with average annual temperature ranging between 23°C and 26°C (RODRIGUES, 2018).

Although turbidity may be natural, causing no direct health inconvenience, it is aesthetically unpleasant in drinking water, and suspended solids may serve as shelter for pathogenic microorganisms (MELO, 2016).

As expected, the turbidity in the rainy period is higher than that in the dry period due to the charging of solid particles. According to Resolution CONAMA 357/2005, for Class II rivers, the maximum allowed value in water is up to 100 UNT, all points below the established limit, except points C, D and E, which refer to sewage directed to the treatment plant.

It is observed that higher values of turbidity were obtained in the rainy period, which is justified by the carrying of solid sediments by the surface runoff. Also, it is possible to note that
there was no difference in the value of turbidity upstream and downstream from the point of release of the sewage.

The solids in the waters correspond to all matter that remains as waste after evaporation, drying or calcination of the sample at a pre-set temperature for a fixed time (CETESB, 2016). It has a direct relationship with turbidity, with higher values occurring the greater the amount of solids. Thus, it was found that the values of total dissolved solids are within the standards of up to 500 mg L\(^{-1}\) since Resolution CONAMA 357/2005 does not establish maximum values.

According to CETESB (2013), electrical conductivity is an indirect measure of the anthropic effect, as it depends on ionic concentrations and temperature, indicating the amount of salts in water. There are no reference values for conductivity in CONAMA Resolution 357/2005, however values between 10 and 100 ms cm\(^{-1}\), for natural waters, have been described by von Sperling (2014) as unpolluted waters. Thus, it is verified that all the points monitored were not polluted, being the highest values, those that refer to sanitary sewage.

Regarding the removal efficiency of turbidity and total solids, there is a reduction of 21.68% and 39.83% in the rainy period and 75% and 66.22% in the dry period, respectively.

Table 2 shows the results of the chemical characterization of the waters of the Sampaio stream, at the points monitored.

**Table 2**

<table>
<thead>
<tr>
<th>Points</th>
<th>pH</th>
<th>N-NO(_3) (mg L(^{-1}))</th>
<th>PO(_4^{3-}) (mg L(^{-1}))</th>
<th>DBO (mg L(^{-1}))</th>
<th>OD (mg L(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.14</td>
<td>6.20</td>
<td>NA</td>
<td>5.12</td>
<td>0.0175</td>
</tr>
<tr>
<td>B</td>
<td>7.00</td>
<td>6.70</td>
<td>NA</td>
<td>2.65</td>
<td>0.0088</td>
</tr>
<tr>
<td>C</td>
<td>7.25</td>
<td>7.00</td>
<td>NA</td>
<td>1.48</td>
<td>0.2942</td>
</tr>
<tr>
<td>D</td>
<td>7.67</td>
<td>7.00</td>
<td>NA</td>
<td>2.79</td>
<td>0.3183</td>
</tr>
<tr>
<td>AND</td>
<td>7.82</td>
<td>7.80</td>
<td>NA</td>
<td>1.78</td>
<td>0.2450</td>
</tr>
<tr>
<td>F</td>
<td>7.54</td>
<td>7.90</td>
<td>NA</td>
<td>1.34</td>
<td>0.0150</td>
</tr>
<tr>
<td>G</td>
<td>7.54</td>
<td>7.60</td>
<td>NA</td>
<td>0.03</td>
<td>0.0160</td>
</tr>
<tr>
<td>H</td>
<td>7.52</td>
<td>7.40</td>
<td>NA</td>
<td>4.25</td>
<td>0.0115</td>
</tr>
<tr>
<td>I</td>
<td>7.39</td>
<td>7.40</td>
<td>NA</td>
<td>8.61</td>
<td>0.0083</td>
</tr>
</tbody>
</table>

Est. = Drought; Rain. = rainy; ND = not detected; pH = hydrogenionic potential; PO\(_4^{3-}\) = total phosphate
N-NO\(_3\) = nitrogen in the nitric form; DBO = biochemical oxygen demand; OD = dissolved oxygen.

The pH is a measure of the concentration of hydrogen ions in a solution, i.e., it expresses the degree of acidity or basicity of a solution, representing the active concentration of hydrogen ions (H\(^+\)) in it. In water supply, pH may increase the effect of chemicals that are toxic to organisms. Thus, the pH of the water needs to be controlled, allowing the carbonates present to be balanced (MELO, 2016).
The observed pH range (6.20 to 7.90) is considered normal, in accordance with the surface water quality standard of CONAMA Resolution 357/2005 for Class II rivers (6 to 9.5), and no spatial pattern of occurrence is evidenced.

The presence of nitrogen compounds in their different oxidation states is indicative of contamination of the aquifer and of possible unsatisfactory sanitary and hygiene conditions. Although nitrogen is an indispensable element for the growth of algae, in excess, it can bring about an exaggerated development of these organisms, a phenomenon called eutrophication.

Excess nitrate causes two adverse health effects, namely induction to methemoglobinemia, especially in children and the potential formation of nitrosamines and nitrosamides, both carcinogenic (SCORSAFAVA et al., 2010). Therefore, although the maximum permitted value established by CONAMA 357 resolution is 10 mg N-NO$_3$ L$^{-1}$ in drinking water, values higher than 5 mg L$^{-1}$ already consider that the water source is being contaminated (CORDEIRO, 2011). Thus, all the points monitored during the rainy period, including the effluent from the ETE, did not show concentrations of nitrate, while during the dry period, the A and I points showed values lower than those required for class 2 water.

Like nitrogen, phosphorus is an important nutrient for biological processes and its excess in water can cause eutrophication. According to Resolution CONAMA 357/05 the limits presented for slow environments present the maximum value of 0.030 mg L$^{-1}$ and, for intermediate environments, presents maximum value of 0.050 mg L$^{-1}$. Thus, it is also verified, in Table 2, that all the points referring to the sewage showed values of phosphorus above the range established by CONAMA 357/05.

The BOD represents the amount of molecular oxygen required to stabilize aerobically decomposed organic matter by biological means (MOTA, 2012). This parameter is used to express the value of pollution produced by organic matter, which corresponds to the amount of oxygen that is consumed by microorganisms from sewage or polluted waters, in biological oxidation, when kept at a given temperature for a conventional time (MATOS et al., 2023).

For Resolution 357/05 of CONAMA establishing limit for Class 2 rivers, which stands out maximum of 5mg L$^{-1}$, all points assessed in the period of drought and rainy were at odds with the value of DBO higher than that recommended by the legislation. In relation to the treatment system, there was a reduction of 77.22% in the rainy period and 84.05% in the dry period.

Dissolved oxygen (OD) is a limiting factor for maintaining aquatic life and self-purifying processes in natural aquatic systems. During the degradation of organic matter,
bacteria use oxygen in their respiratory processes, which can cause a reduction in their concentration in the medium (CETESB, 2013).

The oxygen concentration in the water varies with atmospheric pressure (altitude) and with the temperature of the environment, typically with concentrations around 8 mg L\(^{-1}\) at 25°C in natural waters and at sea level. The OD was found to be above the minimum for aquatic life, with the exception of points for TEE.

The OD content is an indicator of organic matter pollution conditions. Therefore, an unpolluted water must be saturated with oxygen. On the other hand, low levels of OD may indicate that there was intense bacterial activity decomposing organic matter released into water (Mota, 2012). One of the most frequent causes of mortality in aquatic life is the drop in oxygen concentration in bodies of water. The minimum dissolved oxygen (OD) value for the preservation of aquatic life established by CONAMA Resolution 357/05 is 5.0 mg/L, but there is a variation in species-by-species tolerance.

The samples of the ETE effluents analyzed did not show OD rate, which was expected due to high concentrations of solids and turbidity, and did not present sources of oxygenation such as algae and turbulence. Another reason for the low values may be related to the amount of dissolved organic matter, which may be related to the values obtained for BOD in this study (FIORESE, 2019; MATOS et al., 2023).

The determination of the concentration of total coliforms is important as a parameter indicating the possibility of pathogenic micro-organisms responsible for the transmission of water-borne diseases. The presence of thermotolerant coliforms indicates the possibility of occurrence of other enteric pathogenic microorganisms in the water and the possibility of fecal contamination (SOARES; DA COSTA, 2020).

Microbiological analyzes of water at the monitored points are presented in Table 3. It appears that all the points analyzed showed total coliforms above the established limits. In relation to thermotolerant coliforms, it is also observed that all the points evaluated had a coliform count higher than the limit set by CONAMA 357/2005, which should not be exceeded to the limit of 1,000 NMP/100 mL.

It is important to point out that the presence of coliforms in the samples serves as indicators of fecal contamination, normally found in large quantities in domestic sewers. Scorsafava et al. (2010) and Costa (2022) point out that the direct consumption of untreated or even mishandled water can lead to cases of diarrhea, cholera, hepatitis, typhoid fever and even poliomyelitis when digested.
The Water Quality Index (AQI), encompasses nine parameters and represents an overview of water quality at a given monitoring point or station. It consists basically of a weighted product, where the result of multiple parameters is represented in a single value. This index has become an important tool for the evaluation of water quality, allowing comparison with bodies of water from other regions and countries (NSF, 2006). The AQI values in the nine points evaluated are presented in Table 4.

<table>
<thead>
<tr>
<th>Points</th>
<th>Drought AQI</th>
<th>Class</th>
<th>Rainy AQI</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td></td>
<td>Value</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>61.14</td>
<td>Good</td>
<td>58.77</td>
<td>Good</td>
</tr>
<tr>
<td>B</td>
<td>63.86</td>
<td>Good</td>
<td>53.53</td>
<td>Good</td>
</tr>
<tr>
<td>C</td>
<td>8.28</td>
<td>Terrible</td>
<td>9.57</td>
<td>Terrible</td>
</tr>
<tr>
<td>D</td>
<td>10.25</td>
<td>Terrible</td>
<td>10.23</td>
<td>Terrible</td>
</tr>
<tr>
<td>AND</td>
<td>13.05</td>
<td>Terrible</td>
<td>12.73</td>
<td>Terrible</td>
</tr>
<tr>
<td>F</td>
<td>60.38</td>
<td>Good</td>
<td>56.54</td>
<td>Good</td>
</tr>
<tr>
<td>G</td>
<td>55.08</td>
<td>Good</td>
<td>54.08</td>
<td>Good</td>
</tr>
<tr>
<td>H</td>
<td>53.23</td>
<td>Good</td>
<td>52.71</td>
<td>Good</td>
</tr>
<tr>
<td>I</td>
<td>57.28</td>
<td>Good</td>
<td>52.65</td>
<td>Good</td>
</tr>
</tbody>
</table>

The determination of the AQI in the microbasin of the Sampaio stream resulted in values that varied between 8.28 to 63.86 in the dry period and from 9.57 to 58.77 in the rainy period. The analyzes carried out during the experimental period determined that all sampling points presented the "Good" AQI, indicating that there is a need to perform at least simplified treatments such as chlorination. It is also apparent, as was expected, that the effluent from the TEE would present the worst AQI.
By analyzing the separate data, we can verify that all samples collected are unfit for human consumption "in natura" and must undergo treatment prior to consumption, since positive results for thermotolerant coliforms were detected in all samples analyzed.

The quality of the water sources monitored is directly associated with the characteristics of their location, such as reduced sanitation infrastructure, soil erosion and proximity to effluent discharge points. Thus, although the municipality has the privilege of having high water sources they are suffering from pollution, making it necessary to intervene in the micro basin in order to guarantee water quality and quantity for current and future generations.

5 FINAL CONSIDERATIONS

Water plays an extremely important and indispensable role in all forms of life, yet it is not always in a condition suitable for human consumption. In order for the human population to be able to consume water free from contamination, potability parameters provided by environmental bodies and laws must be considered.

Thus, the use of physical-chemical (turbidity, temperature, dissolved oxygen, pH etc.) and microbiological (Total Coliform and Thermotolerant Counts) analyzes as criteria for the evaluation of water potability. Based on these main indicators, it is sought to carry out evaluations in order to meet the water quality standards established in Brazil regulated by Ordinance GM/MS n°888, of May 4, 2021.

The AQI values indicated that the samples collected are of "good" quality, except for the points that are part of the TEE, which presents "bad" quality. When considering, however, the results obtained from the microbiological analyzes, the values of thermotolerant coliforms, show a high contamination of fecal origin, making it unfeasible to consume "in natura".

It is recommended to reconcile urbanization and preservation, through environmental zoning, as well as investments in public sanitation, especially with regard to the treatment of collected effluents.
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