Varginha urban springs, state of preservation, and perspectives for reality changing

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Abstract

Water springs are generally associated with rural areas; however, urban springs are also co-responsible not only for the volume but also for the water quality in the hydrographic basins. Therefore, the goal of the project was to map, and determine the degree of ecological preservation of urban springs located in Varginha city, Minas Gerais state, Brazil. By field visits and following two specific methodologies, the degree of ecological preservation of springs was determined by a simplified index of environmental impact. Among 21 investigated springs, 20% were properly preserved and 80% had unsatisfactory ecological preservation status. The main negative aspects are concerned with the presence of garbage, and the absence of riparian forests of a suitable size. Therefore, this research project indicates the need to mobilize authorities and society to protect their valuable water resources. The work contributed to a reflection based on concrete data acquired during the study, being fundamental in raising awareness and contributing in an important way to sustainable practices and behavior change related to environmental issues. In addition, the methodology of learning by projects allows the integration of different subjects, unifying knowledge and avoiding its fragmentation.

Key words: Challenges, Preservation index, Urban springs

1 Introduction

Usually, people associate the presence of springs and stream sources with rural areas. The demographic and physical growth of the cities during urbanization had a strong impact on the existing springs. Despite many springs located in urban areas are often "forgotten", they are equally important in feeding watersheds and providing water to the population. Spring is the place where the groundwater naturally emerges, even if it is intermittently. According to Brazilian legislation (BRASIL, 2012) springs are permanent protected areas and they must have a minimum dimension of the riparian forest of native vegetation of 50 meters in radius, even if they are intermittent. However, what is often observed is the disrespect for the permanent preservation areas, which must be urgently recovered. The National Water Resources Policy is based on the fact that water, although it is recognized as a renewable natural resource, is also a public domain resource and aims to ensure also the availability of water in adequate standards for future generations. In addition, acts to prevent and defend water resources against events resulting from their inappropriate use. Due to the importance of urban springs, this work used an ecological index to diagnose the preservation status of urban springs in the city of Varginha, Minas Gerais state (Brazil). This article was prepared as an environmental education work developed by teachers and students of the Centro Federal de Educação Tecnológica de Minas Gerais (CEFET-MG) in the city of Varginha, located in the southern region of Minas Gerais state and belonging to the Rio Verde watershed. According to the Institute of Minas Gerais Water Manage (IGAM, 2021), this Basin is 6,864 km2 long, covering 31 municipalities with 460,192 inhabitants. The Rio Verde is one of the tributaries of the Rio Grande river that belongs to the Paraná River Basin.

Environmental Education plays a vital role in encouraging the population to reflect on practices and actions aimed at the preservation and responsible management of these valuable natural resources. Therefore, the present work aimed to alert the community to the importance of preserving urban springs through a diagnosis of their current situation. In addition, the study was used as a tool to develop technical-scientific skills, through an interdisciplinary methodology, and thus awaken to the importance of community-school integration and show up the importance of community work. In addition, it aimed to seek partnerships and study strategies for the preservation of these important water resources.

2 Methodology

The work was developed with the participation of the students of the Technical High School in 2018. The project lasted two years and was interrupted in 2020 due to the Pandemic. On March 2022, it was decided to continue the work with a smaller group of students. The project is under the guidance of the Biology and Geography teachers of the Federal Center for Technological Education of Minas Gerais and the Biologist Jaara Cardoso Tavares. The research was conducted in Varginha (Minas Gerais state, Brazil) located at Rio Verde Hydrographic Basin. This drains the water that falls or that passes through the neighborhoods of the city of Varginha. The mapping of urban spring of this site was carried out by field visits and the classification of the current ecological preservation status of the springs was done following two methodologies. It was decided to use two different and methodologies because they are complementary. Both methodologies contemplate the ecological assessment of the spring and not their water quality based on physical, chemical and biological characteristics. The methodology proposed by TORRES (2016), notes were assigned to the apparent characteristics of the spring water (color and odor of the water, presence of: garbage around it, floating materials, foams, oils, sewage and its use by animals and human) and its surroundings (vegetation degradation, kind of protection, proximity to homes, type of insertion area). A score from 1 to 3 was assigned to each of these criteria (Table 1) and the sum of the scores corresponds to the index of the state of ecological preservation. The higher the sum of the scores of these parameters, the better the degree of ecological preservation. According to the following criteria: scores from 37 to 39 springs were classified as having an "excellent" degree of preservation; scores from 34 to 36 attributed as "good"; scores from 31 to 33 as "reasonable"; scores from 28 to 30 as "bad"; results below 28 were classified as "terrible". Is was investigates by the methodology of GOMES et al. (2016) the characteristics of the spring's surroundings area and the type and size of riparian forest. The impacts evaluated were: vegetation cover in the surroundings, soil sealing, degree of urbanization, distribution of riparian vegetation (BRASIL, 2012) and agricultural activity in the surroundings (Table 2). The sum of the scores awarded was used for the simplified impact assessment (SIA) - scores form zero – 3 springs were classified as "little impacted"; scores of 4 – 6 as "moderately impacted"; and scores of 7 – 10 as "highly impacted". In this methodology, the lower the score, better is the state of preservation.

To measure the radius of the riparian forest, the students used a measuring tape and when the location did not allow the use of a measuring tape due to the slope, the calculation of the radius was made by estimation using the counting of steps. The students obtained the coordinates of each spring using the mobile application, "My GPS Coordinates". The data obtained with the use of the two methodologies, the coordinates, the address and contacts of people in the community were tabulated. The results were structured in Excel spreadsheets, therefore allowing the associating different subjects of knowledge from different areas and allowing the development of technical-scientific skills.

Table 1. Grades assigned to the parameters used to calculate the Environmental Impact Index of Springs (TORRES, 2016).

Parameters	Scores		
	1	2	3
Color	Dark	Cloudy	Transparent
Smell	Intense	Slight	Absent
Garbage around	Very	Few	Absent
Floating material	Very	Few	Absent
Foam	Very	Few	Absent
Oils	Very	Few	Absent
Sewer	Domestic	Superficial	Absent
Degradation of Vegetation	Very	Few	Absent
Animal presence	Visible	Traces	Absent
Human presence	Visible	Traces	Absent
Site protection	Without	Accessible protection	Inaccessible protection
Proximity to urban structures	<50m	>50 and 100 m<	>100 m
Area of insertion	Absent	Private	Protected*

Table 2: Grades assigned to the parameters used to calculate the simplified impact assessment (SIA) of Springs (GOMES et al., 2016).

Parameters	**Scores**
Vegetation cover	
Absence of vegetation	2
Underbrush	1
Arboreal vegetation	0
Soil type	
Impermeable	2
Partial permeable	1
Permeable	0
Urbanization	
Very urbanized	2
Moderates urbanized	1
Conserved environment	0
Size of riparian forest	
< 25m	2
25m < Radius < 50m	1
Radius > 50m	0
Agriculture activity around	
Agriculture area	2
Intermediate area	1
Absence	0

3. Results and discussion

The study mapped 21 urban springs in the city of Varginha, Minas Gerais state. During the field visits, springs were photo-documented. Figure 1 shows some important aspects observed, negative and positive. However, it does not show the identification of each of the springs, as the authorization terms for the use of images were not signed by the owners of the places where the springs are located. Of the 21 springs visited, only 11 are public areas. The other 10 are located on private properties. The data was tabulated and the sum of the scores assigned to each spring was performed using Excel spreadsheets. The final results obtained and the state of preservation of each spring according to the two methodologies used are shown in Table 3. By analyzing the tables, the present research concluded that of the 21 springs visited: four have a "good" and two springs are classified as a "reasonable" state of ecological preservation. Five springs were classified as being "little" impacted. The others have a "bad" or "terrible" ecological preservation status and are "moderately" or "highly" impacted. Springs with an adequate state of preservation are located in areas protected by the government or by community initiative. In addition to the springs listed in the table, three intermittent water holes with large volumes of water during the rainy season were mapped (data not shown).

Nº	Name	Coordinates	Score TORRES (2016)	Ecological status	Score GOMES et al. (2016)	Simplified status assessment
1	Parque Novo Horizonte 1	-21.566313, -45.441797	29	Bad	5	Moderately impacted
2	Parque Novo Horizonte 2	-21.566313, -45.441797	27	Terrible	5	Moderately impacted
3	Campos Elíseos	-21.541815, -45.437591	26	Terrible	7	Highly impacted
4	Zoo –Aligator Spring	-21.568133,-45.446402	34	Good	2	Little impacted
5	Zoo – ET spring	-21.568509, -45.445868	33	Reasonable	4	Little impacted
6	Jardim Petrópolis	-21.567677, -45.443824	30	Bad	8	Highly impacted
7	Cave	-21.560527, -45.437386	28	Bad	6	Moderately impacted
8	Bairro Sion	-21.571683, -45.418092	23	Terrible	7	Highly impacted
9	Parque Rinaldo N1	-21.537948, -45.456668	36	Good	3	Little impacted
10	Parque Rinaldo N2	-21.538278, -45.456593	34	Good	3	Little impacted
11	Parque Centenário	-21.575084,-45.423013	30	Bad	4	Moderately impacted
12	Imaculada	-21.592112, -45.449484	23	Terrible	7	Highly impacted
13	Nascente Bairro Vargem	-21.542290, -45.415618	25	Terrible	4	Moderately impacted
14	Parque Mariela	-21.558877,-45.458937	30	Bad	4	Moderately impacted
15	Parque dos Dinossauros	-21.571989, -45.412437	23	Terrible	7	Highly impacted
16	Nascente Rua José Guedes	-21.572104, -45.415313	26	Terrible	7	Highly impacted
17	Bairro Santa Luiza N1	-21.574651, - 45.448210	28	Bad	8	Highly impacted
18	Bairro Santa Luiza N2	-21.575528, -45.448515	28	Bad	8	Highly impacted
19	Bairro Rezende	-21.591753, -45.433535	31	Reasonable	4	Moderately impacted
20	EE Pedro Alcantara	-21.549363, -45.446386	29	Terrible	8	Highly impacted
21	Alta Vila	-21.573383, -45.455560	28	Bad	4	Moderately impacted

Figure 1: Photo-documentation of positive (A) and negative (B) aspects identified around the springs. A: Positive aspect – presence of riparian forest around some springs. B: negative aspects: presence of human and animal feces, presence of oils and absence of riparian vegeta tion, presence of animals and garbage

Conclusion

The work concluded that only 24% of the springs are properly preserved and more than 76% of the springs have unsatisfactory ecological quality. Therefore, the present work is not only important for the awareness of the owners of the lands where the springs are located, but also requires actions by the government to comply with the law and, above all, claims for social mobilization to achieve the conservation of these valuable natural resources. According to FRANCO (2001), urban planning is essential so that the integrity of water sources is respected, requiring human actions in urban areas in order to consider the sustaining capacity of ecosystems at the local and regional levels. And, nevertheless, the hydrological functions of the riparian forests must be considered for efficient maintenance and integrity of the watershed, and to optimize the quality of water and life of the population. In the city of Varginha, there is any planning for urban springs preservation and, according to this study, a large number of springs tend to disappear due to a lack of actions, public policies, and even compliance with current legislation aimed at the preservation of urban springs. SOUZA et. al (2019) and LOZINSKI et al. (2010) showed that this type of mapping is essential to technically support the development of public policies for the management of urban springs and their environmental conservation

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