

# “Rio Preto Urgente”: A Proposal for Conservation and Recovery

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**Abstract.** The Association of Young People of Alto Rio Preto (JUAP) and the Association of Children and Friends of São Benedito, Maranhão, Brasil (AFASB) develop the “Avante Camaradas” (Forward Comrades) Project and the “Alonga Vida” (Lengthen Life) Operation, for the maintenance of the Preto River and the Mocambo River, its main tributary. From these actions arose the necessity of technical study of the Preto River. In this research we carried out expeditions in the river, we verified its bed, tributaries, vegetation, number of households and riverside. The study area was from Tutanguira village to ETA CAEMA (Water Treatment Station of the Environmental Sanitation Company of Maranhão). Flora, with identification of 89 species and fauna, with identification of 101 bird species, 28 species of herpetofauna (amphibian and reptiles) and 11 species of mammals were studied. Environmental impacts such as cutting and burning vegetation, extraction of wood for sawmill, coal and fishing, sand extraction and pebble stone are frequent in the river area. A socioeconomic diagnosis of the community of the study area was made, being verified that the majority is farmer and with low schooling. The river runs the risk of being no longer perennial and becoming intermittent due to the degradation caused by population growth and the monoculture of soybean and eucalyptus. One suggests the execution of an urgent maintenance and recovery project in the Preto River.

## 1. Introduction

Maranhão is a state located in the northeast of Brazil (01°01' to 10°21'S and 41°48' to 48°40'W), with a total area of 329,555.8 km<sup>2</sup>, limited with the Atlantic Ocean, to the north, and with the states of Piauí to the east, Tocantins to the south and southwest, and Pará to the northwest. [1]

To the east of the state of Maranhão is located the municipality of São Benedito do Rio Preto (03°20'02"S and 43°31'40"W), with an area of 931,592 km<sup>2</sup>, a population of 17,799 inhabitants and a human development index (HDI) of 0.541 [2], [3].

The city is cut by one of the main tributaries of the Munim River Basin, the Preto River, which rises south of the municipality of Buriti, Maranhão, Brazil (03°56'42"S and 43°02'3"W) about 230 km, bathing the municipalities of Buriti, Brejo, Milagres do Maranhão, Anapurus, Mata Roma, Urbano Santos, Chapadinha, São Benedito do Rio Preto and Nina Rodrigues. [4]

In many regions of the world, there have been declines in freshwater reserves, as was already recorded in the Human Development Report of the United Nations Program UNDP [5]. Some of these degradations are: deforestation, removal of riparian forests, practice of irrigated agriculture with the use of agrochemicals and livestock without technical support, allied to the expansion of the urban zone, domestic and industrial waste improperly released into the environment [6].



According to Braga and Rebouças (2017) [7], unsustainable activities have caused serious environmental impacts in Brazilian rivers, such as disappearance or diminution of riparian forests and habitats for aquatic fauna, elimination of the buffer zone between terrestrial ecosystems and aquatic environments, increase of particular suspended material in the water and significant changes in sediment composition of aquatic ecosystems. This also interferes in the quality and quantity of water in a river basin [8]. Like many other Brazilian rivers, the Preto River has suffered a lot of degradation due to the anthropogenic action, mainly in its sources.

Since 2007, two non-governmental non-profit organizations, the Association of Children and Friends of São Benedito do Rio Preto (AFASB) and the Association of Young People of Alto Rio Preto (JUAP) have been developing the “Avante Comaradas” (Forward Comrades) Project - a social program with an educational character with the objective of assisting in the moral, social, spiritual and civic formation of the young person, forming good citizens and conditioning them to a level of adequate preparation to better know how to face the difficulties. The Project is developed by volunteer instructors (teachers) and all financial investment is the result of spontaneous donations from people in the community.

It is a basic course of citizenship and humanization in which young people receive notions of Sociology, Anthropology, Health, Moral, Human Relations, Human Values, Citizenship / Politics, Environmental Education, Civics, Philosophy and Arts (Music, Theater, Dance and Plastic). Upon completion of the course, young people are able to live in society, feeling valued and valuing their neighbor, as a good citizen, knowing their rights and duties.

Undoubtedly, the main consequence of the citizen training promoted by the “Avante Camaradas” Project was the “Alonga Vida” (Lengthen Life) Social Action, a socio-environmental project that aims to revitalize the Preto River and its main tributary, the Mocambo River. It is a joint social action among the residents of the municipality, which has been taking place since 2010, promoting the maintenance, preservation and revitalization of the river bed, the banks and the riparian forest (ebb) of the Preto and Mocambo rivers, from the city of Urbano Santos to São Benedito do Rio Preto and bringing information to the riverside population about the importance of this preservation of river banks and their streams. Expeditions carried out by the “Alonga Vida” Social Action, showed several types of attack resulting from human action on the river [9].

In Brazil, the National Water Resources Policy [10] brings in its foundations that water is a public property and that its management should be decentralized and count on the participation of the Public Power, users and communities.

In the participatory management of water resources, people in the community must act consciously in decision making, and environmental education is essential for people's training and awareness [11]. Strategies should be based on the recovery and preservation of water bodies, especially springs [12], since predatory actions interfere in the natural cycles and the availability of good quality water, which compromises the sustainability of water resources [13].

The results of the Social Action “Alonga Vida” revealed the need for a more in-depth study of the real situation of the Preto River, which culminated with the research object of this article. This research aims to recognize the Preto River basin, to identify the source and the mouth of each of its tributaries, to diagnose the conditions of the river bed and forest and its tributaries, as well as to carry out a socioeconomic study of the communities that inhabit the area delimited in this study.

## **2. Methods**

For the development of this work, the study area was initially recognized through expeditions throughout the Rio Preto basin from its source in the municipality of Buriti de Inácia Vaz to São Benedito do Rio Preto.

The area of study of this stage of the research belongs to the municipality of São Benedito do Rio Preto, upstream of the catchment point of the Environmental Sanitation Company of Maranhão - CAEMA, in an area comprised of the following coordinates: point 01: 3 °26'0 "S, 43 °27'0" W; lane 02: 3 °24'0 "S, 43 °33'0" W; lane 03: 3 °30.0 °S, 43 °27.0 °W; and point 04: 3 °24'0 "W, totalling 344.28 km ?

In this area, a study of the hydrography and survey of the environmental protection areas was carried out. The flora, taxonomy and landscape were also investigated in two points, APA Fazenda Estiva and Marçal village, through parallel transects with plots of 10m x 10m [14]

The areas studied for the study of avifauna were Tutanguira, João Pedro, Bacuri, Gomes, Fautina, APA Fazenda Estiva and the Negro river riparian areas, through transects and fixed points for listening observation. The herptofauna (amphibians and reptiles) [15]-[17] and mastofauna (mammals) [18]-[21] were also surveyed.

Environmental impacts were also investigated in the affected area, such as cutting, burning, logging, predatory fishing and mineral extraction.

In order to obtain socioeconomic data of the families living in the area of influence of the project, a survey was carried out with the population of 17 villages in the vicinity of the Preto River, where age, sex, schooling, economic activity and ties to class entities were verified.

### 3. Discussion and Results

#### 3.1. Hydrography

Within the area delimited for this study, the Preto River crosses 43 km and receives 24 tributaries, being: Pau Mole stream (source: 3°26'13.19"S, 43°27'48.31"W, mouth: 3°25'59.66"S, 43°26'1.60"W), Bacuri stream (mouth 3°15'18.37"S, 43°15'54.75"W), Zé Raimundo stream (source: 3°24'55.84"S, 43°27'9.84"W, mouth: 3°25'33.39"S, 43°26'41.71"W), Santa Rosa stream (mouth: 3°22'13.08"S, 43°25'23.05"W), Gomes stream (source: 3°21'53.79"S, 43°26'15.68"W mouth: 3°21'27.54"S, 43°25'50.05"W), Olaria stream (source: 3°19'49.82"S, 43°29'47.16"S, mouth: 3°19'36.32"S, 43°29'47.16"W) Santa Luzia stream (source: 3°20'46.10"S, 43°26'38.70"W), Faustina stream (source: 3°21'29.15"S, 43°26'3.84"W mouth: 3°21'26.11"S, 43°25'49.97"W), Mangueira stream (source: 3°20'42.43"S, 43°25'46.34"W), Prata stream (source: 3°11'34.61"S, 43°15'41.81"W, mouth: 3°19'29.46"S, 43°26'16.14"W), Juçara stream (fz: 3°18'53.29"S, 43°26'58.88"W), Mocambo River (mouth: 3°18'52.26"S, 43°20'55.20"W), Pardo stream (source: 3°12'7.02"S, 43°16'19.66"W, mouth: 3°19'28.34"S, 43°27'11.80"W), Buriti stream (source: 3°12'7.02"S, 43°27'54.41"W, mouth: 3°20'39.31"S, 43°27'56.97"W), Céero stream (source: 3°18'35.05"S, 43°29'18.33"W, mouth: 3°19'37.03"S, 43°29'18.33"W), Izabel stream (source: 3°20'17.92"S, 43°29'16.46"W, mouth: 3°18'35.05"S, 43°29'9.65"W), Jaime stream (mouth: 3°19'36.16"S, 43°26'51.12"W) Arlindo stream (mouth: 3°19'37.44"S, 43°29'41.78"W), Pedemeti stream (source: 3°19'44.98"S, 43°30'10.18"W, mouth: 3°19'21.38"S, 43°30'1.37"W), Marfisa stream (mouth: 3°19'9.31"S, 43°30'22.62"W), Barra Grande stream (source: 3°29'16.38"S, 43°31'6.17"W, mouth: 3°22'22.44"S, 43°25'27.47"W), Mapá stream (source: 3°18'16.07"S, 43°30'10.18"W, mouth: 3°19'11.94"S, 43°30'44.93"W), Cemitério stream (mouth: 3°19'11.94"S, 43°30'44.93"W), Genilson stream (mouth: 3°19'50.32"S, 43°31'5.05"W).

From these tributaries, only 3 resist to the drought period, being. The most voluminous, the Mocambo River, is born in the municipality of Urbano Santos. The fact that the river has most of its affluent inactive during a great part of the year has compromised the volume of water in its bed.

In the area studied in this research, there are two areas of environmental preservation (APA). The first, private, is Fazenda Estiva, located on the banks of Highway MA 224, in the municipality of São Benedito do Rio Preto. The second, created through a state decree, is the Environmental Protection Area of Upaon Açu / Miritiua / Alto Preguiças, which covers 17 municipalities, among them São Benedito do Rio Preto.

#### 3.2. Flora

A total of 89 plant species belonging to 49 families were identified, with the most representative families being *Fabaceae* (11), *Arecaceae* (7), *Myrtaceae* (7), *Malvaceae* (5), *Anacardiaceae* (4), *Caesalpinioideae* (4) and *Mimosaceae* (4). In the transect on the banks of the Preto River, the dominant species is the "mofumbro" (*Viborgia polygaliformis*), pioneer species that extends its successional stage until the secondary one. On the banks of the Marfisa Stream, "becuiba" (*Virola bicuhyba*), "Açaí" (*Euterpe oleracea*), "Pau-pombo" (*Tapirira guianensis* Aubl) and "Buriti" (*Mauritia flexuosa*) are

predominant species. These species are adapted to hydromorphic soil, having a fundamental role for the wetlands ecosystem [22].

### 3.3. Fauna

#### Bird Fauna

In the area of the Preto River studied in this research, 101 species of birds were found, distributed in 39 families, with no species threatened of extinction [16] and only two considered almost endangered [16], “Maracanã” (*Primolius maracana*) and “Aracua-de-sobrancelhas” (*Ortalis superciliaris*). The APA Fazenda Estiva was the point that presented the greatest diversity of species, where 62 taxa of the 101 were located in all sampling areas

The observation points for Bacuri village (João and Bacuri streams, together, due to their geographical proximity) presented the second largest number of bird species, 58 taxa. Then the Gomes and Faustinas points, with 40 taxa and the Tutanguira point, with 28 species. These last three points present strong anthropic influence and present great similarity in the composition of the species, which can be explained by low phytophysiological heterogeneity of the environment [23].

The survey on the banks of the Preto River did not show a significant number of species, 44 taxa, although it was the longest route. Certainly, this is verified by the high degree of anthropization of these margins, which has affected the most dependent species, without adaptations.

### 3.4. Herpetofauna and Mastofauna

Twenty-eight species that comprise the herpetofauna (amphibians and reptiles) belonging to 17 different families were found, and the status was of little concern (LC) for all, regarding the degree of threat of extinction [16]. On the other hand, it was found that the species of mammals (11 species) were distributed in 9 families. The jaguar (*Puma yagouaroundi*) was the only one threatened with extinction, with vulnerable degree, VU [16].

### 3.5. Environmental Impacts

Many are the impacts of anthropocentric origin on the Preto River basin, many of them with an intimate relation with the cultural historical context of natural resources management of the region.

The cutting and burning of vegetation on the banks of the river is often verified as a way of cleaning areas for family farming. It is not uncommon for fire to escape control and spread to areas beyond the interests of these farmers, which leads to major degradation [24]. Many are the damages brought by these fires, such as the release of carbon dioxide into the atmosphere, destruction of the soil microbiota, destruction of retention forests and even riparian forests, which accelerates the flow of water, damaging the water supply of the groundwater, [25].

The extraction of wood for sawmill is already little verified in the forests of the studied area, since the trees are practically extinct and will take many decades to be recovered. It is also quite common to see the extraction of wood for the production of coal near the river and its tributaries, which is detrimental to the forests that are necessary for the survival of these springs.

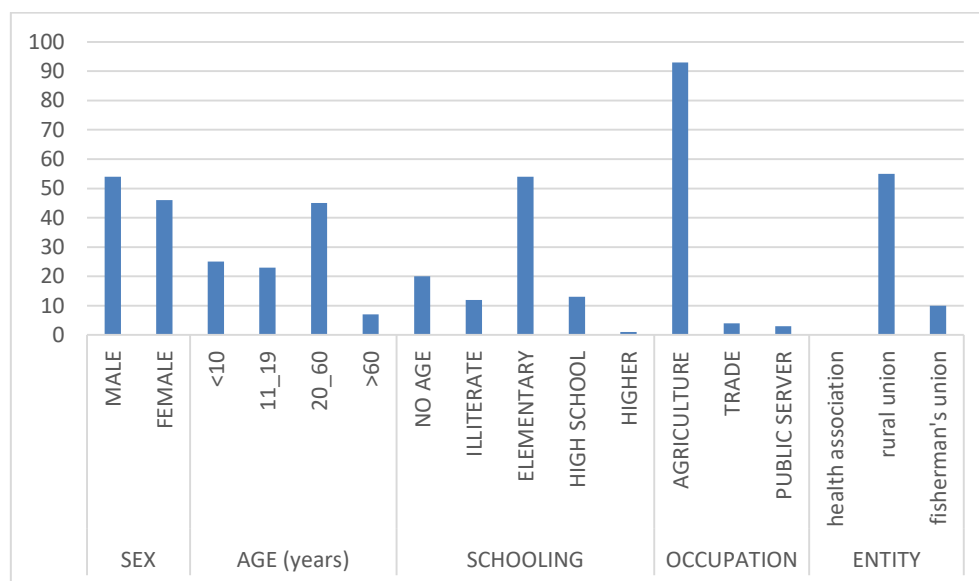
Predatory fishing is also a cause of deforestation along the banks of the Preto River in at least three ways. One is the removal of small portions of riparian forests to have a clean place for fishing. This causes a lot of damage, since the removal of the ciliary forest accelerates the sedimentation process, with elevated accumulation of organic matter, besides the interference in the ecological restoration [26]. The second form is the removal of vegetation to create a physical barrier that prevents the passage of fish, facilitating their capture. This intervention compromises the reproduction of fish, putting species at risk even of extinction [22]. In the region there is also the “moita” or “coivara” fishery in which riparian trees are cut so that their branches and leaves are accumulated submerged in the river to serve as a fishery which will be captured after a few months. The latter, in addition to causing siltation and compromising reproduction, may still cause contamination of water with excess organic matter [27].

Another form of frequent degradation in the river is the extraction of sand and pebble for the civil construction. This withdrawal is done either manually or through machines that dredge material out of the river. Many are the damages caused by this form of extraction, such as the formation of craters,

destruction of riparian vegetation, destruction of biological chains and contamination of water by fossil fuels [28].

### 3.6. Socioeconomic Situation of the Riverside Communities

In this research a socioeconomic diagnosis was carried out with the population located in the areas near the Preto River, which comprises 17 villages, totaling 1387 inhabitants. The indicators were age, schooling, sex, economic activity and link with class entities. The data are shown in Figure 1.



**Figure 1.** Socioeconomic diagnosis of the inhabitants of the study area

In these communities, there are residences built of bricks or of “taipa” (mud and straw), as some are covered of tiles, but others are of straws. Children have access to schools and most families participate in government income transfer programs. It is observed that the population has low or no schooling, most of them are farmers and most of them are associated with some class institution, most of them being in the Rural Workers' Union. In the visits to the communities, it was observed that agriculture is subsistence and are mainly cultivated rice, beans, maize and cassava.

### 4. Conclusions

Many environmental impacts due to population growth, monoculture and high number of fires threaten the availability of water resources in the Preto River basin, the water volume of which has been reduced each year. If actions are not taken to maintain and recover the river, it runs the risk of being no longer a perennial river and becoming intermittent, which would put at risk many activities that are currently performed by the community, since the river is responsible for the water supply of more than 90% of the population of São Benedito do Rio Preto.

From the analysis of the socioeconomic data collected, it is perceived that they are people lacking basic needs and who survive primarily from the resources and potentials of the place. This leads to the conclusion that there should be an environmental education plan so that these people can produce their food in a sustainable way, that is, without causing damage to the environment in which they live.

In this sense, this research shows the urgent need for a recovery plan for Preto River, passing through the immediate recovery of the water catchment forests to the water tables and the riparian forests. As it is estimated that many areas can not be recovered immediately, a specific study is recommended for the construction of dams to capture water in order to revitalize the sources of the river.

If there is no immediate intervention by local authorities, the damage to the environment and the economy of the region will be so significant that the financial resources currently committed will be insignificant in the amount that should be committed to repair future damages.



## 5. Future Perspectives

Execution of a project to monitor, preserve and recover the Preto River in the next ten years, where it is estimated that topographic stabilization and restoration of organic soil can be achieved, as well as revegetation of native species, where vegetation is not naturally restored.

For reforestation, seedling control and pest control will be required. Other needs include burn and deforestation controls, as well as the systematic evaluation of all stages of the process.

It is also recommended the immediate recreating of the Environment Secretariat as an executive body for environmental management of the municipality, including promoting projects at the state and federal levels.

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