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Diagnosis and proposal of an alternative system for the supply and treatment of water in the Mato Stream, municipality of Simonésia-MG.

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***Keywords*— Diagnosis. Water supply, Alternative water treatment Quality of life.**

***Abstract*— Basic sanitation services are essential to promote the improvement of quality of life and human dignity. The present study took place in the hydrographic microbasin of the third tributary of the Mato Stream, located in the São Braz community, in the municipality of Simonésia-Minas Gerais. This work aimed to diagnose the supply and propose an alternative system for the treatment of water consumed by the local community. To obtain the diagnosis, field research of an exploratory nature "in loco" was necessary. Visits were carried out at the water catchment points and the situation was investigated. of them, to later select alternatives to water treatment that meet local conditions through literature review research. It was found that the water supply was constituted by individual alternative systems, under the sole responsibility of the users. A worrying scenario was observed, in which in most cases, water was consumed without any type of treatment, and there was a lot of degradation around the contribution basins and water sources, impacts related to agriculture, in addition to others arising from the presence of animals and dumping solid and liquid waste without prior treatment.*

I. INTRODUCTION

Basic sanitation services are essential to promote the improvement of quality of life and human dignity, however, the disorderly growth of cities, combining the lack of planning and the non-definition of management priorities, mainly related to the cultural issue, states the situation of basic sanitation as one of the biggest problems faced in the country.

Access to basic sanitation services is guaranteed by law, in a universal, equal and integral way. In the last decade, there have been some advances in their coverage, however, the basic sanitation scenario in Brazil is still worrying and far from ideal. AND estimated that only 83.7% of the Brazilian population has access to treated water, and only 61.8% has sewage collection. In addition, there are problems related to the collection and inadequate disposal of solid waste in urban drainage (TRATA BRASIL, 2019)

The municipality of Simonésia-MG has 18,298 inhabitants, around 61% live in rural areas (IBGE, 2010); having coffee cultivation as its main economic activity. And with regard to basic sanitation, it is estimated that 81.68% of the urban population has an adequate water supply; 99.23% of urban domestic sewage is collected but not treated (SNIS, 2019).

In addition to untreated sewage, resulting from inadequate sewage disposal, which is commonly released into water courses, open air, or rudimentary septic tanks, which can contaminate surface and groundwater used to supply homes, it is very common in rural communities o consumption of water without any type of treatment, a situation that puts the health of people in these places at risk.

Therefore, a diagnosis of the water supply situation was carried out, and an alternative water treatment system was proposed in the microbasin located in the São Braz Community, in Simonésia-MG. Thus, due to the precarious sanitation conditions observed in this area, in view of the need for improvements in the living and health conditions of families and the environment. It was also intended with this proposal, to give a new perspective to the problems of rural basic sanitation in this region, which sometimes, due to misinformation, do not fully understand the serious sanitary problem and the lack of sanitation, which in this way promote the inaction and lack of understanding of the inhabitants of this community regarding the real problems that exist in the issue of rural sanitation.

II. MATERIAL AND METHODS

2.1 Characterization of the study area

The municipality of Simonésia is located in the São Braz community, 207 km from the capital of Belo Horizonte, in the Mata Mineira zone (Fig.1) and the coordinate relations at the central point, de is between 20°07'21.74"S and 42°00'10.05"W. Access to the region is via the MG-111 highway. It has an area of 489.51km², a population of 18,298 inhabitants, around 61% live in rural areas, and a demographic density of 37.39 inhabitants/km2 (IBGE, 2010); with a per capita GDP of 8622.44 reais, it occupies the 677th position in the ranking of the state of Minas Gerais. According to IPEA, it occupies the 642th position in the state ranking when it comes to the Human Development Index, with an HDI of 0.632. In 2010, 88.94% of the population had a bathroom and piped water in their homes.

The region in which the municipality is located is included in the Tropical Atlantic Domain. It has topographical, geological and biodiversity contrasts in the forest domain (GALINDO-LEAL & CÂMARA, 2005).

Coffee cultivation is the predominant economic activity. The plantations are located on a half slope to the thalwegs, and generally occupy areas with a strong slope and high altitude (Fig. 2). They are permanent crops, and often have soil changes caused by chemical fertilizers, correctives, pesticides, used without proper management, which can cause contamination. In addition, it has hilltops susceptible to the risk of mass movements (FUNDAÇÃO BIODIVERSITAS, 2011).

Fig.1: Geomorphological aspects in the municipality of Simonésia-MG.

Source: Authors (2021).

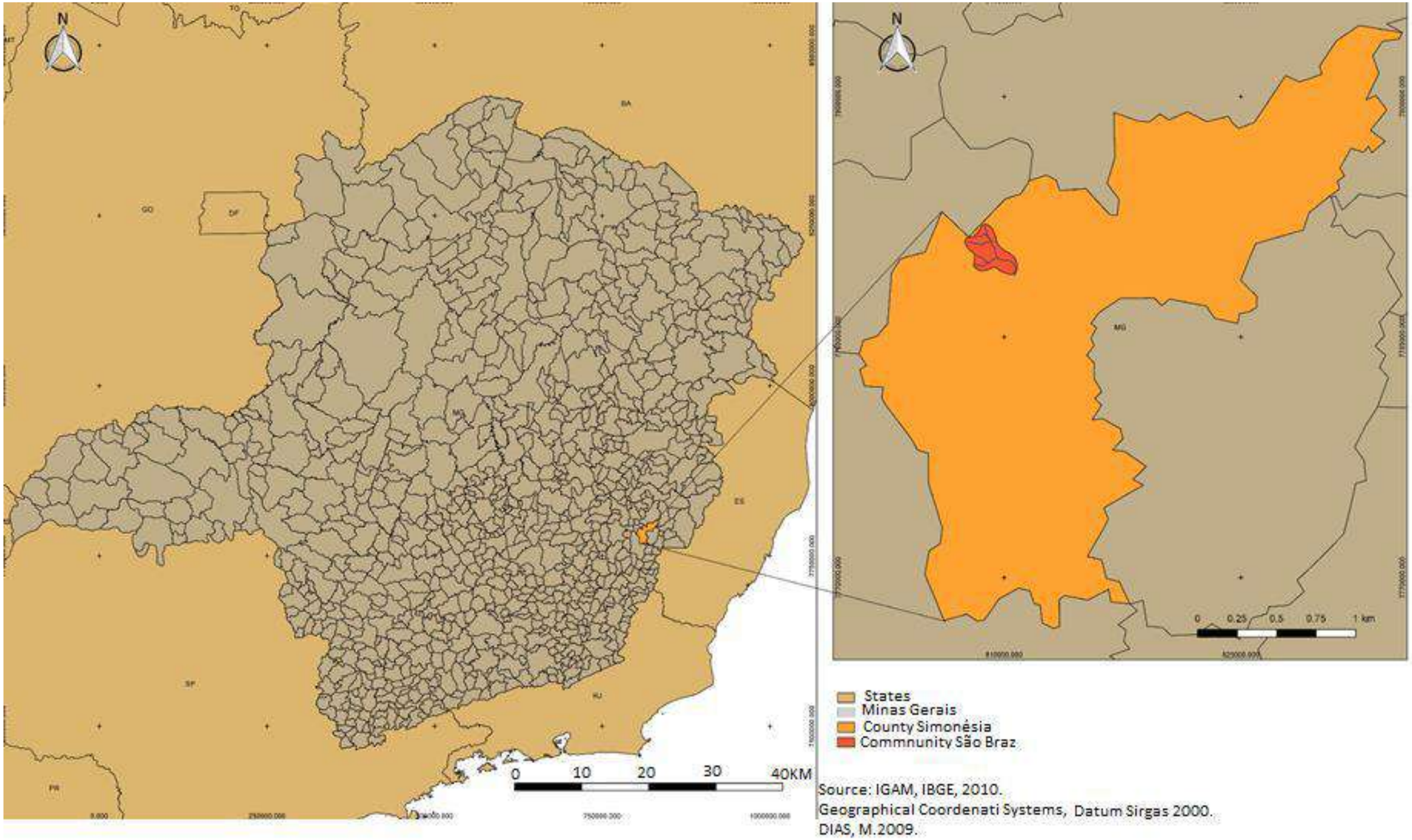

Fig.2: Location of the municipality of Simonésia-MG.

Source: Authors (2019).

The area determined for the study consisted of a portion of the São Braz community, located in the municipality of Simonésia - MG, the microbasin of the third tributary of the Mato Stream, consists of a hydrographic basin up Stream of an important natural heritage of the municipality. , the Cachoeira do Marreco, with great relevance in regional ecotourism. The area is also part of the Ecological Corridor that links the RPPN Mata do Sossego-Simonesia to the RPPN Feliciano Miguel Abdala-Caratinga, important conservation units that house the northern muriqui primate (Brachyteles hypoxanthusI), whose species is endemic to Minas Gerais and Espírito Santo, and is one of the most threatened with extinction in the world (FUNDAÇÃO BIODIVERSITAS, 2011). This micro-basin of the Mato Stream has 14 residences, with a population of 53 inhabitants (figure 3).

The delimitation of the microbasin was carried out by remote sensing, observing the relief and the altimetric dimensions, as they determine the direction of drainage flow; which was based on the topographic map SE-23-ZD-VI – Caratinga, available in the library of the Brazilian Index of Geography and Statistics (IBGE), satellite images from Maxar Technologies (2019), available on Google, and Shapefiles from courses in 'water available at the Instituto Mineiro de Gestão das Águas (IGAM), in the format – SHP (in GIS Databases). The processing was done with the help of Qgis® software - version 2.18.3 and Google Earth Pro.

The delimitation by remote sensing is important for demarcating the area to be studied and where the field work will be carried out, being a guiding instrument.

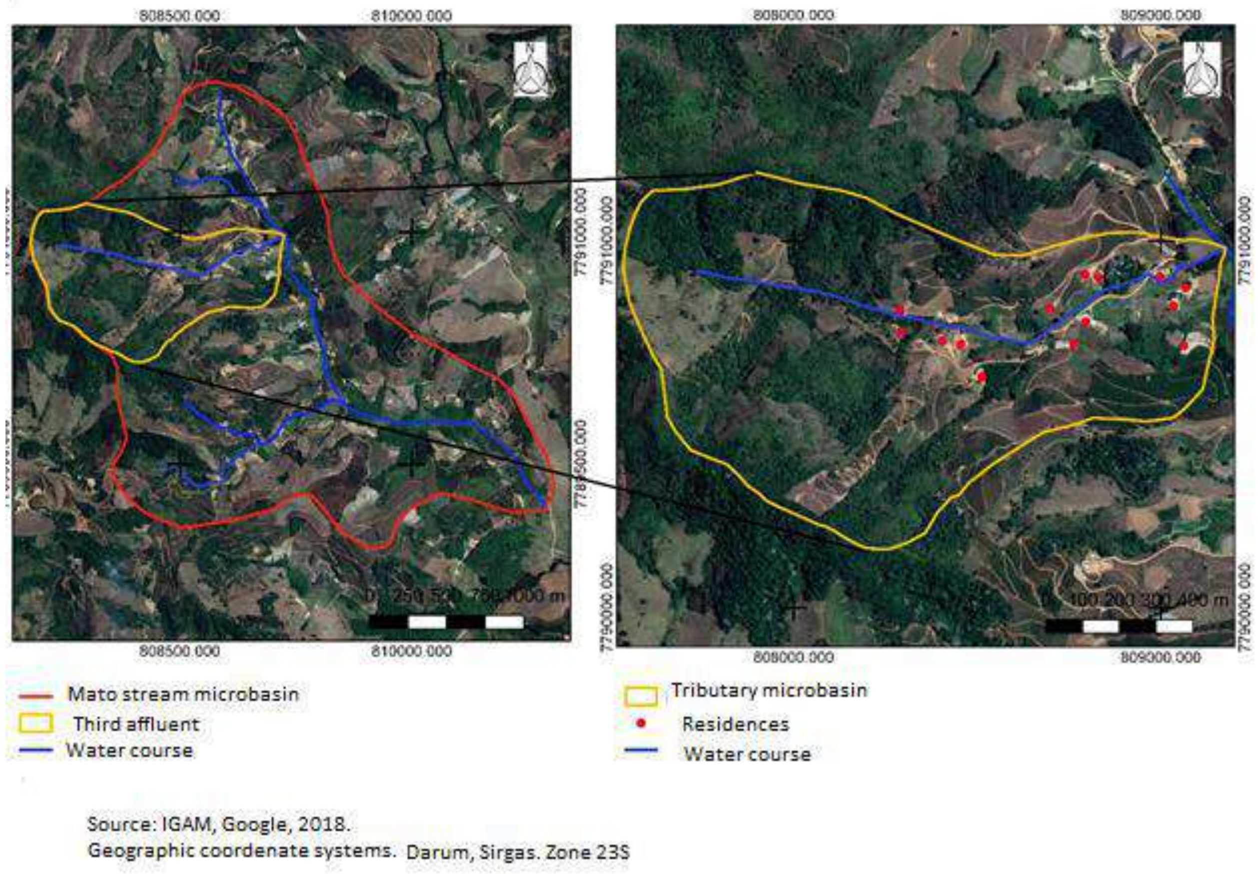

Fig.3: Location of the microbasin of the third tributary of the Mato Stream.

Source: Authors (2021).

The hydrographic microbasin of the third tributary of the Stream do Mato, has a territorial area of 107 ha and maximum and minimum altitudes of 1336m and 947m. The land use and occupation in the region is very diversified Fig.4. Family farming is the main economic activity, with a predominance of coffee (24.59ha), but there are areas for the cultivation of vegetables (2.65ha) such as cabbage, tomatoes, cauliflower, broccoli, green beans, among others (figure 5 and 6); and specific areas for different crops (2.66ha), such as cassava, potato, avocado, yam, banana, and so on. There are pastures for cattle (6.9ha) and eucalyptus (0.54ha).

The water used for irrigation in this area comes from the main river of this microbasin, which is fundamental for the livelihood of the families who live there.

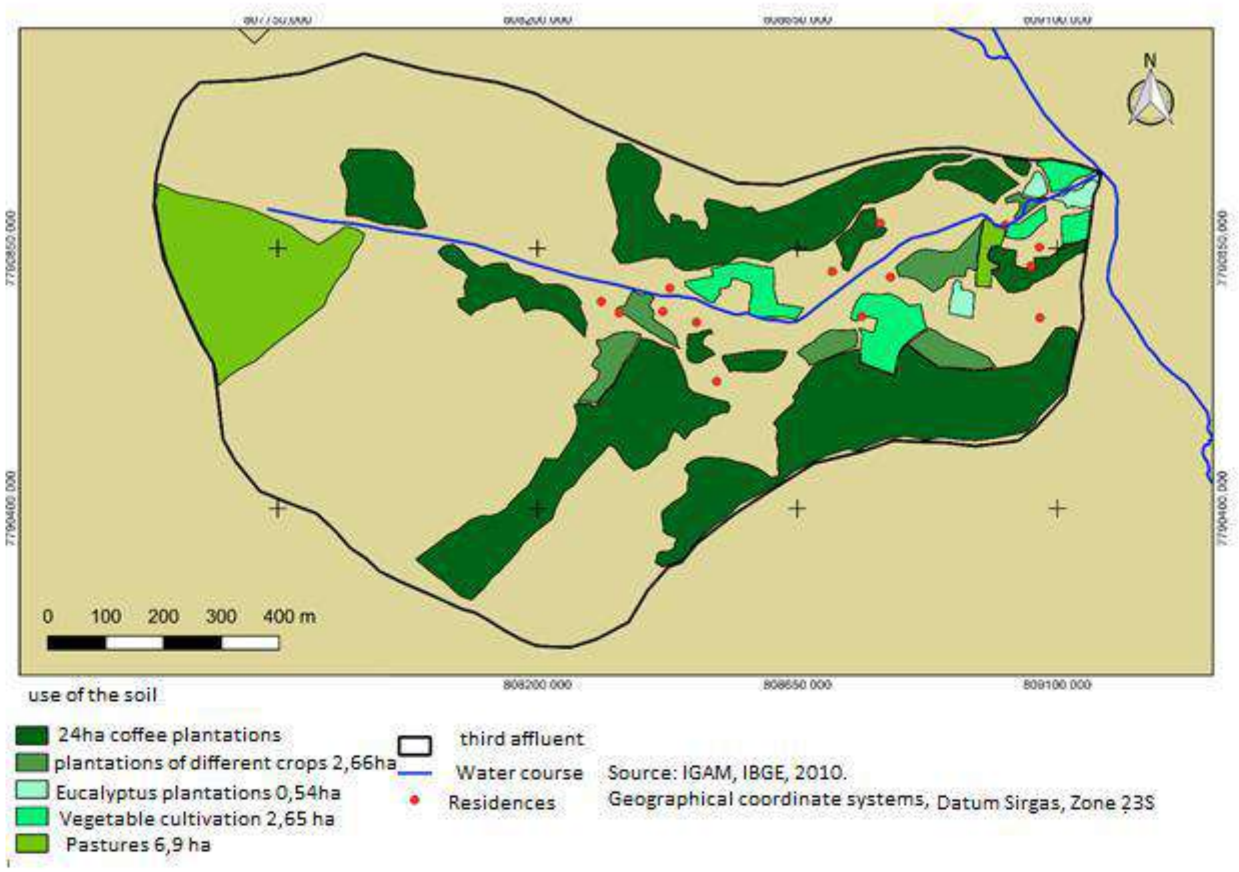

Fig.5: Land use in the microbasin of the third tributary of the Mato Stream.

Source: Authors (2020).

Fig.6: Vegetable planting.

Source: Authors (2020).

2.2 research structure

To carry out the diagnosis of the water supply system, a field research was carried out, of an exploratory nature, through a bibliographical survey to support the study, and provide a deepening of knowledge regarding the ideal alternative treatments for rural locations, and to help in decision-making. The bibliographic research was performed in several sources, such as: scientific books, sanitation manuals, procedures and sanitary surveillance, periodical articles, current regulations.

2.3 Field research

The field research took place in the microbasin of the third tributary of the Mato Stream in the period from 25/04/2021 to 02/05/2021, to obtain a diagnosis of the water supply system for human consumption in this region, visits were carried out at the points of water abstraction using observation procedures and photographs, in order to investigate their situation in a clear and visual way, and to collect geographic coordinates and altimetric quotas.

At each point, geographic coordinates and altimetric dimensions were removed, using the Waze® application version 4.72.0.0 installed on a mobile phone. Afterwards, the collected data were processed in the Excel-version 2016 software, and a map was drawn up containing all water catchment points in the region under study.

The map was made with data collected in the field and inserted into the file structure in the Qgis® software - version 2.18.3, from satellite images from Maxar Technologies (2019), available on Google Earth Pro.

2.4 Suggestion of a technological alternative for water treatment

After characterizing the water supply in the area under study and pointing out possible problems, improvements to the system were suggested, such as alternative technologies for treatment.

The selection of the most suitable technology for water treatment was considered through a research in the literature, in which some alternative sources of more common water treatment were raised, and a comparative table was elaborated with their advantages and disadvantages.

III. RESULTS AND DISCUSSION

3.1 Characteristics of the water supply system

Through field research carried out in the study area, it was found that the water supply system in the watershed of the third tributary of the Mato Stream is composed of individual alternative systems, under the sole responsibility of the user, having only abstraction, adduction of raw water, and reservation and distribution to the points of use, as shown in the diagram in Figure 7.

The water used to supply homes comes from springs and the water course (surface catchment), from direct intake, being transported by PVC pipes to the reservoir (water tank), and distributed to the points of use of the residence, such as faucets, showers, and toilets, without receiving any type of treatment. It is known that surface water sources are more susceptible to contamination, which poses a risk to the health of the population served, requiring greater expenditure on treatments (LIBÂNIO, 2008). Surface springs also present, in most cases, changes in the quality of raw water, due to seasonal variations between periods of rain and drought (BRASIL, 2007), which demands attention, and implies, in some cases, interruption of supply .

The adduction of raw water in the studied area is carried out by gravity, with the exception of a spring, which reduces the consumption of electricity. PVC tubes are used in this process, which Medeiros Filho (2009) claims to have excellent corrosion resistance, due to their composition, being less subject to attack by water and aggressive terrain.

Medeiros Filho (2009) also says that the smooth walls of the tube facilitate the flow, being able to provide a flow rate of up to 1.4 times greater than that of cast iron, under the same conditions.

For the reservation, polyethylene water tanks are used, with a storage capacity of 200 to 500 L, which distributes the liquid through PVC tubes to the points of use of the residence. In this context, Funasa (2017), pays attention to the possibility of water contamination in the reservoir, and highlights the need to take preventive and protective measures, such as the adoption of periodic cleaning, adequate structures, ventilation tube, waterproofing, cover, spillway , among others.

Most of the water is consumed in natura. The only type of treatment observed is the use of clay filters with ceramic candles with activated charcoal, however, in only 5 of the 14 homes. The clay filter has high efficiency in removing particles (turbidity), E. coli, and microorganisms, according to studies by (SILVA, 2016).

Silva, 2016, reports that around 98 and 99% were found to remove turbidity, and reduce between 4 and 5 logs of E. coli, using clay filters in their study. However, Heller & Pádua (2010), warn about the exclusive use of the filter to make drinking water potable, suggesting a combination of filtration with home disinfection. These data further expose the precariousness of the supply in the studied area and highlight the need to adopt other measures to improve water quality.

3.2 Description of water catchment points

According to what was observed in the field, there are a total of 8 water collection points, which supply 14 homes. At each point, geographic coordinates and altimetric dimensions were taken, shown in table 1. According to the data collected in loco, a map was created (Figure 8), containing this location and location.

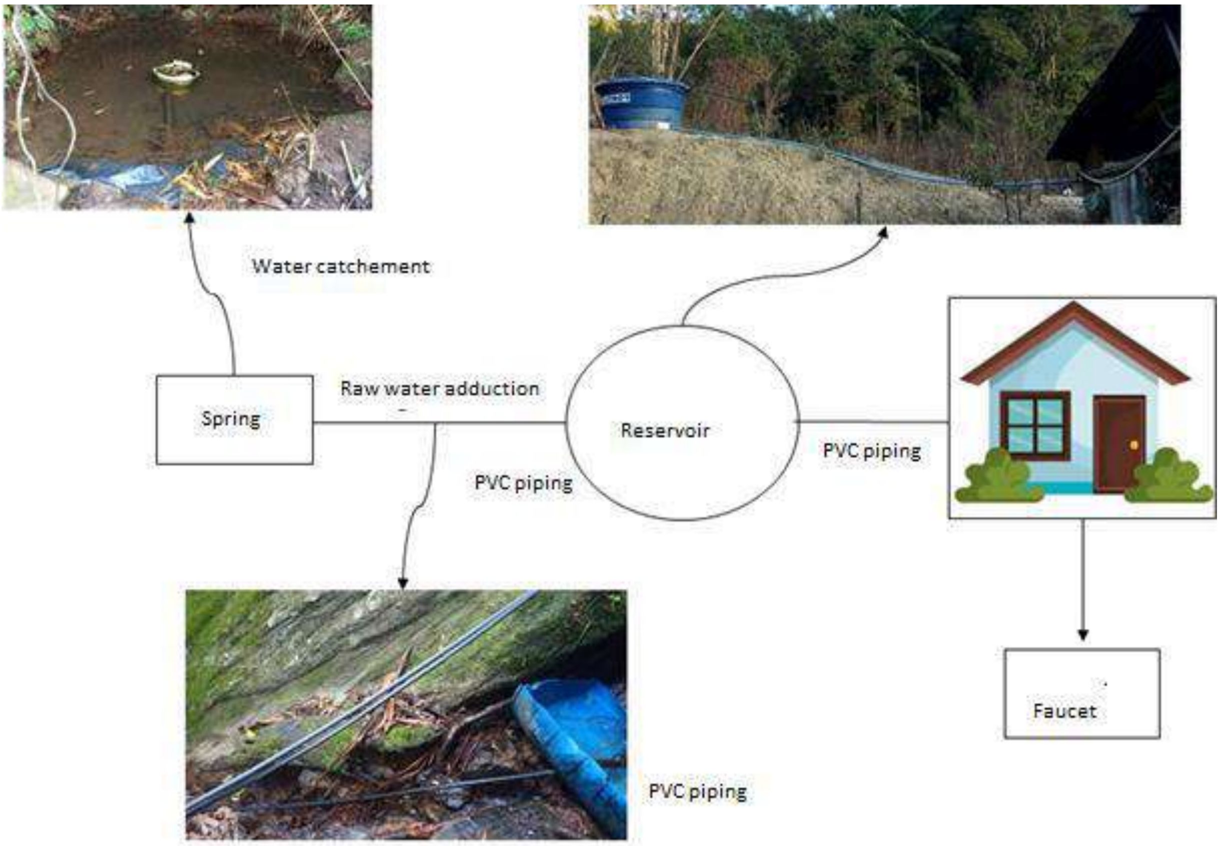

Fig.7: Scheme of the water supply system used.

Source: Authors (2021).

Table1: Geographic location of catchment points.

catchment points	Altitude (m)	Latitude (UTM)	Longitude (UTM)
P1	1075	7790803.44 m S	808225.08 m E
P2	1219	7790385.38 m S	808138.96 m E
P3	1181	7790424.02 m S	808182.13 m E
P4	1036	7790591.32 m S	808453.11 m E
P5	1012	7790616.55 m S	808593.54 m E
P6	994	7790756.67 m S	808642.28 m E
P7	992	7790762.17 m S	808662.17 m E
P8	969	7790788.43 m S	808831.72 m E

Source: Author (2021).

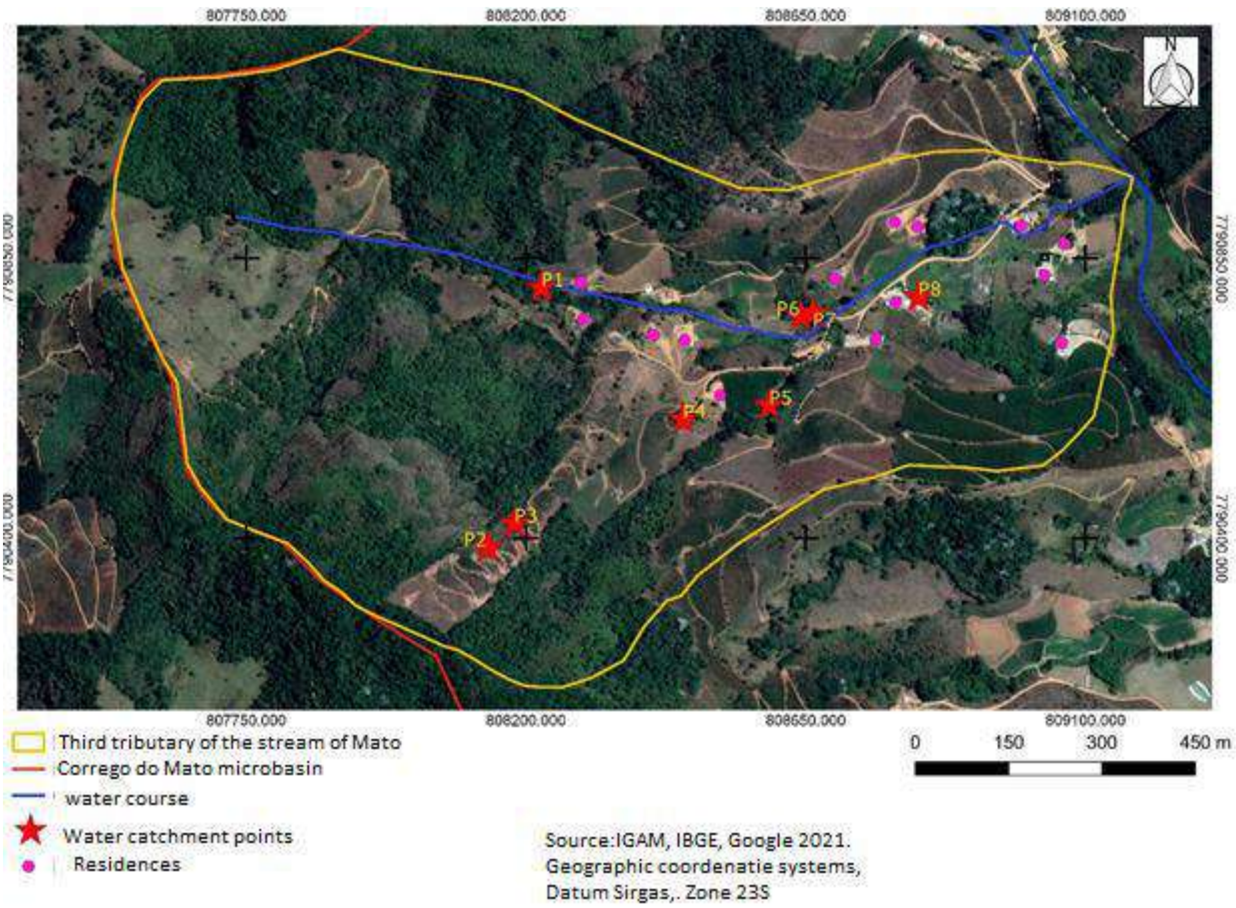

Fig.8: Location of water collection points for supplying homes.

Source: Authors (2021).

- **Vegetation**

The plant species found in the surroundings and in the springs are remnants of the Atlantic Forest, as shown in Figure 9. It was possible to identify some of them, presented in table 2, according to their popular and scientific name.

Table 2: Common plant species identified in water sources.

Local popular name	Scientific name
Palm heart	*Euterpe edulis*
Fern	*Cyathea delgadii*
Catscraper	*feathery acacia*
Bromeliad	*bromeliad*
fish roasting	*polysphaera vernonia*
Fern	*Pteridium aquilinum*
Embaúba	*Cecropia*
Cedar	*Cedrela fissilis*
Manacá da Serra	*Tibouchina mutabilis*
Bamboo	*Merotachys*

Source: Authors (2021).

Fig.9: Vegetation found in the study area.
Source: Authors (2021).

3.3 P1-Water catchment point 1

The first source of water intake is located at approximately 1075m of altitude. It is a perennial Stream, supplied by a hillside spring, which concentrates the largest number of individual users of this microbasin, supplying 5 homes, as can be seen in Figure 10. Each user is responsible for the implementation and individual maintenance of the system itself, having reports of disputes over the use of the source.

Fig.10: Location and perspective around P1.

Source: Authors (2021).

The collection takes place from the watercourse, using 1" or ¾" PVC pipes, being inserted in the most favorable places for the adduction of water, with the help of rocks found in the place. These ducts are inserted with the tip protected with a porous material, usually improvised with onion bags, fabrics or pieces of sieve, which allow the liquid to flow and at the same time, retain particles such as sand, branches, leaves and insects.

The water has a transparent and odorless visual appearance. However, there is the presence of biodegradable organic matter such as branches, flowers and leaves, which, when decomposed, naturally release nutrients such as nitrogen and phosphorus, responsible for water fertilization. However, Esteves (1998) states that, under natural conditions, these nutrients are limiting, as they are in low concentration compared to those required for the proliferation and maintenance of algae.

Furthermore, De Filippo (2000) mentions that in shallow water courses, such as the one analyzed, the vertical movements are more intense, which reduces the phosphorus sedimentation rate. What may explain the absence of algal blooms visible to the naked eye in the watercourse, however, also serves as an alert to the possibility of algal blooms if there is a greater supply of nutrients due to human activities.

- **significant anthropic action**

It was observed that there was the suppression of part of the natural vegetation for the implantation of coffee cultivation in point 1 of collection.

The vegetation on the banks of rivers plays a fundamental role in protecting the river. In addition to reducing siltation and/or erosion, it also influences the rainwater infiltration process, reducing surface runoff. And its replacement by agricultural practices poses a risk to the quality of water in the source, due to the transport of chemical residues from the use of fertilizers and pesticides, which can contaminate the water supply.

3.4 P2 and P3-Water catchment point 2 and 3

The second capture point is located at approximately 1219m altitude, having a central coordinate point 7790385.38 m S and 808138.96 m E, shown in figure 11.

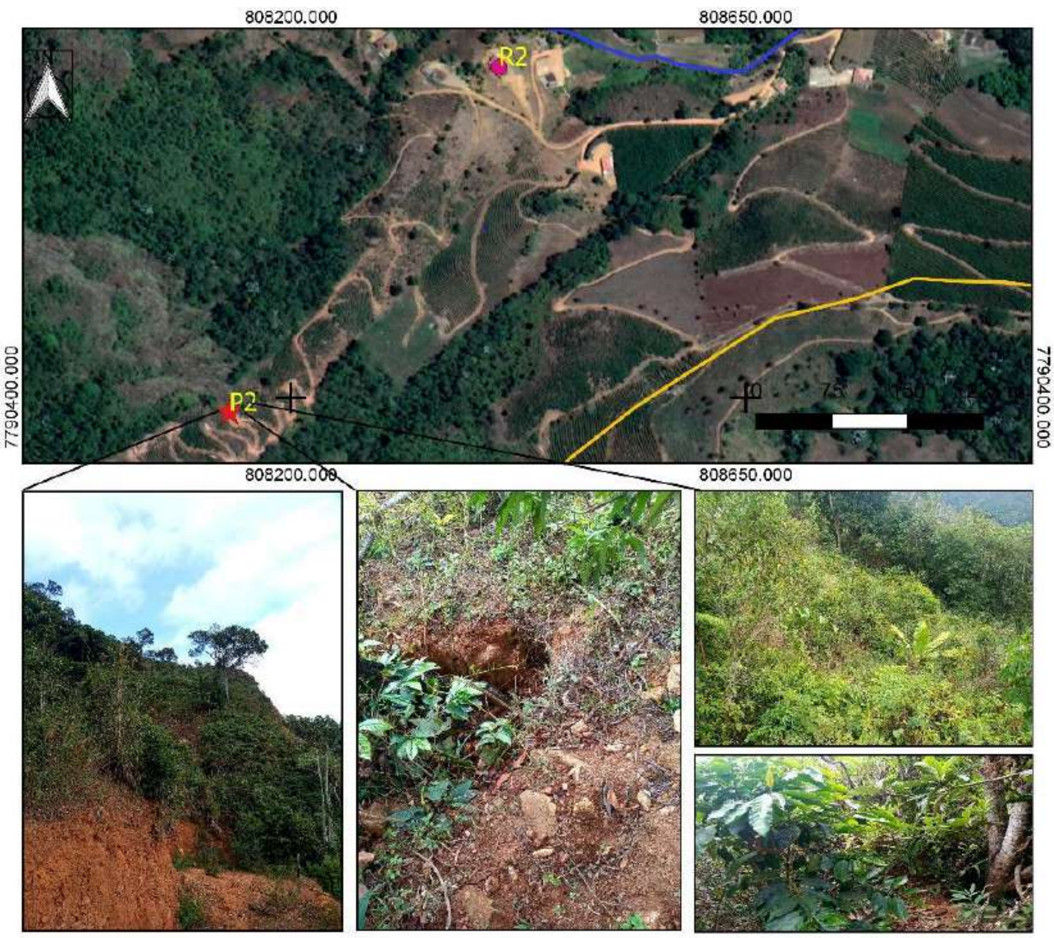

Fig.11: Location and perspective around P2.

Source: Authors (2021).

This point consists of a perennial slope spring in which there is no flow. Water infiltrates near the outcrop. The collection is carried out with the introduction of a 1" PVC pipe where there is a fountain, which transports water to a small asbestos box, from where the adduction begins.

It was noted that there is a lot of plant-derived debris at the site, which makes it impossible to see the water, and which can cause clogging of the pipes, in addition to interrupting abstraction. Also, it was observed that there is decomposition of this organic matter, which can influence the water quality.

At this point, the collection is carried out precariously, improvising a water intake tank with an asbestos box to ensure the flow, however, the use of this material is prohibited due to its danger, exposing these people to the risk of developing serious diseases when consume this water.

Asbestos consists of a fiber of mineral origin, composed of hydrated silicates of magnesium, iron, calcium and sodium. Over the last 100 years, it has been widely used in Brazil as a raw material for the production of asbestos cement artifacts, especially for the civil construction industry. However, scientific studies have proven its high carcinogenic potential, at any stage of production, transformation and use. This culminated in November 2017, with the ban on marketing and producing asbestos across the country (CASTRO, et al., 2003; HONAIN, 2021).

In the inspection "in loco", the interior of the box developed mosses, pioneer plants, avascular, which have bioaccumulative characteristics, being widely used as bioindicators of heavy metals and atmospheric pollution.

The location of the location is a favorable scenario for water contamination. In the vicinity of the collection point, animal feces were found, traces of the presence of horses, as shown in figure 12. This situation can be aggravated by the physical conditions of the site, an area that presents erosion and sediment drag problems (figure 24). In addition, the container where the water intake takes place does not have a lid, and is located under a fruit tree, which can attract birds due to the supply of food, which can defecate on the spot.

Fig.12: Presence of animal feces close to the collection point.
Source: Authors (2021).

The third capture point is located at about 1181m altitude, having a central coordinate point 7790424.02 m S and 808182.13 m E, is close to P2, as can be seen in Fig.13.

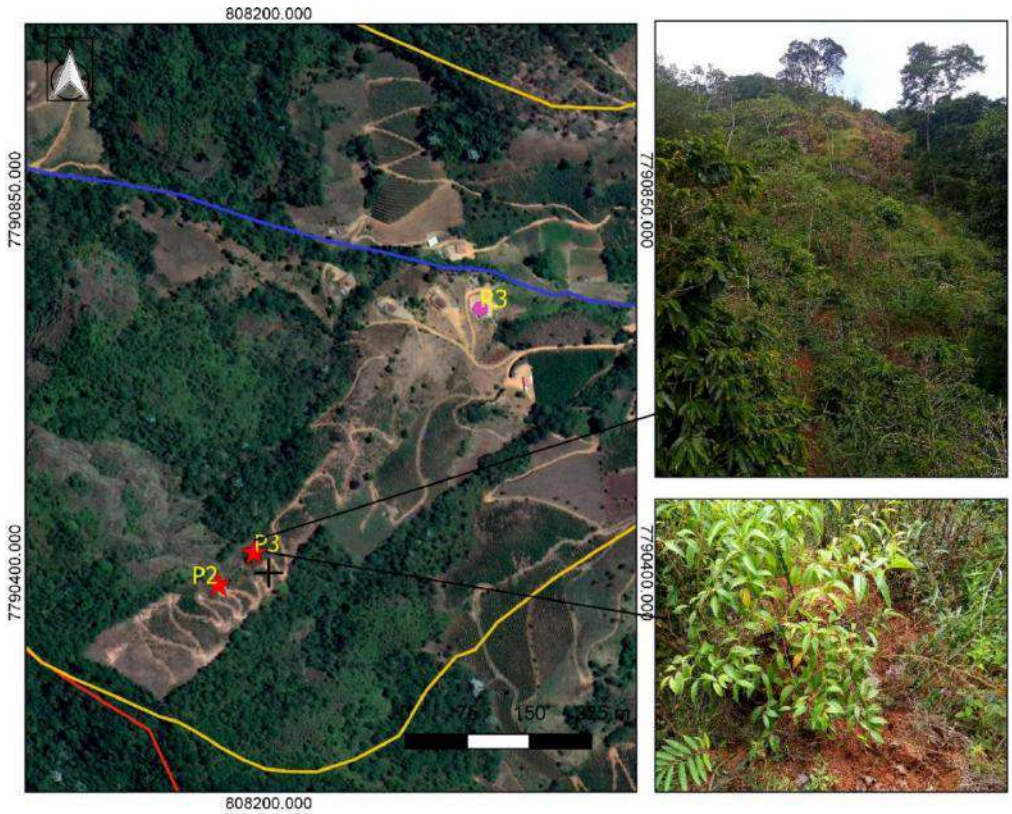

Fig.13: Location and perspective of the surroundings of P3.
Source: Authors (2021).

The collection of water at point 3 takes place directly from the spring, where a small dam was carried out and the PVC pipe inserted. The presence of sludge was identified, which leaves the water with a yellowish color and can modify its taste and odor. In the vicinity of the capture site, traces of the presence of animals were also detected.

- **Most significant anthropic action**

Through field research, it was noted that the area where points P2 and P3 are located, represents a great risk for maintaining the quantity and quality of water in these springs. In addition to the presence of animals, it was also observed that the region has steep slopes that are susceptible to mass movements.

The top forest, important for water infiltration and maintenance of the water table, as well as for the protection of the soil against erosive agents, was removed to make way for coffee cultivation. The situation was aggravated by the construction of roads, which serve as paths for the runoff and make the soil more suitable for the detachment of particles and drag of material, as can be seen in Fig. 14.

Fig.14: Erosive process caused by floods.

Source: Authors (2021).

In the rainy season of 2020, there was a large release of soil in the area due to the situation exposed above, shown in Fig.15.

Fig.15: Mass movement occurred in the area in question.

Source: Authors (2021).

3.5 P4-Water catchment point 4

The fourth capture point is located at an altitude of 1036m, with a central point of coordinates 7790591.32 m S and 808453.11 m E, which supplies a residence.

It consists of a perennial lowland spring, which requires equipment to carry out the suction and hold of water, illustrated in Fig. 16.

Fig.16: Suction and water holding in P4.

Source: Authors (2021).

The process uses a submerged pump, Sapo type, ½ CV of power, powered by electricity, and ¾" PVC piping, which pumps the water to the reservoir. The source has little fluid movement, with slow flow, which implies greater sedimentation of particles and microorganisms (protozoa), however, accentuates the color and allows the proliferation of algae and cyanobacteria, as cited by Brasil (2007).

- **Most significant anthropic action**

It is highlighted in Fig.17, that in this source, the vegetation consists of banana trees cultivated around it. This fact is due to the popular belief that this species brings benefits in terms of increasing the amount of water.

In addition, it is observed that the land where the source is located has a concave shape, which implies the surface runoff towards the source. Another aggravating factor is the cultivation of coffee around this area and throughout the catchment basin.

Fig.17: Location and perspective of the surroundings of P4.

Source: Authors (2021).

3.6 P5-Water catchment point 5

The catchment source 5 consists of a slope spring, located at an altitude of 1012m with a central point of coordinates 7790616.55 m S and 808593.54 m E.

The collection takes place at a natural waterfall point, with favorable conditions for drainage and water intake, as can be seen in Fig.18.

It was observed that the water has a light yellowish color, with the presence of mud and rust, which changes the flavor and odor. In addition, its domestic use without proper treatment sets up some inconveniences, such as stains on clothes, incrustations on surfaces, and clogging of filters.

Fig.18: Water abstraction at point 5.

Source: Authors (2021).

- **significant anthropic action**

Fig.19 presents a perspective through the processing of satellite images and photographic record, in relation to the geographic location of the catchment source 5, and the anthropic activities that can interfere in the quality and quantity of water.

Fig.19: Location and perspective of the surroundings of P5.

Source: Authors (2021).

The red arrow in Fig. 19 indicates where the capture point 5 is located in relation to the geographic space. Note that it is also an area of concave terrain, with steep slopes, where the flow converges to the source. There is also coffee growing.

The use of herbicides in this area was identified, as suggested by the presence of dead vegetation, illustrated in Fig. 20.

Fig.20: Use of herbicides on plant cover.

Source: Authors (2021).

3.7 P6 and P7-Water catchment points 6 and 7

The capture points 6 and 7, consist of individual springs, being considered shallow springs, located at 994 and 992m of altitude, respectively. They are located on the right bank of the main watercourse of the hydrographic microbasin of the third tributary of the Mato Stream.

In Fig. 21, the geographic position of P6 and P7 can be seen from satellite images, as well as the photographic record of these two points, with emphasis on the capture. The main river of this microbasin can also be seen.

The sources present a slow flow, with smooth movements, favorable to the sedimentation of heavier particles.

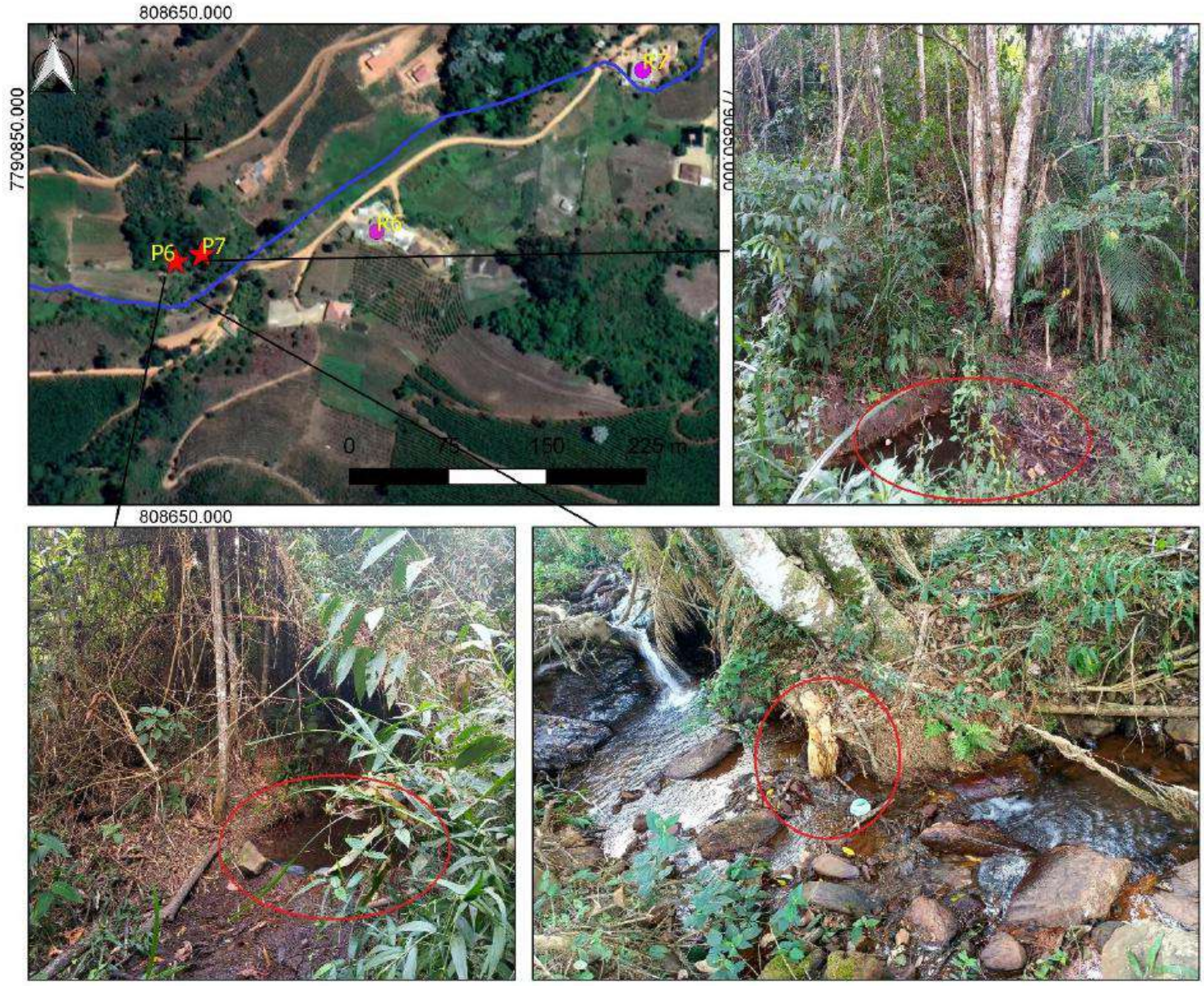

Fig.21: Location and perspective of the surroundings of P6 and P7.

Source: Authors (2021).

Fig. 22 illustrates the water catchment from P6. It should be noted that an intervention was carried out to allow for water intake and flow regulation, which consisted of a dam with soil, stones and canvas, ensuring the amount of water needed to meet the demand of this user.

To carry out the capture, a system was improvised to avoid the collection of sedimented particles, consisting of a perforated bucket, with a pipe inserted at this point, as can be seen highlighted in Fig.22. However, it was noticed in this system, the development of a biofilm layer[1]wrapping the bucket. The adduction is carried out by gravity, through a ¾" PVC pipe.

[1]Biofilm: consists of a polymeric matrix with a gelatinous appearance, adhered to a solid surface. They have a huge diversity of microbial species, often found algae, fungi, protozoa, bacteria and viruses (CHAVES, 2004).

Fig.22: Water abstraction at P6.

Source: Authors (2021).

- **significant anthropic action**

It was found that there is the development of agricultural activities in the vicinity of the basin of contribution of the springs. There are banana and cassava cultivation, as shown in Fig.23. The presence of solid waste in the main watercourse was also observed.

Fig.23: Agricultural activities in the vicinity of P6 and P7.

Source: Authors (2021).

3.8 P8-Peonto water abstraction 8

The catchment spring 8, located at 969m of altitude, consists of a spring. It is responsible for supplying 3 residences.

To protect the source, a masonry box with a slab roof was built, sealed with pieces of wood, as illustrated in the image in Fig. 24. The capture takes place inside it, with the insertion of a 1½" PVC tube , which then branches to individually supply the 3 residences.

Fig.24: Water abstraction from P8.

Source: Authors (2021).

- **significant anthropic action**

The catchment basin has several impacts, being devoid of natural vegetation cover and banana trees being cultivated. In addition, the site is occupied by houses and sheds for the processing of coffee, with a lot of people and vehicle traffic.

He also noted that downStream from the source, it consists of a floodplain, in which the land was drained to facilitate the implementation of agricultural activities.

Another source of impact observed and highlighted in the set of images in Fig. 25, as 'DE', consists of the discharge of domestic sewage and effluents from swine production, also existing at the site.

Fig.25: Location and perspective of the surroundings of P8.

Source: Authors (2021).

3.9 Important discussions about catchment points

Von Sperling (2005) states that the characteristics of raw water depend on natural conditions and on the use and occupation of land in the hydrographic basin. In this sense, the results presented in the previous topics demonstrate that the situation in the studied area poses a risk to the quality and quantity of water available in the supply, and especially to the health and quality of life of the population, corroborating Daniel (2001) , which states that the control of the spread of waterborne diseases is linked to the protection of water sources.

At all 8 catchment points, problems related to watershed degradation were observed. The Brazilian Forest Code provides, through legislation No. 12.651, of May 25, 2012, that Permanent Protection Areas -APP's are considered to be the marginal strips of any watercourse and springs, according to some criteria. Among these criteria, 30m of APP is considered for water courses up to 10m wide, which fits the analyzed one, and 50m for springs. However, it was noted that it is not met in the analyzed points.

The protection of native vegetation in the contribution basins of water sources, riparian forests, and hilltops is fundamental for the quality and quantity of water. In this regard, Tunisi & Tunisi (2010) discuss the costs of treating water from protected springs and argue that they can reach up to R$ 3.00 (three reais) per 1,000 m³, while in degraded and deforested springs, the cost can reach R$ 300.00 (three hundred reais) per 1,000 m³. What is even more worrying is that the water consumption in the analyzed microbasin is carried out without any treatment, or when there is, it consists of a simple filtration.

Grossi (2006) emphasizes that riparian forests act as filters, preventing chemical residues and sediments from reaching the watercourse. They also provide a physical and biochemical barrier against the entry of sources far from water courses, in addition to attenuating the impacts of the raindrop directly on the soil, which can cause the detachment of particles and contribute to the siltation of rivers.

In addition to the degradation of APP's, agricultural practices, especially traditional, also cause impacts on the soil. It was found that the main economic activity developed in the area under study is coffee growing, which corresponds to 65.9% of agricultural practices developed there, occupying an area of 23% of the micro-basin. This activity was identified in the vicinity of 5 of the 8 water sources.

According to Lopes et al., (2014), traditional coffee growing is characterized by the artificialization and simplification of agro-systems, being highly dependent on pesticides and chemical fertilizers. This causes a serious ecological imbalance, such as the loss of fauna and flora biodiversity and contamination and degradation of water resources. This activity impoverishes the soil, and subjects it to erosive processes, which leads to the loosening and carrying of particles into the watercourse, causing siltation. This is aggravated on terrain with a steep slope. In the process, particles from agrochemicals can also be carried into the watercourse, which may contain heavy metals. In this sense, Brasil (2007) highlights that substances such as heavy metals and pesticides,

The health effects arising from exposure to pesticides can be acute or chronic, as shown in Table 6. They can occur immediately, in months, years or even decades after exposure, manifesting in various diseases such as cancers, but congenital formations, endocrine, neurological and mental disorders (CARNEIRO et al., 2015).

In addition to these impacts, the presence of animals was also observed in two of the springs, dumping of effluents from pig farming and domestic use in the vicinity of another.

Dias et al., (2008), analyzed in their study the presence of Giardia spp. and Cryptosporidium spp. in water from a surface water supply that contained human and animal populations in the basin area, and found geometric mean results in the order of 3.92 oocysts/1 for Giardia spp. and 3.62 oocysts/l for Cryptosporidium spp. This shows the potential for contamination in a population that consumes water from sources with human and animal presence. This is also highlighted by Amaral (2011), which puts the health of the inhabitants of this region at risk.

3.10 Selection of the technological alternative for water treatment

From the bibliographical survey on some of the most common alternative sources of water treatment, table 3 was created, indicating their advantages and disadvantages.

Box 3: Advantages and disadvantages of alternative sources of water treatment.

Technology	Benefits	Disadvantages	Reference
Ozonation	More efficient disinfection when compared to the use of chlorine, chlorine dioxide and chloramines in inactivating bacteria, protozoa and viruses; Oxidation of micro pollutants that cause taste and odor in water; Reduction in the dosage of coagulants; Oxidation of macro pollutants; Reduction of chlorine dosage in post-chlorination; Decrease in the concentration of trihalomethane precursors; Algae annihilation; Increased duration of filtration lines; General improvement in water quality in the different treatment units.	Initial cost for installation is high; High energy cost for ozone generation; It is highly toxic and corrosive; There is no persistent residual production in the water; Ozone concentration rapidly decreases with increasing water pH and temperature; Formation of brominated by-products (when there are bromides in the water), as well as acetones; Biologically activated filters are needed to remove assimilable organic carbon and biodegradable by-products.	DI BERNARDO & DANTAS, 2005.

Ultraviolet (UV) radiation	Effective in inactivating many viruses, spores and cysts; UV disinfection is a physical process, which eliminates the need to generate, handle, transport or store toxic, dangerous and corrosive chemicals; Do not generate residual effects harmful to humans or aquatic life; Disinfection has a shorter contact time when compared to other disinfectants (20-30 sec.); Ease of operation; UV disinfection equipment requires less space than other methods.	Turbidity and total suspended solids in water can impair inactivation efficiency; Microorganisms can sometimes repair and reverse the destructive effects of UV through reactivation or photoreactivation mechanisms, or even in the absence of light; Need for a preventive program to control the formation of biofilms in quartz tubes; Low dosages may not be effective in inactivating some viruses, spores and cysts.	BASTOS, 2007.
Technology	**Benefits**	**Disadvantages**	**Reference**
Zeolites in filter media	Possibility of sizes, shapes and selective loads, thanks to their structures; Abundant synthesis material; Lower cost than other polymeric resins responsible for ion exchange.	-	FUNGARO & SILVA, 2002.
	-	The ionic selectivity, as well as the parameters related to adsorption efficiency and ion exchange capacity, is related to the crystal structure of zeolites, and the chemical characteristics of the ions detected in the solution; Temperature, pH and initial ionic concentration can affect metal removal.	SHINZATO, et al., 2007.
Moringa oil	It costs only a fraction of conventional chemical treatment; Bacteria reduction; The coagulant can be prepared on site, making its use in rural communities advantageous; Efficiency in the treatment of turbidity ranging from 50 to 100 NTU.	There is a need for complementary treatments such as chlorination, slow filtration, solar radiation.	PATERNIANI, et al., 2009.
	Reduces use of alkalinizers for pH correction; Forms more erosion-resistant microflakes in the filter interstices; Provides greater ease of treatment and final disposal of the sludge.	It can add organic matter to water, making chlorine disinfection difficult due to the potential for formation of trihalomethanes.	FRANCO, 2015.
Technology	**Benefits**	**Disadvantages**	**Reference**
Slow sand filtration	Low cost; It is easy to install, operate and maintain; Efficiency in removing pathogenic organisms; Absence of toxic residues;	Large area demand; Limitations regarding the characteristics of raw water, especially the concentration of solids; Possibility of using complementary treatments; Clogging of the filter bed;	MURTHA, HELLER & LIBANIO, 1997.

	Efficiency in the order of 90% in the removal of total coliforms, turbidity and apparent color, with the use of slow filtration preceded by pre-filtration.	Use of synthetic blankets to mitigate the effects of seasonal variations due to increased turbidity;	PATERNIANI & CONCEIÇÃO, 2004.
Clay filter with ceramic candles	Efficiency in removing turbidity and E. coli. Simple and low-cost technology; Cultural acceptability.	Periodic maintenance, such as cleaning and filling.	SILVA (2016).
Chlorinator	Simple system, easy to install and cost-effective; Can be mounted by the user; Ease of obtaining the necessary materials; Efficiency in removing germs and microorganisms.	Daily manual addition of 65% calcium hypochlorite by user; Need to check the amount of chlorine in the water;	EMBRAPA, 2014.
	High efficiency; Inactivation of pathogenic microorganisms existing in water; It works in the removal of hydrogen sulphide, iron and manganese; Free residual chlorine;	Calcium hypochlorite must be handled with protective equipment. Do not breathe vapor, avoid contact with eyes, skin and mucous membranes;	FUNASA, 2014.

Source: Authors (2021).

According to the diagnosis carried out in loco, and the comparison of the advantages and disadvantages of the technologies presented in table 6, the joint use of filtration and chlorination in water treatment in the hydrographic microbasin area of the third tributary of the Mato Stream was considered, corroborating with Héller and Pádua (2010), who suggest the combination of filtration and home disinfection.

Simpler, low-cost technologies were chosen, which do not require large areas, but which are also efficient, so that the needs of this population are met.

For filtration, the adoption of a clay filter with ceramic candles is suggested, due to its simplicity and ease of operation and maintenance, as cited by Silva (2016).

For the chlorination of water, the chlorinator is suggested, which is a technology whose treatment principle is chlorination, and has low cost, accessibility, ease of operation, and efficiency in removing pathogens, as shown by studies by Lima et al. , (2012), Druzian et al., (2020), characteristics that make it applicable in the community.

Brito et al., (2015), state that, in water disinfection, chlorine is a practical and effective product in the removal of pathogenic microorganisms, breaking molecular chemical bonds, with oxidation of free oxygen atoms and substitution reactions occurring with chlorine . They emphasize that the effectiveness of disinfection with chlorine depends on the pH of the water, being more efficient at pH between 5.5 and 7.5.

Furthermore, it acts on most pathogenic microorganisms present in water; not harmful to man at the dosage required for disinfection; it's economical; does not change other water qualities after application; it is relatively easy to apply; it leaves an active residual in the water, that is, its action continues after being applied and is tolerated by the vast majority of the population (BRASIL, 2015).

The EMBRAPA model chlorinator (B) was the alternative considered in the present work for water disinfection. The suggestion of this model was based on the low cost of the system compared to others. To make this comparison, a survey was carried out on the quantity and cost of materials needed to install four different types of chlorinators.

IV. CONCLUSION

The present work made it possible to know the main characteristics of the water supply in the hydrographic microbasin of the third tributary of the Mato Stream, to carry out a diagnosis of it, and in view of the needs, to propose alternative systems for the treatment of water for this rural community.

It was found that the water supply is made up of individual alternative systems, under the responsibility of the user, from the cost of implementation to its maintenance.

It comprises abstraction, adduction of raw water, reservation and distribution to points of use. There is no treatment system, being used in only 5 of the 14 homes, only filtration through a clay filter with a ceramic candle.

A worrying scenario was observed, mainly in relation to the degradation of the contribution basins and the catchment springs, fundamental for the maintenance of the quality and quantity of water for the supply, and that, in accordance with the Brazilian Forest Code, should be preserved.

In this sense, impacts were noted on riparian forests, hilltops and spring recharge areas, especially for the cultivation of coffee. The presence of horses in some springs was also observed, as well as the discharge of domestic and swine effluents. This highlights the possibility of contamination of water supplies by pathogenic organisms such as viruses, bacteria and protozoa, and by chemical residues from agricultural practices; which can compromise the quality of life and health of the population residing there and the health of the environment.

The adoption of alternative water treatment systems in this region is essential, and measures for the recovery and conservation of preservation areas are urgent. This requires an awareness and training work for this population, which can be started in schools attended by residents.

Therefore, it is concluded that this study contributes to the adoption of measures that can bring significant changes in the quality of life of this population, due to the reduction of disease risks, especially of water supply, and to the availability of water for supply in quantity and quality.

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