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Conservation and Recovery of the water Eye of Alto da Santa Cruz in the Municipality of Saúde/ Ba/ Brazil

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Abstract*— *The present work had the intention to study on springs, having as main objective to understand how the actions of the Municipal Secretariat of Development, Agriculture and Environment and of the associations and groups of environmentalists of the municipality of Saúde/Bahia/Brazil contributed with the conservation and recovery the Alto da Santa Cruz water eye. Through this research it was possible to identify the methods that contribute to the recovery and conservation of springs, aiming to understand and highlight the actions of the Environment Secretariat and the groups of environmental researchers from Saúde – Bahia as relevant in the attempt to revitalize the water eye, however not being sufficient to recover it. It was also possible to notice that many actions, despite being in compliance with the legislation and with the studies that have already been done in the area, can not contribute to the environment in any way if there is no support from the population, the government and the higher inspection bodies.

Keywords*— *Spring recovery; Environmental degradation; Conservation.

I. INTRODUCTION

The existence of life on Planet Earth depends essentially on a liquid that, despite being abundant on Earth, is poorly distributed (does not reach the taps of the entire population) and is used irrationally by man, compromising its quality, its capacity for renewal and your availability.

In addition, in Brazil the distribution of water does not occur in an equal amount in the territory, so there is a shortage in some regions while in others, water is left over. In the North Region, for example, one of the smallest populations per m² is concentrated, however, the highest concentration of liquid fresh water in the country. In the Northeast and Southeast Regions, where most of the population resides, water is lacking and it is necessary to adopt protective measures of coexistence (OLIVEIRA; MOLICA, 2017, p.09).

In this sense, it is possible to inquire and reflect on who actually uses water. Has human consumption been prioritized as described by the law? It is known that there are still many people who do not have access to water, much less of good quality, in some cases this is not the result of contrasts of poor disposition in the country, which is mainly due to the distribution and irregularity of rainfall in the territory, but rather by lack of public policies that do not reach these populations, in addition, another factor that interferes is the pollution of superficial and underground rivers, the degradation of springs, among other aspects.

Oliveira and Molica (2017) corroborate stating that even attitudes considered small in the eyes of the population, such as the conservation of a water source is fundamental to guarantee the quality of water for human consumption.

Based on this, thinking of springs as a fundamental resource for water supply and at the same time as a target of environmental degradation, observing the significant number of springs that dry up for numerous reasons, especially due to the lack of conservation and disorderly use of groundwater, the present work proposed a research based on the following problem: To what extent,

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the actions of the Municipal Secretariat for Development, Agriculture and Environment and of environmental associations and groups in the municipality of Saúde – Bahia, contribute to the preservation, conservation and recovery of the Eye of Water of Alto da Santa Cruz of this municipality? Have these actions had the expected effect? Has there been a reversal of the environmental impacts in the springs and in the Eye of Water from Alto da Santa Cruz?

In the city of Saúde – Bahia, many reports are made by former residents of the neighborhood and even of the city, related to the Eye of Water focus of this research, which during the dry season supplied and alleviated the lack of water for a good part of the population.

In these reports, it is noticeable that the anthropic attitudes of degradation are the main causes that culminated in the extinction of the water flow of the small spring. It is known that many can be the causes, therefore, it was necessary to carry out this research, not to deepen this perspective, but to understand how it is possible to recover the source and protect it.

In this way, the research becomes of great relevance, o it is considered essential to raise the population's awareness in the context of the preservation of springs and that through groups or associations join the municipal public power, through the Municipal Development Secretariat, Agriculture and Environment and carry out actions that can assist in its recovery through efficient recovery methods.

The research also serves as an evaluation of the attitudes/actions already carried out by the municipal public power and by the associations in an attempt to preserve and recover the Eye of Water, checking if they could indeed have contributed to its revitalization, if it contributed emphatically, or it didn't help.

The general objective of the work was to understand how the actions of the Municipal Secretariat for Development, Agriculture and Environment and of environmental associations and groups in the municipality of Saúde – Bahia contributed to the conservation and recovery of the Alto da Santa Cruz. In relation to specific objectives, it was proposed: A. Characterize springs; B. Identify the methods of conservation and recovery of springs; C. Analyze attempts to preserve and recover the water eye in Saúde – Bahia by the Municipal Secretariat for Development, Agriculture and the Environment and by environmental preservation associations and groups.

Finally, this article is subdivided into topics, where in the first part of the work a reflection is made on the water cycle and the springs, then some methods of recovery and preservation of springs are presented, therefore the typology of the research is presented, through the materials and methods, and finally, the results obtained are analyzed, reflecting on the attempts to preserve and recover the Eye of Water in Saúde – Bahia. As closing, we have the final considerations and references used to support the research.

II. BRIEF LITERATURE REVIEW

2.1 WATER CYCLE AND SPRINGS

The water cycle or hydrological cycle, os its name suggests, refers to the ability that water has to change its physical state (liquid, solid or gaseous) during the path it travels until it returns to its previous state, forming thus a cycle that has no end (WWF – Brasil, 2007).

According to Castro and Lopes (2001), “simply put, the hydrological cycle is the path that water takes from evaporation in the sea, passing through the continent and back again to the sea” (Apud Secretariat of State for the Environment, 2009, p.05). In fact, the authors are very happy to make such a statement since the water leaves a certain state and as a cycle goes through the other stages and returns to its initial state.

The following figure shows the hydrological cycle in an illustrated way, see:

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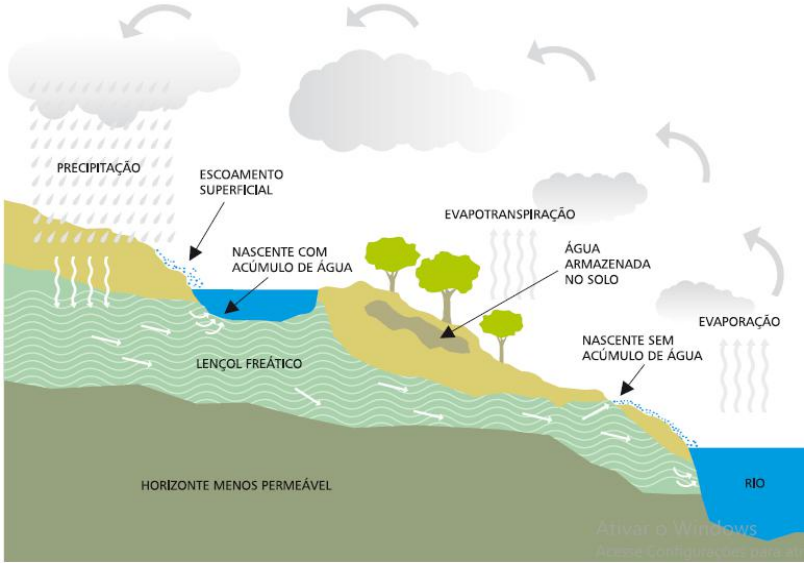

Fig.1: Scheme of hydrological cycle

Source: ENVIRONMENT STATE SECRETARIAT, 2009.

Looking at the figure above, it is possible to visually perceive that through the sun's rays, the water leaves its liquid state and passes into the gaseous process through the evaporation and transpiration of the plants, then when it reaches the atmosphere, it condenses, passing from the gaseous state to the liquid, forming clouds and returns to the Earth's surface through precipitation (rain, snow or fog). When precipitating, before reaching rivers and oceans again, part of the water infiltrates the surface supplying the water table and the part that does not infiltrate drains superficially until it reaches the surface water bodies such as rivers and seas.

According to the State Secretariat for the Environment (2009, p. 4). "The spring is understood as the outcrop of the water table that will give rise to a source of accumulation water (dam), or watercourses (streams, streams and rivers)". Still looking at the image above, it appears that some springs arise from the contact of the water table with the soil, which in some cases may have water accumulation and in others run off superficially until reaching a receiving body (river). Another concept that exemplifies this situation very well, says that a spring:

> i. [...] deals with the outcropping, on the surface of the soil, of water from a water table (which, roughly speaking, can be compared to a granulated layer through which water flows, located between or over other layers, of solid rock) or even from an underground river. When this occurs, a source can be formed, where the water is dammed and accumulates, forming, for example, a lake. Or else, a watercourse can be born (the liquid is not dammed and starts to flow in a stream, a stream or a river). (WWF – Brasil, 2007, p.20).

In addition, the spring can be of the slope type, when it originates in higher parts, as in hills or mountains, due to the contact of impermeable layers with the surface. They can also be known as diffuse springs, when they originate in lower areas, due to the outbreak of the water table. It is also noteworthy that the springs can have a continuous or seasonal flow, that is, they can appear all the time or dry out in certain periods. There are, therefore, as many other types of springs which it is not necessary to present in detail each one of them (SEMA, 2010, p.12).

2.2 METHODS OF PRESERVATION, CONSERVATION AND RECOVERY OF SOURCES

The permeability capacity of the soil is directly related to vegetation, this is a crucial factor to ensure that underground rivers are supplied, so it can be said that water and vegetation are directly related, whether in terms of humidity, precipitation, or even in guaranteeing soil permeability, both are inseparable (SEMA, 2009, p. 03).

The guarantee that a spring can have a seasonal or continuous flow necessarily depends on the infiltration capacity of the soil, when most of the water after a rainfall infiltrates, controlling runoff and decreasing erosion or silting processes (SEMA, 2010, p. 12).

However, the anthropic attitudes of degradation end up intensifying the seasonality of these springs, and in most cases, these in turn, do not reappear. It is a fact that many other agents also contribute significantly to this

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process, like animals, but not in the same quantity and intensity as humans.

Thus, it is necessary that methods of conservation and recovery of springs, be adopted, to guarantee the quality of the water, the recharge of rivers and springs and the guarantee of the life of the fauna and flora, in addition, the conservation of springs brings, above all social benefits such as supplying the population who need them, reducing water scarcity in some locations.

For these reasons, some authors claim that in order to conserve rivers, springs and, consequently, springs, one must start by preserving vegetation and riparian forests. This is confirmed in the statement by Maria, Milano and Seixas (2012, p. 11), when they say that "so that fresh water remains available for different uses (eg consumption and leisure), in addition to not polluting rivers, lakes and oceans, it is necessary to preserve the vegetation that protects the areas of water sources ".

The "Ciliary Forest Notebooks: Preservation and recovery of water and life springs", which is a booklet organized by the State Secretariat for the Environment of the State of São Paulo published in 2009, brings in a brief but very detailed way, some suggestions of actions that can be taken by landowners where they have springs or even by the local population.

It is known that according to Federal Law 4,771/65, repealed by Law No. 12,651, of 2012, the springs are protected, being considered Permanent Preservation Areas (APP), where they must be conserved, especially the vegetation that surrounds them in an area of at least 50 meters. So the first thing to do is to conserve this APP area.

Other suggestions given by the aforementioned booklet are to surround the area of APP to prevent the approach of animals that can by trampling, compact the soil and decrease its permeability, the removal of animals also prevents water from being contaminated by feces and urine. Redistributing the roads that are located close to the springs, avoiding the construction of pits less than 30 meters from the APP, are, among others, some proposals that also contribute to the preservation of springs.

Professor Maria Aparecida Ribeiro de Almeida, in 2013, developed a proposal with the students of Dr. Osvaldo Cruz State College to recover a spring in the city of Campo Mourão – PR, according to her the proposal was as follows:

> ii. The method used in recovery consists of manually cleaning the surrounding springs by removing organic materials such as roots, leaves, branches and mud. Then crack stone is placed (fill every spring) then the pipes are installed. The headboard is sealed with a mixture made with sieved soil, cement and water in the proportion of 3 x 1. The stones are intended to filter the water. The pipes serve to allow the water to drain and will be arranged according to their function: a 50mm pipe to receive previous treatment with bleach is installed in the upper part of the spring, whose objective is that the farmer makes a disinfection using bleach every three months. A 50mm pipe with a reduction to ½ inch will send water for consumption, another 50 mm pipe will be installed from 15 cm to 20 cm above the pipe that serves water to the residence and this will serve as an overflow (thief) and the pipe that will serve to exhaust the spring in the period of bimonthly disinfection must be 100 mm to speed up the flow process (ALMEIDA, 2013).

Despite the methodology adopted by the teacher and her students, before carrying out any source recovery method, one must take into account the type of source to be recovered and in the case of reforestation of the riparian forest, which consists of another method that can be adopted, choose native species from the place and distribute them properly on the ground.

The recovery through vegetation occurs in several ways and here we will mention only two analyzed by Mateus Robert Cardoso Winer in his Course Conclusion Work, the first is direct seeding that:

> iii. It is a process of recovering the vegetation of a given area through the release of seeds in large numbers of native species with good germination potential, which can be manual, mechanized or both. In this process, pioneer species must be sown, in high diversity, or together with secondary species, depending on the resilience of the location (EMBRAPA, 2017 apud WINER, 2017, p.13).

The second recovery process analyzed by Winer (2017) which we quote here is the planting of seedlings, according to him:

> iv. It is a practice adopted mainly in cases in which the agropastoral activity occupied the area where previously there was a forest formation, or else where the natural

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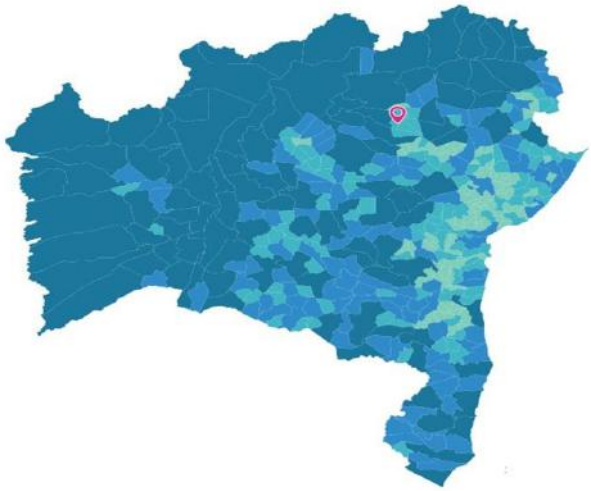
> vegetation around the place to be recovered does not exist or is quite compromised [...]. The process in general has many positive aspects. Once stabilized, the seedlings will start to develop layers of litter and humus, which can attract seed dispersing animals and consequently accelerate the process of plant succession (RODRIGUES et al., 2009 apud WINER, 2017, p. 15).

The aforementioned methods aim at recovering the riparian forest from a spring, which in the same way as the eyelashes have the function of protecting the eyes, so is the riparian forest, it protects the spring from possible silting, ensures the infiltration of water, among other functions, are of fundamental importance to ensure that these natural resources are preserved and conserved, in addition, they are simple and possible measures to be applied either by landowners or by the interested community.

III. MATERIAL AND METHODS

The Municipality of Saúde (map 1) belongs to the State of Bahia, located in the microregion of Piedmont of Chapada Diamantina, where the object of study consists of the Eye of Water/spring located in beighborhood Alto da Santa Cruz which has stopped coming out continuously.



Map 01: Map of the Municipality of Saúde/BA/Brazil

Source: IBGE Cities (2020)

The Municipality of Saúde – BA is located at geographic coordinates 10°56'27" latitude S and 40°25'04" longitude W, with a semitropical climate, altitude around 542m, with a total area of 499.722 km² and population around 11,845 inhabitants, with an estimated 12,913 inhabitants, for 2020. The economy of the municipality today generates a GDP per capita 5,951.69 R$ (IBGE, 2010).

Regarding the territory and environment, the Municipality of Saúde has 18.6% of households with adequate sanitation, 42% of urban households on public roads with afforestation and 8.1% of urban households on public roads with adequate urbanization (presence of manhole, sidewalk, paving and curb). When compared to the other municipalities in the State of Bahia, it is ranked 221 out of 417, 347 out of 417 and 152 out of 417, respectively. When compared to other cities in Brazil, its position is 3733 of 5570, 4434 of 5570 and 3002 of 5570, respectively (IBGE, 2010, p. 2).

Taking into account that this work aimed to describe and characterize the object of study (water eye/spring) and to analyze the various attempts of preservation, conservation and recovery of the spring and to understand which the main measures can be adopted for this purpose, consists of descriptive and qualitative research. According to Gil (2008, p.28) "research of this type has os its primary objective the description of the characteristics of a given population or phenomenon or the establishment of relationships between variables".

From the point of view of its nature, this is an applied research, having in mind that it aims to generate knowledge for practical applications directed to the solution of specific problems, having a qualitative approach. Furthermore, from the point of view of the objectives, it is an exploratory research, where it aims to provide greater familiarity with a problem, involving bibliographic survey, bringing the main concepts referring to the source and methods of recovering them, then an observation was made location and photographic record, identifying the object of study and describing the observed situation (GIL, 2008).

It is also characterized as a survey survey in the field since in the data collection a questionnaire was applied with the representatives of groups and movements of environmentalists, Friends of Nature Group (GAN), Grupo Live Water Eye respectively, as well as representatives from the Municipal Secretariat for Development, Agriculture and Environment and from them we identify whether and what actions have already been carried out to benefit the water eye.

Finally, a questionnaire was applied with the representatives mentioned above, and finally the analysis and discussion of the collected results was made. In the application of the questionnaires, inquiries were made to the representatives of each group or secretariat, to identify if they knew the water eye that is in the neighborhood of

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Alto da Santa Cruz, in the municipality of Saúde and all said that they were aware of the spring. Then they were asked to describe the previous state of the spring and how it is currently, as will be seen in the results and discussions of the research findings.

IV. RESULTS AND DISCUSSIONS

From now on, the results found in the survey will be presented. As stated in the methodological part, questionnaires were applied to the target audience (representatives of each group or secretariat) in order to identify whether they knew Eye of Water, in the case of knowing, to make a comparison between its state previously, and today. In response to inquiries, the following findings were obtained:

GAN representative: *"Before, the water eye was perennial, with good quality water, even families made money selling water, it had very good forest cover, the residents of Alto da Santa Cruz were supplied by it, it came to the train station. Currently, from the 1980s onwards, the spring began to suffer deforestation in its proximity, fires, exploration of stones and the removal of the land around the spring for use in gardens. In 2000, the spring began to disappear, returning at intermittent periods".*

Representative of the Environment Secretariat: *"Before, it was once a source that supplied the municipality of Saúde (human consumption), but over time it disappeared".*

Representative of Grupo Live Water Eye: "*Before the water eye came out of its source and passed through Alto da Cruz towards the station, today the cultural center, it was a stream where this same water also supplied the trains of railroad, had a fountain where several families survived and raised their children taking water and selling it to wealthy families in Saúde, for a long time it was the best water we had in the city, the kids had a party taking baths in its crystalline waters, more in 1977 the water eye shows the first signs of degradation, the fluids start to diminish and the water starts to become scarce, but the water eye has been undermining its water in time and time with limited flow, if it were two people to get water at the same time one had to wait for the water to sprout*".

In figures 02 and 03, on the left, in 2016, the Eye of Water with a small outcrop of water can be seen, and in the photo on the right recorded three years later, in 2019, practically in the same period, between the September and October, we observed that the small spring is completely dry.

Fig.2: Eye of Water in 2016
Source: ALMEIDA (2016).

Fig.3: Eye of Water in 2019.
Source: ALMEIDA (2019).

The images, although recent, actually illustrate the statements of the surveyed representatives. Then, a personal question was asked, so that they could say, in their opinion, what factors contributed to the water eye stop coming out and the responses were similar, signaling the environmental aggression, where they were mentioned:

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the disposal of garbage, fetus, and other situations, deforestation, the removal of black soil next to the spring (Figure 04), the neglect of public authorities, the planting of exotic trees that are aggressive to our region such as ficus (Ficus benjamina) and neem (Azadirachta indica), explosions for the removal of green quartz, in addition to the exploration of green marble, and the construction of roads that give access to the hill.

The following figure shows some of the situations described, it shows the area where Eye of Water is located, it also shows a part of the exposed and compacted soil in the vicinity of the source, see that there is still a significant forest upstream, and at the on the other hand, the place where the residents remove the black earth mentioned by the representatives surveyed here.

Fig.4: Eye of Water: current situation

*1 - Eye of water; 2 - exposed soil; 3 - extraction of black soil.

Source: ALMEIDA (2019).

According to the World Wide Fund for Nature (WWF – Brazil, 2007) the main problems affecting springs are:

> v. soil salinization in irrigated cultivation areas, in the semiarid region, which in general is due to inadequate irrigation management; ii. lowering the level of groundwater in regions where there is overexploitation of groundwater; iii. pollution of water bodies due to its use as a sewer receiver, which is possibly the biggest environmental problem generated by the irrational use of water resources (in São Paulo, for example, 70% of water and domestic pollution, against 30% of industrial origin); iv. disorderly growth of cities and; v. deforestation of springs, banks of watercourses (WWW BRASIL, 207, p.33).

Thus, it is observed that not only the problems mentioned above, but there are many situations that can affect the water quality and the perpetuity of the springs. The speech of this author reaffirms that in fact some of the statements described by the representatives of the groups and by the secretariat may indeed have contributed to the current situation of the source.

Then the survey participants were asked whether the location where Eye of Water is located is open and has free access for people and animals and unanimously stated that it was. In this case, the "Cadernos da Mata Ciliar" has already been cited, which says the following:

> vi. The area adjacent to the spring (APP) must be completely fenced in order to prevent access by animals, people, vehicles, etc. All measures must be taken to favor their isolation, such as prohibiting fishing and hunting, avoiding contamination of the ground or directly from the water by

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> unscrupulous individuals (SEMA, 2009, p. 12).

In this way, it is observed that Eye of Water is currently in a situation of vulnerability, exposed to free access of animals and people and as we saw earlier this can cause several damages to the water quality and to the soil. In addition, a small barrier was built in the vicinity of the source, as can be seen in figures 02 and 03, a ditch and a tank for storing the water that sprouted, the reports made by the representatives participating in this research were that this structure is concrete and that the material used in the small water barrier around the spring was basically sand and cement.

When asked if they knew any source recovery methods, the participants' responses were:

GAN representative: *"Isolate a large area around the source so that no one has access and reforest with trees in the region".*

Representative of the Environment Secretariat: *"There is only one, the PRAD (Project for the Recovery of Degraded Areas). The process has three steps, the first is to isolate the area, according to what needs to be recovered on site, whether it needs a plant replacement, etc. and the third is the planting of species, then it is necessary to carry out periodic monitoring for three years ".*

Representative of Grupo Live Water Eye: *"Today there is only one way to recover the same, involving all communities, especially the residents of that community".*

Asked if they had already planted seedlings at the site, all said yes, they also said they were native plants, among them: angico (Anadenanthera colubrina), ipe (Handroanthus), jatobá (Hymenaea courbaril), jenipapeiro (Genipa americana), ingazeiro (Inga), licuri (Syagrus coronata), brazilwood (Paubrasilia echinata), aroeira (Schinus terebinthifolius), bellies (Ceiba glaziovii), mango (Mangifera indica), among others. In this sense, it is more than clear to scientists, the indescribable value of maintaining native forests.

> vii. Scientists have known for a long time that forests and forests play a relevant role in the existence and abundance of freshwater systems. The most accepted thesis says that forests, forests and preserved environments fulfill, among other functions, that of maintaining a constant supply of good quality water. (WWF – Brasil, 2007, p. 33).

With this, we can affirm that the attitude of reforestation, and with seedlings of the local vegetation, guarantees the supply of fresh water in the rivers and in the water table, in addition, it helps to maintain the relationship between water and vegetation, since the proper functioning of a it necessarily depends on the other and mutually.

Finally, the last questions, which had the objective of identifying the actions promoted by the groups and secretariat in an attempt to recover and conserve Eye of Water, aiming to identify if such actions were successful. For such inquiries, the following answers were obtained:

Representative of GAN: *"Replanting of specimens of the original forest, lectures with the nearest residents, raising awareness of the danger of the removal of black soil around the source, Garbage collection". Was it successful? "In some, yes, like the planting of trees that remain in place and the failure is that the government did not provide support".*

Representative of the Environment Secretariat: *"Planting trees, isolating the area and placing signs on the site". Was it successful? "In some, yes, in others not, such as the isolation of the area".*

Representative of the Live Water Eye Group: *"I, plus a group of friends, decided to make a great joint effort known as Live Water Eye Group, in favor of cleaning the water eye, only when we were cleaning we noticed that water started to sprout among the garbage at that moment, the task force that would be just one day passed for a week in a row each time the cleaning came to an end, the water was increasing more and more, finally we spent a month doing the restoration of the big tank, after the little one, we made four fountains, two next to Maria Anita school and one next to Seu Luiz's house, and two in front of the water eye and a community laundry, we passed wires around the living water eye, all with help of the Health Society, where we created the Live Water Eye Group with CNPJ, with the title of public utilities Municipal and state utility, [...] several projects were made available. Those for the community, 18 classes of classes by EJA, 2 Licuri Cidadão projects where 40 more families benefited generating jobs and income, another 3 community gardens, another 28 families benefited from the Natal Feliz Project, where all the children received gifts, we had these projects for the group and we also took care of the water eye". Was it successful? "In some cases, like the removal of garbage, in others it does not achieve its expected result".*

The actions described above take up everything that has already been diagnosed in this work on methods of preservation, conservation and recovery of springs. The groups and associations, as well as the Secretariat for the Environment (SEMA), have developed projects in line with what is expected for the recovery of these water sources, based on the APP Law and on studies already carried out on the recovery of springs.

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However, such attempts were not enough to guarantee the conservation of the Eye of Water, perhaps due to the lack of support and supervision from the higher bodies and also by the residents, who often for lack of knowledge, contribute negatively to the environment, and with the available natural resources.

V. FINAL CONSIDERATIONS

The present study had the purpose of proposing a study on springs, identifying methods of preservation, conservation and recovery of springs, through an analysis of the attempts to revitalize Eye of Water in the municipality of Saúde – Bahia.

Through research, it was possible to realize the fundamental role that an informed population has, in situations that may have some impact on the environment. We realized that many actions, despite being in compliance with the legislation and with the studies that have already been done in the area, can not contribute to the environment in any way if there is no support from the population, the government and the higher inspection bodies.

In short, we emphasize that the objectives of this work have been achieved and we hope that it will serve as a reference for the residents of the municipality of Saúde, so that through it they can have a different look at nature and all that it offers us and so they can change his posture based on a reflection of his attitudes of environmental degradation. May it also serve as a base for the Environment Secretariats of this and any other municipality, which are focused on working with the recovery of springs and Eye of Water. In addition, that can support numerous other researches, linked to the listed theme, even if there is no intention here to end the discussion and debate.

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