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Characterization of the Bananal Stream Hydrographic Sub-Basin in Brasília/Brazil

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***Abstract*-** The Ribeirão Bananal has its source within a National Park, where preservation struggles to maintain its natural characteristics. This hydrographic sub-basin is located in the Federal District, in the central-western region of Brazil. It is responsible for supplying several regions of the Federal District. The Bananal sub-basin is influenced by other smaller streams, making it a perennial stream. Thus, this research aims to characterize the Bananal sub-basin, identifying the location, climate, vegetation, geology, land use and occupation and water resources. A literature review on the Bananal hydrographic sub-basin was carried out in order to contextualize, analyze and discuss what the academic literature discloses about this area. It was observed that the Bananal sub-basin has as its characteristic the climate and vegetation of the cerrado, red-yellow oxisols and cambisols. It is entirely constituted in the Federal District, from its source to Paranoá Lake, being considered the sub-basin with the best quality among the others inserted in the hydrographic basin of Paranoá Lake. The sub-basin also has an average flow of 216,564 m³/day and the possibility of supplying 314,316 people.

***Keywords*-** *Hydrographic Sub-basin, Paranoá Lake, Ribeirão Bananal*

I. INTRODUCTION

The Federal District (DF) has an area of almost 6,000 km², is located in the Central Plateau region, with elevated places that reach altitudes of up to 1,400 meters. Due to its position, the DF is a watershed in the three main hydrographic regions of Brazil, namely: the hydrographic region of Paraná or Prata, the hydrographic region of São Francisco and the Tocantins-Araguaia hydrographic region [1]. This means that, depending on the place where precipitation occurs, water can flow into one of these watersheds.

In this district, the predominant biome is the Cerrado, which is the second largest biome in the country, occupying about 24% of the Brazilian territory. Distributed in 11 states, from different regions, from the north, in states like Maranhão and Tocantins, to the south region, in the state of Paraná. Classified as the richest savannah on the planet, it is estimated to have more than 12,000 plant species, of which more than 4,000 are endemic to the biome, that is, they only occur in this type of environment [2]. With regard to fauna, in the Fauna-DF Project, which aimed to list endemic or non-endemic species in the biome, it was possible to identify that the DF has 833 records of vertebrate species, 2 endemic rodent species and in the fish group, 11 endemic species were identified, cataloged as new in 2008 [3]. I am also pleased with huge groundwater that supplies rivers and springs, where they feed one of the three hydrographic regions [4].

It is noticed that the area where the DF is included is of extreme environmental importance, however, after the location was chosen to be the new capital of the country, the construction of Brasilia began. Currently Brasília-DF is divided into 31 administrative regions (RA´s). At first, only the pilot plan was one of the planned ARs, the others were occupations scattered throughout the territory, irregularly, but which were necessary to support the huge number of immigrants who were arriving to work in the country's capital. However, these people ended up occupying areas that played an important role in recharging aquifers, cutting down forests, waterproofing the soil and destroying springs [5]. In a study carried out by the United Nations Educational, Scientific and Cultural Organization (UNESCO) [6], in 2002, it was estimated that from 1954 to 2001, about 74% of the original Cerrado coverage was deforested throughout the Brasilia area.

Agricultural activities also had an impact on the use and territorial occupation of the Federal District, however, to a lesser extent, when compared to the urbanization process. But it is quite common, the remaining green areas to be pressed between urban and agricultural expansion, suffering destruction, largely criminal [7].

Nowadays, it is believed that there are 2,906,000 million inhabitants, of which 210,067 live in the pilot plan and 2,695,933 in the remaining 30 RA's [8]. The sum of this rapid and intense population increase, with the absence of public social and environmental policies, has resulted in excessive pressure on natural resources, especially water resources.

According to [9], another frequent problem is the unrestrained occupation in watershed areas, an example of which is the Paranoá Lake Basin. This same author, continues to say that in order to try to prevent this destruction totally, areas of environmental protection were created, which are the conservation units, much encouraged by the 1988 constitution, which said that everyone has the right to an ecologically balanced environment. For this reason, spaces have been protected, but it is still difficult to seek a balance between the environment and human actions, because there is still no environmental awareness on the part of the population in general and neither an efficient inspection by the government, so, many of these spaces are not respected.

The Hydrographic Basin of Paranoá Lake, is entirely inserted in the DF, having an area of 1,034.07 km², from a population point of view, this basin contains 9 RA´s, which are: Lago Sul and Lago Norte, Cruzeiro, Núcleo Bandeirante, Candangolândia, Riacho Fundo, Guará, Paranoá and a piece of Taguatinga, making it the densest area in DF [10]. This basin is formed by 6 sub-basins, which are: Santa Maria/Torto, Bananal, Riacho Fundo, Cabeça de Veado Stream, Ribeirão do Gama and Paranoá Lake. This work aims to give a greater focus to the hydrographic sub-basin of the Bananal stream.

Through a bibliographic search, the present work sought to characterize the entire area of Ribeirão Bananal. Therefore, the main purpose of the work is to carry out a brief investigation of the place.

II. Methodology

The methodology sought to be aligned with the objective, presenting a literature review on the Ribeirão Bananal hydrographic sub-basin, in order to contextualize, analyze and discuss what the academic literature discloses about the characterization of this sub-basin, focusing on the location, climate, vegetation, geology, land use and occupation and water resources. The database consulted for this research was Google Scholar, using the following descriptors: hydrographic basin, Paranoá lake, bananal stream, Ribeirão Bananal sub-basin, water quality of Ribeirão Bananal.

One-off information was extracted from two databases, the first from the National Sanitation Information System (SNIS), of the Ministry of Regional Development (MDR) and the second was information provided by the Federal District Water, Energy and Sanitation Regulatory Agency (ADASA), which monitors the water quality of the rivers of the DF monthly, through the Water Quality Index (IQA), created by the National Sanititation Foundation and modified in Brazil by the Environmental Company of the State of São Paulo (CETESB), being used by water agencies in several countries.

III. Results and Discussions

A. Location of the Bananal Stream Sub-Basin

The Sub-Basin of the Bananal Stream is found almost entirely, inside the National Park of Brasilia, a part of it is found outside the park and all the water from the river flows into Paranoá Lake. Occupying an area of 127.74 km², the Bananal stream is formed by the stream of the water pit, the stream of the camp, the stream of the pit of the tapir, the stream of Capão Comprido and the stream of the stream [1, 10-12].

According to the resolution of the National Environment Council (CONAMA) number 357/05 [13], the rivers are classified in classes, being able to be of special class, class 1. class 2, class 3 and class 4. Those of special class, 1 and 2 have excellent good quality, while those of class 3 and 4 have terrible quality. Most waters in Brazil are class 2, this also applies to the DF.

B. Climate

There are two well-defined periods in the DF, the drought, beginning in May and ending in late September, totaling 6 months without rain and the rainy period, which runs from October to April, also totaling 6 months, but with the presence of rain [14]. Still according to [14], the annual precipitation varies between 1200 mm (mm) to 1700 mm, what makes the DF a place with high rainfall, mainly when compared with other cities, as for example those of the Northeast.

The predominant climate is the Tropical de Savana, according to the Koppen classification, the average annual temperature varies from 18 to 22 degrees and the relative humidity is 70 to 20 percent [10].

C. Vegetation

For [15], eleven types of cerrado vegetation can be cited, subdivided into three categories: Forest formations (Mata Ciliar, Mata Seca, Mata de Galeria and Cerradão); savannas (Cerrado sensu stricto, Cerrado Park, Palmeiral and Vereda) and, finally, the rural features (Campo Sujo, Campo Rupestre and Campo Limpo). Such phytophysiognomic types may still have subtypes. Within this great plant diversity, the Cerrado sensu stricto is the dominant phytophysiognomy, occurring in 70% of the biome, as illustrated in Figure 1.

Figure 1. Typical vegetation of the cerrado, medium-sized, spaced trees, with a height of 15 to 25 meters, with tortuous trunks and branches. And the presence of the Ipê-Amarelo (in the middle), a symbol of Brasilia [16].

D. Geology

It was possible to discover that most of the soils present in the Cerrado are characterized as Oxisols, covering approximately 46% of the biome's area. This type of soil, in turn, can have a color ranging from red to yellow, they are deep and well drained most of the year, they are acidic, they have

aluminum toxicity and they are low in essential nutrients for most plants, such as calcium, magnesium, potassium and some micronutrients. Specifically, in the Ribeirão Bananal Sub-Basin we have three types of soils, red-yellow latosols and cambisols [10].

E. Land Use and Occupation

About 1/3 of the basin area is within the Brasília National Park, that is, it is protected. Part of the basin is outside the park, which is the most affected by anthropic actions, however, when compared to the other sub-basins that are part of the basin of Paranoá Lake, the Bananal is the most intact. From 1998 to 2009 a large part of the area continued to be composed of Cerrado vegetation and there was a small evolution in urbanization and agriculture (Figure 2).

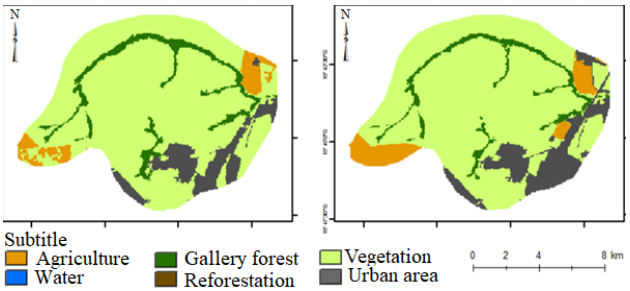

Figure 2. Land use and occupation in the sub-basin of the bananal, 1998 in the image on the left and 2009 in the image on the right [10].

F. Water resources

In the research carried out by [17], using information from ADASA, the quality of the water resources present in the basin Paranoá Lake was calculated, where Ribeirão Bananal showed good quality, about 66%. After the years of water crisis in the Federal District, Ribeirão Bananal became another source used to supply water to the city (Figure 3).

Figure 3. Beginning of construction of the infrastructure for yet another water collection, treatment and distribution system, the Ribeirão River [18].

G. Estimated Water Consumption of Ribeirão Bananal

The average flow of Ribeirão Bananal is 2.51 m³/s, multiplying this flow by the number of seconds you have in 1 day (86.400 seconds), you have the average daily flow, which is about 216.564m³/day, converting to liters (multiplying by 1000), there is a flow of 216.564.000 L/day. Of this total, according to the index Q7.10, which is an important index for the planning and management of water resources, about 20% would go to human water supply, which represents about 43,312.800 L/day.

Data on average per capita water consumption provided by SNIS, showed that consumption in the years 2017, 2018 and 2019 in the DF, was 132.4 L/hab/day, 135.2 L/hab/day and 145.9 L/hab/day respectively, when taking the average of these values, we have that the daily consumption of a resident of DF is 137.8 L/hab/day. Dividing the possibility of daily human water supply from Bananal (43,312,800 liters), by the daily consumption of a resident of DF (137.8 liters), it can be obtained that the number of people supplied by the stream, would be 314,316 people.

IV. Conclusion

The Bananal hydrographic sub-basin is located in the National Park of Brasilia, capital of Brazil. It is located in the Brazilian cerrado and occupies an area of 127.75 km², being responsible for supplying several cities in the central-west region of Brazil, especially the Federal District.

It was possible to conclude that he sub-basin of the Bananal is characterized by the climate and vegetation of the cerrado, soils of red-yellow latosols and cambisols, entirely constituted in the Federal District, from its source to Paranoá Lake, being considered the sub-basin with better quality among the others inserted in the basin of Lake Paranoá. The sub-basin also has an average flow of 216,564 m³/day and with the possibility of supplying 314,316 people.

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