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Pilot Study Of Anthropic Impacts Through Physicochemical Parameters From The Waters Of The Hydrographic Basin From District Of Caraparu In Santa Izabel Of Pará (Brazil)

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Abstract
Justification*:Due to the different types of use that the population of the district of Caraparu in Santa Isabel of Pará in Brazil make in the region's hydrographic basin, including for consumption and irrigation by some segments of the population, there is a need to monitor the quality of the water, to ensure preservation limnology and environmental health.*
Objective: *general, identify possible impacts of urban development on the limnological resources of the city of Santa Izabel of Pará; specific, identify possible risk agents for local environmental degradation; predict possible impacts on environmental health due to the degradation of limnological resources, among others.*
Methodology: *The sample were collected on November 22nd, 2023, in the morning. The pH was measured in the samples using a portable electronic pH meter and compared with test strips as a control. The electrical conductivity values of the water samples were measured using a portable electronic conductivity meter, expressed in µS/cm-1 (microSiemes per centimetre), as well as the sample temperature and Total Dissolved Solids. For environmental temperature, an environmental thermometer was used. The samples were subjected to multiparameter test strips with 3 tests for each sample to identify: alkalinity, lead, bromine, nitrate, nitrite, iron, chromium (VI), copper, mercury, fluoride, among others. The Secchi disc was used to evaluate turbidity, visibility in centimeters, among others. The qualitative observational method was used to obtain information regarding anthropogenic environmental pollution of the rivers studied and its surroundings and the presence of wild flora and fauna.*
Conclusions: *The Caraparu River is the main river in that hydrographic basin, having importance for local tourism, small agriculture and, in many cases, supplying supplies to populations in need of public policies; The Maguari River has almost the same characteristics, even because it is a tributary of the Caraparu River. In this sense, there is a need for monitoring to guarantee both economic and social functions for the district of Caraparu, in the Municipality of Santa Isabel of Pará.*
Key-Works:*Santa Izabel of Pará (Brazil), Environment, Caraparu hydrographic basin, Limnology, Waters - Physicochemical Parameters, Caraparu river, Maguari river.*

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I. Introduction

The municipality of Santa Izabel of Pará has a population of 73,019 inhabitants, with a diarrhea rate of 0.2% per 1000 persons. It presents only 10.7% of homes with adequate sewage, 19.9% of urban homes on public roads with trees and 6.3% of urban homes on public roads with adequate urbanization (presence of manhole, sidewalks, paving, etc.)[1].

The city's main river is the Caraparu River, a dark-coloured river, which begins in the Americano district in the city of Santa Izabel and flows into the Guamá River, with great importance for agriculture, commerce, small industries, tourism and in some cases for consumption by the population not served by public. The Maguari river is a tributary of the Caraparu river, also with coloured water, which despite being a river of secondary importance, has great importance for agriculture, small industries, and other uses by the local population, for example, consumption by the population not served by the public supply network.

Due to the different types of use that the population of the district of Caraparu in Santa Isabel of Pará in Brazil make in the region's hydrographic basin, including for consumption and irrigation by some segments of the population, there is a need to monitor the quality of the water, to ensure limnological preservation and environmental health. Given this, the general objective of this paper is to identify possible impacts of urban development on the limnological resources of the city of Santa Izabel of Pará and, as specific objectives: Identify possible risk agents for local environmental degradation; predict possible impacts on environmental health due to the degradation of limnological resources, among others.

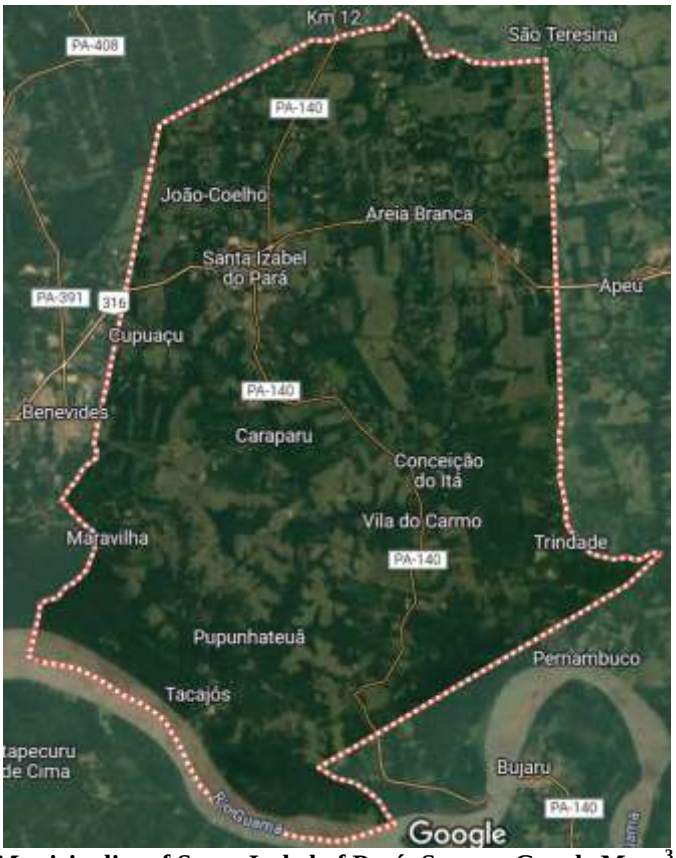
II. Methodology

This research is part of the project "Environmental impacts of urbanisation on water resources in the Metropolitan Region of Belém and its effects on the health of local populations and the environment: A brief look at geomedicine"[2] by Professor Aureliano da Silva Guedes from the Faculty of Chemistry of the Ananindeua Campus of the Federal University of Pará and his team, in the part that refers to the municipality of Santa Izabel of Pará.

The samples were collected on November 22nd, 2023, in the morning.The pH was measured in the samples using a portable electronic pH meter and compared with test strips as a control. The electrical conductivity values of the water samples were measured using a portable electronic conductivity meter, expressed in µS/cm-1 (microSiemes per centimetre), as well as the sample temperature and Total Dissolved Solids. For environmental temperature, an environmental thermometer was used.

The samples were subjected to multiparameter test strips with 3 tests for each sample to identify: alkalinity, lead, bromine, nitrate, nitrite, iron, chromium (VI), copper, mercury, fluoride, among others. The Secchi disc was used to evaluate turbidity, visibility in centimeters, among others.

The qualitative observational method was used to obtain information regarding anthropogenic environmental pollution of the rivers studied and its surroundings and the presence of wild flora and fauna.



Municipality of Santa Isabel of Pará. Source: Google Maps[3]

Caraparu River. Source: Google Maps[4]

III. Results and discussions

Parameters	Caraparu River	Maguari River	Tolerability in recreational waters/Source
Environmental visibility	Normal	Normal	-
Environmental temperature Cº	35,1	23,3	-
Wind	No	No	-
Ciliary forest	Yes	Yes	Varies depending on the type and width of the river
Tide	Low	Low	-
Aquatic macrophyte presence	Yes	Yes	Must not present eutrophication
Ph	6,2	6,2	6-9
Temp Cº - Sample	27,9	26,6	-
Visibility (Secchi disc)	95cm	Not applied	-
Color	Dark Brown	Dark Brown	True colour: natural color level of the water body in mg Pt/- CONAMA[5]
Turbidity	Normal	Normal	≤ 40 nephelometric turbidity units (NTU) - CONAMA
Odour	Normal	Normal	Absent odour
Electrical conductivity(mS/cm).	0,046	0,104	Depends on ions, geological aspects, pH and others
TDS (Total Dissolved Solids)	0,023	0,052	<1,000 mg/litre - WHO[6]
Carbonate	0	0	Observe pH, presence of macrophytes and other factors
Water Hardness	25	25	500mg/l Revisão[7]
Lead	20	20	0,01mg/L CONAMA
Bromine	1	1	25mg/L - WHO
Nitrate	0	0	10,0 mg/L - CONAMA
Nitrite	0	0	1,0 mg/L - CONAMA
Iron	5	0	0,3 mg/L - CONAMA
Chromium (VI)	1	0	0,1 mg/l
Copper	0	0	0,009 mg/L - CONAMA
Mercury	0	0	0,0002 mg/L - CONAMA
Fluoride	0	20	1,4 mg/L - CONAMA

Lotic systems as they present flow and permanent interaction with their tributaries, their waters can present significant variables between the collection of one sample and another, given their transport capacity, decomposition of organic and inorganic materials, difference in water temperature per area and depth, among others.

The chemical quality of water is measured by identifying the component in the water, using specific laboratory methods. Such chemical components must not be present in water above certain concentrations determined with assistance of epidemiological and toxicological studies. Tolerable limit concentrations mean that the substance, if ingested by an individual with an average physical constitution, in a certain daily amount, during a certain period of life, added to the expected exposure of the same substance through other means (food, air, etc.), subjects this individual to an unacceptable risk of developing a resulting chronic illness.Two important groups of chemical substances, each with specific origins and effects on human health, are inorganic chemicals, such as heavy metals, and organic chemicals, such as solvents[8].

For recreational water users, risks associated with chemical hazards will depend on the type and concentration of the chemical contaminants, and the characteristics of the area. River flows, and tidal and wave action can dilute and disperse chemical discharges. In contrast, slow-flowing lowland rivers and lowland lakes may be more susceptible to contamination and provide low levels of dilution or dispersal. Water bodies subject to continuous or intermittent discharges could accumulate contaminated sediments. Potential sources of chemical hazards include onshore and offshore industrial discharges and spills; wastewater discharges; discharges from contaminated sites; local use of motorised crafts; petroleum receiving stations; pesticides; mining wastes; naturally occurring chemicals, including algal toxins[6].

Visualisation of depth by Secchi disc is a qualitative value as it depends on the observer's vision and solar radiation in the probed environment, in addition to the influence of organic and inorganic materials that make up water.The Visibility by Secchi disc in the dark brown colour of the Caraparu river was adopted; however, in the Maguari River, as it is at low tide and is a very shallow river, the Secchi disc cannot be applied at that time. However, turbidity, colour, odour, and visibility did not present characteristics that could present problems. The predominant dark colour in the waters of the Santa Isabel of Pará hydrographic basin is characterised by the large contribution of organic compounds from trees that fall and decay, flowers, fruits, leaves, and roots of the ciliary forest, in addition to aquatic macrophytes, influencing the turbidity, colour and pH of the waters of rivers, streams, among others.

The electrical conductivity of water constitutes one of the most important variables in Limnology, as it can provide information both about the metabolism of the aquatic ecosystem and about important phenomena that occur in its drainage basin.Among the information that can be provided by electrical conductivity values includes information on the magnitude of ionic concentration. The ions most directly responsible for electrical conductivity values in inland waters are the so-called macronutrients (calcium, magnesium, potassium, sodium, carbonate, sulfate, chloride, etc.), while nitrate, nitrite and especially reactive soluble phosphorus have little influence. The ammonium ion can only have an influence at high concentrations; the daily assessment of the electrical conductivity of water provides information about important processes in aquatic ecosystems, such as primary production (reduction in values) and decomposition (increase in values); electrical conductivity can help detect sources of pollution in aquatic ecosystems; geochemical differences in the tributaries of the main river or a lake can be easily evaluated with the help of electrical conductivity measurements[9].

The Electrical Conductivity presented in the rivers studied, at the time of this collection, did not present any indication of risks to the environment, with its measurement being appropriate to the type of pH, soil, sediments, and micronutrients provided by the aquatic vegetation and the ciliary forest.

The presence or absence of carbonate ions defines hard water rivers or acid water rivers with a low concentration of carbonate ions[10]. In the case of carbonate (CO_3^{-2}),considered inorganic carbon, closely related to the pH of the water, it may be related to minerals leached from riverbanks, type of sediment, eutrophication, among others. In the sampling taken from the rivers surveyed, in November, there was no presence of carbonates.

The water temperature in lotic systems varies daily and for season, due to factors such as climate, altitude, type and extent of ciliaryforest and the contribution of groundwater. This temperature sets limits to the geographic distribution and physiology of organisms, influencing the reproduction, survival, and life cycle of organisms[10]. At the time of collection of this pilot study, the pH of the waters of the Caraparu and Maguari rivers was adequate for the type of sediment, soil on the banks, tropical climate of the region and type of vegetation that interact with the rivers.

As for aquatic macrophytes, beyond. water levels and rainfall, biomass, primary productivity and, consequently, the population dynamics of aquatic macrophytes are affected by several other abiotic factors, among which physical factors can be highlighted (e.g. ecosystem morphometry, water speed, temperature, and underwater radiation), chemicals (e.g. water and sediment nutrients, and inorganic carbon) and physiochemical (e.g. pH). However, these factors affect each biological type of aquatic macrophyte differently. In addition to the

effects of abiotic variables, aquatic macrophyte populations are also affected by biological interactions, highlighting competition (intra and interspecific), herbivory and facilitation[11].

In June 2023, in the first incursion, a large quantity of free-floating macrophytes of the species *Pristia stratiotes* were observed in the Caraparu River, characterizing a large eutrophication in the area. It is noteworthy that in some of the team's forays into that river, city hall workers were observed removing large quantities of these macrophytes from the water to promote tourist use of the area, which occur in July. However, this mechanical removal of the large excess of this species has the positive point of reducing shading for other species and the siltation of certain areas of the river, close to the district of Caraparu, by foliage of this species and contributes to better oxygenation of the Caraparu River and its tributaries; as a negative point, mainly the reduction of shelter for some types of fish and availability of food and nutrients for other species, for example, macro-invertebrates and micro-invertebrates, among others.There is a need to identify whether eutrophication is natural or artificial; if artificial, it is necessary to identify the source to establish solutions to minimise harmful impacts on the river.

Caraparu River with eutrophication by *Pristia stratiotes* - June 2023

In collecting materials, the presence of bromine and lead was identified in both rivers, in addition to the presence of fluoride in the Maguari river and chromium in the Caraparu river. However, it requires more water collections at different tidal levels, periods, among others, to be able to assess whether it was seasonal or coming from some polluting source. It is observed that the presence of iron, nitrite, nitrate, copper, and mercury were not identified in the samples collected.

Caraparu river. June 2023

Maguari river. June 2023

IV. Conclusions

It is worth mentioning that this research presented a pilot characteristic, therefore, to correct the methods, other collections are needed, with the methods tested and appropriate to determine a real diagnosis of the condition of these rivers studied. However, it must be remembered that lotic systems are constantly changing their chemical composition depending on climate, current, rainfall, atmospheric chemical conditions, anthropogenic impacts, among others.

The Caraparu River is the main river in that hydrographic basin, having importance for local tourism, small agriculture and, in many cases, supplying supplies to populations in need of public policies; The Maguari River has almost the same characteristics, even because it is a tributary of the Caraparu River. In this sense, there is a need for monitoring to guarantee both economic and social functions for the district of Caraparu, in the Municipality of Santa Isabel of Pará.

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