Research, Society and Development, v. 12, n. 4, e26212441165, 2023
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v12i4.41165

Springs environmental perception in rural properties

A percepção ambiental sobre nascentes em propriedades rurais

Percepción ambiental sobre los manantiales en propriedades rurales

Received: 03/23/2023 | Revised: 04/12/2023 | Accepted: 04/13/2023 | Published: 04/18/2023

Hanna Fajardo Ramos
ORCID: https://orcid.org/0009-0008-8092-4081
Fluminense Federal University, Brazil
E-mail: hannafajardo@outlook.com
Danielle da Costa Rubim Messeder dos Santos
ORCID: https://orcid.org/0000-0002-2470-493X
Fluminense Federal University, Brazil
E-mail: daniellerubim@id.uff.br
Roberta Fernanda da Paz de Souza Paiva
ORCID: https://orcid.org/0000-0001-5856-822X
Fluminense Federal University, Brazil
E-mail: robertapaz2003@yahoo.com.br
Welington Kiffer de Freitas
ORCID: https://orcid.org/0000-0001-5506-8801
Fluminense Federal University, Brazil
E-mail: wkiffer@id.uff.br

Abstract
Springs are one of the main sources of water supply for the population living in rural areas. Through the application of a questionnaire composed of 16 questions and based on IIAN (Springs Environmental Impact Index), the objective was to capture the environmental perception of producers about ten springs, with each owner evaluating those belonging to his property. The study region is in the rural area of Floriano, district of Barra Mansa, located in the state of Rio de Janeiro. According to the environmental perception of these owners, 50% of the springs fit within the degree of reasonable preservation, 40% were considered to be in good condition and 10% were classified in the degree of preservation considered poor. The type of questionnaire applied can supply, indirectly, the lack of information on water quality and the conservation of springs in that area. Therefore, the analysis of environmental perception allows to understand the man/environment relationship.
Keywords: Environmental impact; Water resources; Groundwater; Conservation of springs; Environmental perception.

Resumo
As nascentes são uma das principais fontes de abastecimento de água para a população residente em áreas rurais. Através da aplicação de um questionário composto por um total de dezesseis perguntas e embasado no IIAN (Índice de Impacto Ambiental de Nascentes), objetivou-se captar a percepção ambiental de produtores acerca de dez nascentes, sendo que cada proprietário avaliou aquelas pertencentes à sua propriedade. A região de estudo localiza-se na área rural de Floriano, distrito de Barra Mansa, localizado no estado do Rio de Janeiro. Segundo a percepção ambiental desses proprietários, 50% das nascentes enquadraram-se no grau de preservação razoável, 40% foram consideradas com bom estado de conservação e 10% foram enquadradas no grau de preservação considerado ruim. O tipo de questionário aplicado pode suprir, de maneira indireta, a falta de informações sobre a qualidade da água e a conservação de nascentes nessa área. Assim, a análise da percepção ambiental permite compreender a relação homem/ambiente.
Palavras-chave: Impacto ambiental; Recursos hídricos; Águas subterrâneas; Conservação de nascentes; Percepção ambiental.

Resumen
Los manantiales son una de las principales fuentes de abastecimiento de agua para la población que vive en las zonas rurales. Mediante la aplicación de un cuestionario compuesto por un total de dieciséis preguntas y basado en el IIAN (Índice de Impacto Ambiental de Manantiales), el objetivo fue captar la percepción ambiental de los productores sobre diez manantiales, y cada propietario evaluó los pertenecientes a su predio. La región de estudio está ubicada en el área rural de Floriano, distrito de Barra Mansa, ubicado en el estado de Río de Janeiro. Según la percepción ambiental de estos propietarios, el 50% de los manantiales se clasificaron como razonablemente bien conservados, el 40% se consideraron en buen estado de conservación y el 10% se clasificaron como malos. El tipo de cuestionario aplicado puede suplir indirectamente la falta de información sobre la calidad del agua y la conservación de los manantiales en

esta zona. Así, el análisis de la percepción ambiental permite comprender la relación hombre/medio ambiente.
Palabras clave: Impacto ambiental; Recursos hídricos; Agua subterránea; Conservación de manantiales; Percepción ambiental.

1. Introduction

Water is a way of subsidizing social well-being and inclusive growth, it offers several services that can minimize poverty, improve economic growth and environmental sustainability. They also ensure food and energy security, in addition to human health (UNESCO, 2015). The scarcity of these resources and their problems are the focus of a growing debate, sometimes in relation to their quality, sometimes in relation to their quantity and/or the modes of use by the human beings.

Considering this information and the importance of water resources, it is essential to highlight the role of springs as a water outcrop, in addition to being used as a source of water by the population living in rural areas. According to Tanner and Johnston (2017), rural populations depend on local natural resources to survive.

Thus, to assimilate the social and environmental changes resulting from land use and the change in land cover, there must be an analysis of qualitative research on environmental and social perceptions, since collective and individual choices and attitudes are determined by local history. Since population stability, occupation time, historical knowledge and collective memory express the relationship between man and nature; consequently, they favor conservation (Kohler, Marchand & Negrão, 2015).

The parameters for visual analysis of the environmental conditions of the springs are also important to define their physical characteristics and their conservation status. This must occur in accordance with the land use modes of a locality.

Research on the subjects' environmental perceptions is essential to understand how the relationship between men and the environment in which they live occur, their expectations and satisfactions, how they acquire values and conduct, how they perceive their actions and how they behave in the face of socio-environmental problems (Oliveira & Corona, 2008). To this end, it is important to define the problems that will be addressed in qualitative research with data collection. According to Boni and Quaresma (2005), the use of questionnaires is advantageous as it ensures the research participants anonymity. It is also considered a quick and accurate way to get answers.

From this idea emerges the question about the environmental perception rural producers in the studied region have concerning the springs in their properties. Therefore, this research aims to evaluate the rural producers' environmental perception about the environmental conditions and the preservation degree of springs present in their properties in the district of Floriano in Barra Mansa-RJ. For this, a questionnaire based on the IIAN method (Springs Environmental Impact Index) was used, showing their behavioral opinions of preservation and the geographic characteristics of the springs areas.

1.1 Environmental Perception

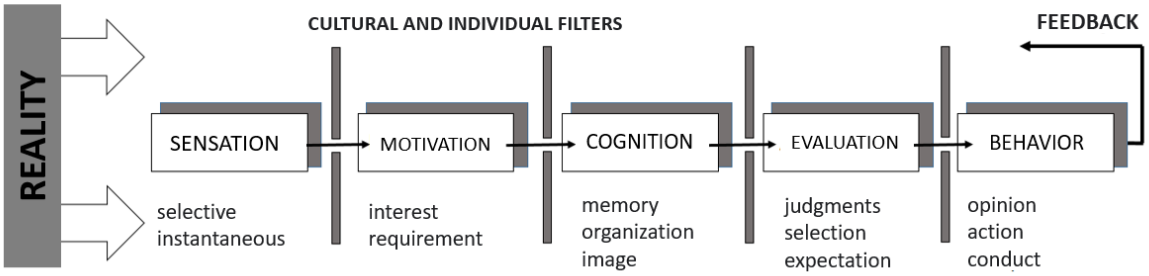
According to Souza (2017), Anne Whyte was a pioneer when writing about environmental perception in her 1977 work "*Guidelines for fields studies in environmental perception"*. Since then, other authors have addressed the subject. Ribeiro, Lobato and Liberato (2009) state that studies on this topic were most expressive in the area of knowledge focused on geography.

To Tuan (1980), perception is the response to external stimuli by the senses. Through perception, the individual can add value to a particular place by obtaining and organizing information through the senses (sight, hearing, smell, taste and touch) (Moimaz & Vestena, 2017).

According to Del Rio (1999), the senses would be the perceptual mechanisms that, together with cognitive mechanisms such as motivations, moods, needs, prior knowledge, values, judgments and expectations, would allow interaction

between the individual and the environment, understanding perception as this mental process of interaction. The perceptual process depends, therefore, on the interaction between these mechanisms (Figure 1).

Figure 1 - Perceptual process theoretical scheme.



Source: Adapted from Del Rio (1999).

The reality of this process, verified by every citizen, defines actions and behaviors that will directly and indirectly impact spaces and environments. In this way, feeding back new perceptual processes. Melazo (2005) highlights that perceptions and values differ between individuals and different groups, which must be considered in the conservation of the natural environment.

Filho and Braga (2007) recognize that assessing environmental perception enables to expand knowledge of how the residents' relations with the territory where they live occur. This fact, consequently, facilitates the identification of perception patterns and the interpretation of individuals' choices and actions. Thus, the evaluation of human actions about their place in the environment becomes possible when there is some reflection on the human-environment relationship, being able to express their expectations, anxieties, satisfactions and dissatisfactions, judgments and behaviors (Schiavinato & González, 2020).

The environmental awareness relevance is also reinforced in other studies with different themes. For example, Frozza et al., (2016) conducted a survey on the perception of family farmers related to environmental legislation in the municipality of Nova Erechim (SC). The authors identified a lack of knowledge about environmental legislation, specifically related to limits and legal areas of the APP. Thus, they suggested that, in order to improve these farmers' perception of environmental legislation, it would be important to hold courses, lectures and workshops on the subject. The authors also point out that it would too be important for public bodies should clear up doubts and make farmers aware of the importance of environmental preservation, both for the legal aspect and for resources preservation.

Mombach et al., (2018) estimated the environmental value given by Lages (SC) population about the Carahá River preservation and evaluated the differences about the environmental perception of the interviewed population according to their relationship with the Carahá River or its influence on their daily life, considering its geographic location. People's difficulty in understanding the importance of preserving urban rivers was perceived by the authors, reinforcing the idea that the appreciation of natural resources is an instrument capable of reflecting their importance of public policies context, which contributes to the recovery efforts and for the environmental resource preservation.

Soares et al., (2014) carried out works aimed at heritage education and environmental perception of fossiliferous heritage in the Araripe Basin, aiming to make people aware of the importance of preserving paleontological heritage. The questionnaires applied by the authors showed that the participating students of the research recognize the importance of this natural resource, both for the promotion of tourism and scenic beauty, as well as for its role in the reconstruction of the history of the planet. In this research, Soares et al. (2014) also identified that the drawings reproduced by the students showed that there are values and existing bonds related to natural resources that surround them, in addition to highlighting important

elements of the natural and cultural region landscape.

According to Oliveira, Santos and Turra (2018), the formation of a connection or identity with a given location has great influence on knowledge, be it informative or experienced, and on local use by an individual. This makes the population careful with the environment where they live and preserve it, due to the physical proximity and the time of contact with it.

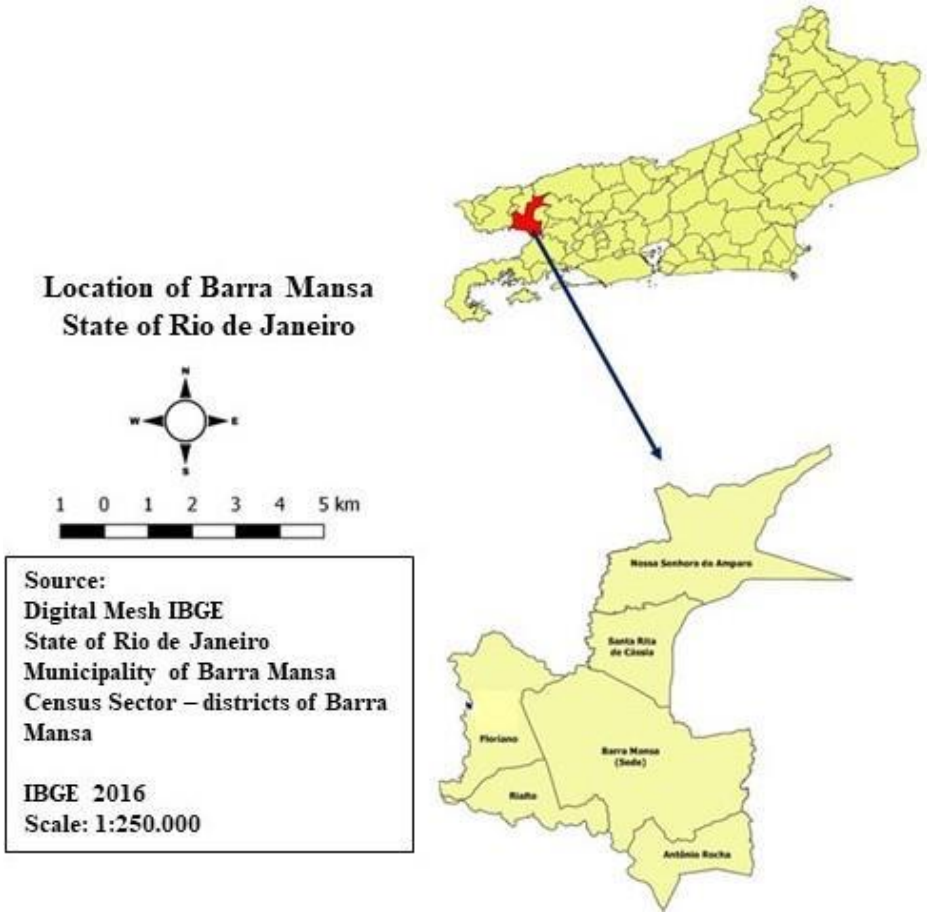
Oliveira and Corona (2008) also report that the current environmental problems have resulted in progressive changes in society. Therefore, it is necessary to analyze how modernization interferes in the construction of individuals' concepts about the consequences of their actions on the environment. In order to understand the relationship between human beings and the environment in which they live, it is then necessary to recognize values, actions and concepts about the environment in the subjects through their environmental perception. Taking possession of these perceptions would be possible, according to Frasson (2011) through instruments that allow the interpretation of singular subjects, such as open questionnaires, interviews, mental maps, photographs, among others.

2. Methodology

2.1 Study area

This study was carried out in the rural area of the district of Floriano, part of the municipality of Barra Mansa, Rio de Janeiro, inserted in the Hydrographic Basin of the Middle Paraíba do Sul (BHMPS) (Figure 2). BHMPS has an area of 6,517 km², containing 42 main micro watersheds, distributed in 19 municipalities and totals a population of 943,164 inhabitants (Oliveira, et al., 2017).

Figure 2 - Location of the municipality of Barra Mansa in the state of Rio de Janeiro.



Source: Elaborated by the authors.

The BHMPS region was the scene of several economic cycles, which were sustained by the inappropriate use of agricultural practices. Extractive agriculture was the first mode of use of these lands, which was gradually being replaced by coffee culture and, later, also modified by beef cattle, which was the last most expressive activity developed in the region and responsible for occupying large areas of pastures. The result left a legacy, inscribed on the landscape, represented by small forest fragments between large areas of pasture and, on a smaller scale, between subsistence agriculture (Toledo & Pereira, 2004).

Furthermore, Oliveira et al. (2017) state that BHMPS is one of the units of the Hydrographic Basin of River Paraíba do Sul (BHPS), which has its territory greatly impacted by degradation, either by deforestation, by agricultural exploitation or even due to urbanization. And the main economic activities developed in the region are the industries and the agricultural sector.

The city of Barra Mansa, in the last decades, has undergone a sharp urban growth that, together with the lack of adequate public policies, has led the region to experience environmental problems, such as erosion and landslides. This results in the silting of river courses and increase of floodings (Castro, Mello & Peixoto, 2002).

2.2 Methodology

The Springs Environmental Impact Index (IIAN) method is a didactic and practical classification used to analyze the degree of environmental impact of springs, based on a macroscopic assessment of their physical characteristics and quality (Felippe & Magalhães, 2012). This method can be used as a qualitative and visual investigation of the degree of protection in which the springs are found. The IIAN theoretical basis, method chosen to collect qualitative data, was used to ensure the applied variables, to assure credibility to the applied questionnaire and to the classification of the springs protection class. This interpretation is performed by researchers and has a detailed description of each parameter used, ensuring accuracy of the IIAN method and calculation, which was initially developed by Gomes et al., (2005) and improved by Felippe and Magalhães (2012), Leal et al., (2017), among others.

The field research was composed by the application of semi-structured questionnaires, based on the IIAN (Table 1), which took place during June 2018, for four rural landowners, totaling ten springs. The purpose was to identify the knowledge, values and experiences about the conservation status of the springs in the properties of these producers.

Table 1 - Methodology of the macroscopic environmental impact index in springs.

MACROSCOPIC PARAMETERS	**QUALIFY**		
	BAD (1)	**MEDIUM (2)**	**GOOD (3)**
Color of the water	Dark	Clear	Transparent
Water smell	Strong smell	With smell	No smell
Garbage around the spring	A lot	Little	No
Garbage in the water	A lot	Little	No
Foams	A lot	Little	No
Oils	A lot	Little	No
Sewer on the spring	Visible	Maybe	No
Vegetation	Degraded or absent	Changed	Good state
Uses of the spring	Constant	Sporadic	There is not
Access	Easy	Difficult	No access
Urban equipment	Less than 50m	Between 50 and 100m	More than 100m

Source: Adapted by Felippe and Magalhães (2012).

The IIAN was reexamined and reformulated in the form of a questionnaire (Table 2) to meet the needs and objectives of this research. The qualitative methodological procedures involved also included the exposure and analysis of testimonies/considerations mentioned by the owners to the researchers.

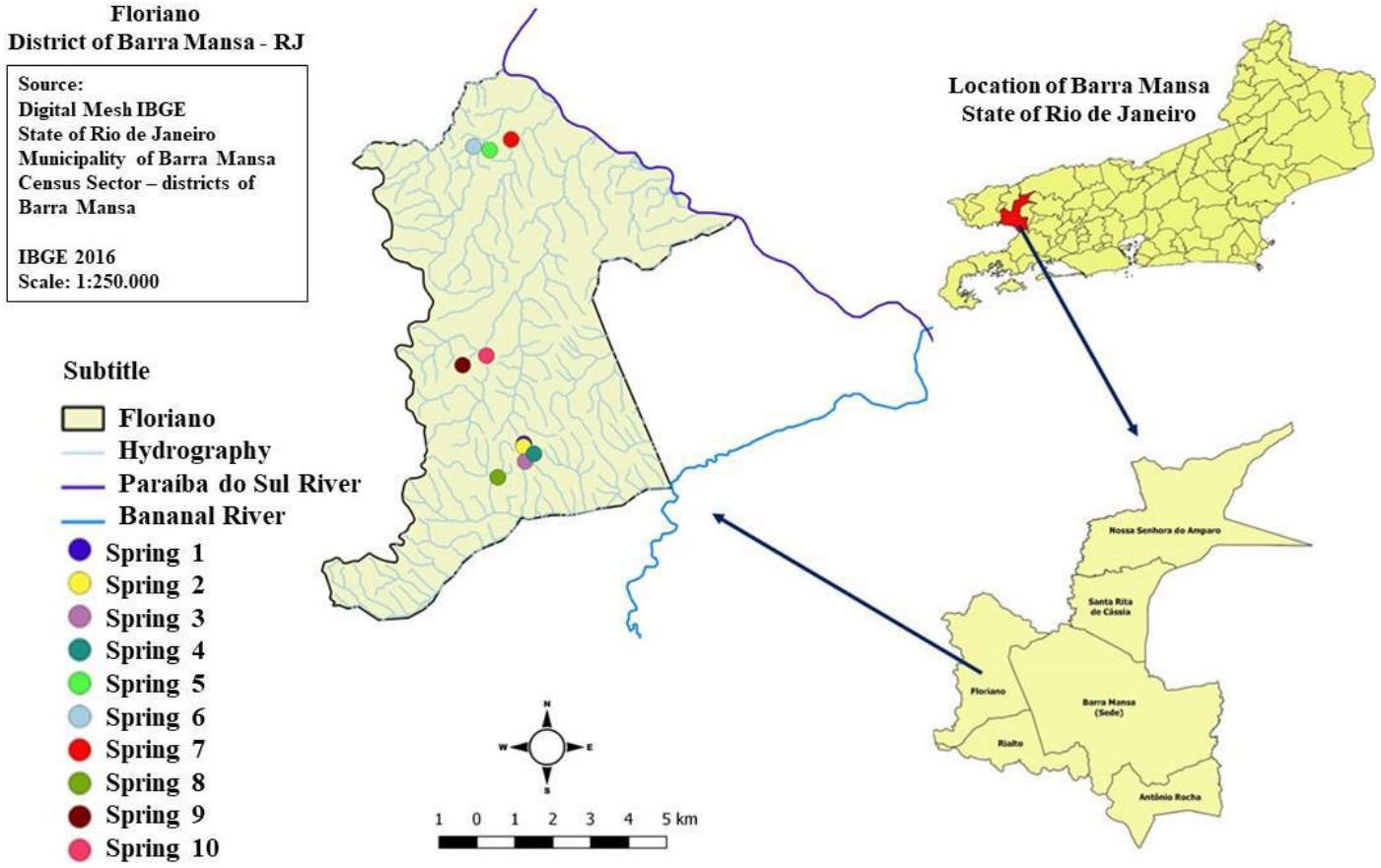
Table 2 - Applied Questionnaire.

PARAMETERS	**MARK WITH X WHAT YOU THINK**		
How is the color of the water?	Dark	Clear	Transparent
Does the water smell?	Strong smell	With smell	No smell
Is there garbage around the spring?	More than 3 (packagings/plastics/ bottles/jars)	Up to 3 (packagings/plastics/ bottles/jars)	No
Is there garbage in the water?	A lot (more than 3)	Little (up to 3)	No
Do you have foams in the water?	A lot	Little	No
Is there oil in the water?	A lot	Little	No
Is there a sewer near the spring?	Yes (when the spring is close to the house)	Maybe (when the house is on the ground above and towards the spring)	No (when the house is far from the spring)
How are the trees and vegetation near the spring?	None (only grass)	Little	A lot
Are there seedlings of plants/trees appearing near the spring?	No	Some	Yes
How is the situation of the soil/terrain near the spring?	Bad (with many cracks and holes)	Medium (with few cracks and holes)	Normal (no changes)
Do animals use this water?	Yes	Sometimes	No
Does any human being use this water?	Yes	Sometimes	No
Is the spring protected?	No protection (no fence)	With protection (fence and easy to reach)	With protection (fence and difficult to reach)
Is it easy to get close to the spring?	Yes	Difficult	No, too difficult
How close is the spring to the residences?	Less than 50 meters	Between 50 and 100 meters	More than 100 meters
Where is the property located?	I don't know	Private property	Public or conservation area

Source: Elaborated by the authors.

The ten springs were chosen at random, according to the voluntary acceptance of producers to participate in the research (Figure 3). In addition, this district was chosen due to the partnership established with the Rural Union of Barra Mansa, which facilitated contact with producers in that area. Thus, the geographic scale used was partially small, due to the number of producers involved in the research.

Figure 3 - Mapping and location of spring.



Source: Elaborated by the authors.

The methodology was composed of three parts. In the first stage, rural producers in the study area were asked to answer a short questionnaire about the springs on their properties. They were instructed to fill in the answer with "X" (only one of three options) most appropriate for each of the sixteen questions contained in this material. Such as in the IIAN, the questions were centered on a visual environmental analysis of the springs, emphasizing their physical characteristics and conservation status.

Each of the three answer options was classified as good, medium and bad and, values of 3, 2 and 1 were assigned, respectively. This classification was based on the environmental situation in which each questioning parameter was found. According to Leal et al. (2017), the minimum sum would represent a set of parameters considered bad and the maximum sum would indicate that all parameters would be good. The producers were not informed about how the questionnaires would be evaluated in order not to bias their responses.

Thus, in the second stage performed by the researchers, the responses of each producer were classified into one of the three different classes of analysis. Subsequently, for each spring, a sum of the results of questions was calculated to define and classify the preservation degree of the spring, with class A: excellent, class B: good, class C: reasonable, class D: bad and class E: terrible (Table 3).

Table 3 - Classification of springs according to environmental impacts.

Class	Protection degree	Score*
A	Excellent	46-48 points
B	Good	43-45 points
C	Reasonable	40-42 points
D	Bad	37-39 points
E	Terrible	below 37 points

* Sum of points obtained in the sixteen questions in Table 2. Source: Elaborated by the authors.

The third part of the methodology consisted of analyzing the producers' answers, considering and examining their environmental perception in relation to the preservation of springs, based on the answers to the questionnaire and the classification of answers in the preservation degree of the springs. In addition, this perception was compared with other studies that also analyzed the environmental perception of rural producers about water resources, as described in Results and Discussion.

3. Results and Discussion

The questionnaires were answered by four cattle breeders and only one organic farmer. From the questionnaire, it was possible to define the class in which each spring fits, according to these owners' views (Table 4).

Table 4 - Quantification and qualification of the preservation degree of springs based on the environmental perception.

Water parameters	**SPRINGS**									
	N1	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**	**N9**	**N10**
Color of Water	2	3	3	3	3	3	3	3	2	2
Smell of water	3	3	3	3	3	3	3	3	3	3
Garbage around the spring	3	3	3	3	3	3	3	3	3	3
Floating materials (garbage in water)	3	3	3	3	3	3	3	3	3	3
Foams	3	3	3	3	3	3	3	3	3	3
Oils	3	3	3	3	3	3	3	3	3	3
Sewage in the spring	3	3	3	3	3	3	3	3	3	3
Vegetation (degradation)	2	2	3	2	3	2	3	2	3	2
Regeneration	2	3	2	3	3	3	3	1	3	1
Presence of erosion	3	3	3	3	3	3	3	3	3	3
Use by animals	3	3	3	3	3	3	3	3	3	3
Use by humans	3	3	3	1	1	3	3	3	1	1
Site protection	3	3	3	2	3	2	2	2	3	1
Accessibility to the site	1	1	1	1	2	1	1	1	1	1
Proximity to residences (meters)	2	2	3	2	3	3	3	2	3	3
Insertion area type	2	2	2	2	2	2	2	2	2	2
Total	41	43	42	40	44	43	44	40	42	37
Class	C	B	C	C	B	B	B	C	C	D

Source: Elaborated by the authors.

Even with few results the adapted IIAN represents a capable tool for helping the owner to recognize his region rural characteristics. The information about geographic and demographics characteristics of a location favors specific public policies application, the recovery of degraded areas and the qualitative and quantitative increase in water, generating economic return.

The analysis of the perception of rural producers, based on the *in situ* observation of physical characteristics of the springs in their properties, indicated, in general, five springs (50%), N1, N3, N4, N8 and N9, with a reasonable preservation degree (Class C); four springs (40%), N2, N5, N6 and N7, in good conservation status (Class B) and only one of them (10%), N10, was classified in the degree of bad preservation (class D). According to the rural owners' perception, most of these analyzed springs presented reasonable environmental conditions.

There is no way to standardize the results obtained between the producers' answers. This happens due to the physical differences of each property, according to its location, and the inconsistency of the number of springs analyzed.

Among the questions used in the questionnaire, the ones that received lower scores by the producers were those related to the protection of the place and the easy access to the area. The ones with the highest scores were the color of the water, the smell, the absence of garbage, floating materials, foams, oil and sewage.

According to an explanation by Doria (2009), acceptance of water quality can vary geographically. For example, in a region where drinking water has a yellowish color, the population that has contact with bluish water may consider it to be of unsatisfactory quality.

Through informal conversations with the rural owners who contributed to this research, it was possible to perceive how they are concerned with the springs in their properties and also recognize the importance of this resource. Therefore, there is already an environmental awareness among these owners. However, restoration and conservation actions are necessary in favor of such resources for future improvements, since most of the analyzed springs showed a reasonable preservation degree.

As in this research, in other studies (Alam, 2011; Azevêdo, et al., 2022; Galvão & Tedesco, 2022; Gao, et al., 2018; Gonçalves & Gomes, 2014), regardless of the methodology used and the geographic region, researchers have detected the existence of environmental perception on local water quality among residents of the study area. Doria (2009) also states that information about water can be obtained through several impersonal and interpersonal sources; furthermore, the degree of importance of some sources of information will also vary geographically, depending on the influence of some factors, such as demographics.

As an example, we have the research by Gonçalves and Gomes (2014), which observed different perceptions of rural producers about the environment, in the same region, but the differences were based on the meanings, identities and cultural aspects of each group. Differently, Azevêdo et al. (2022) analyzed the perception of local communities about the water quality of the reservoirs used by them, in northeastern Brazil, and identified the presence of these communities' perception of various environmental quality indicators, through the Community Conservation Perception Index (CCPI), created by the authors. And according to Alam (2011), the reflection related to an individual's attachment to a place has been increasingly frequent in studies on ecosystem management.

Another aspect highlighted by two producers was the lack of government incentive through financial contributions and guidance programs on the recovery of springs. Dissatisfaction with environmental public policies was also identified in the research by Oliveira et al. (2018), when assessing the environmental perception of a community, in a hydrographic basin in the state of São Paulo.

The owners participating in the research discussed here still claimed that there is a high cost in the process of springs recovery and maintenance, even if they do this recovery on their own. This happens because they value the presence of water in their properties. This link between rural producers and nature was also observed in the research by Gonçalves and Gomes (2014), by analyzing their environmental perception, especially those who live in the same place where they work and are

close to the river, showing greater concern in relation to the water.

Corroborating the citations described by the owners, Oliveira et al. (2018) state that individuals' environmental perception may be related to several factors. Among them, the importance given to the place where they live, their sense of belonging, of responsibility and interest in issues involving this place.

The lack of knowledge about the environmental legislation that involves the springs, water resources and the forestry issue was also noticed among the owners who contributed to this research. During *in loco* visits, and through interaction with the owners, it was possible to notice that only half of the interviewees have greater knowledge about these laws; however, they show an interest in knowing the issues surrounding the environmental area of their properties. The rest, despite recognizing the importance of springs, were less aware of the procedures required to protect them and were also not very interested in legal issues.

The limited knowledge and/or interest of producers in Environmental Legislation in relation to the protection of springs was also identified in the research by Gonçalves and Gomes (2014). In their study, the researchers highlight that for further clarification in relation to such Legislation and its importance, there must be effective participation by the public interested or involved with environmental issues in lectures and courses on Environmental Education.

There is also a need to reduce the distance between managers and practices carried out in rural properties, such as more visits to properties. In this way, producer-manager contact would increase (Mendonça et al., 2022). Furthermore, it is still necessary to recognize the importance of the environmental perception of a local community that lives in direct contact with water resources and their quality (Azevêdo, et al., 2022).

The analysis of the activities of the Pipiripau Water Producer Project, in the Federal District, based on the Payment Policy for Environmental Services, by Mendonça et al. (2022) pointed out, through qualitative questionnaires applied in the interviews, a similar perception between managers and rural producers, however, the managers have only superficial knowledge about the water situation and the dissemination of the project.

According to Pouey et al., (2007), it is also important that government agencies include the population when developing strategies to protect ecosystems, as it is a way of solving environmental problems and directing public decisions.

The environmental perception of local communities is of paramount importance for management programs, for the conservation of ecosystems and environmental quality. Therefore, the authors emphasize the need for these communities to participate, for example, in research projects on pollution in reservoirs, the collection of parameters related to water quality, in addition to their collaboration in the development of conservation strategies (Azevêdo, et al., 2022). In this context, the application of methods of analysis and evaluation that can be done by the owners themselves, as proposed in this research, can contribute to the conservation and recovery of natural resources more efficiently and at lower costs.

Furthermore, analyzing citizens' perception of local water resources is necessary for groundwater management and for its qualitative and quantitative improvement. Therefore, understanding the citizens' perception of local water resources, the chains of their exploitation and climate change is important for collaboration between water users themselves and for conflict management (Vélez-Nicolás et al., 2021). Galvão and Tedesco (2022) also claim that research on environmental perception cooperates to reduce human-environment conflicts, both through the creation of policies and the elaboration of more sustainable strategies.

Two of the four properties visited during this research, which have seven of the ten springs that were the object of the research (N1, N2, N3, N4, N5, N6 and N7), have already hosted a Reforestation Course (with emphasis on protecting springs), whose theoretical and practical parts are carried out on the properties. This course is offered by the Rural Union of Barra Mansa and was the only support mentioned by the producers. In addition, the union invites several associate producers to participate in the course and distributes educational material to the participants, with didactic and practical guidelines, as well

as some elements of the legislation (Dias, et al., 2011). During the practical part, at least one of the springs of each property is used as a model for the application of reforestation.

Therefore, the Reforestation Course offered by the Rural Union of Barra Mansa is a tool that unites rural landowners and brings knowledge to the rural population, thus contributing to changes in this population's attitudes towards environmental conservation. In addition, the transmission of knowledge among stakeholders is essential for improving environmental quality in this region. Once an owner changes their attitudes, they can influence other owners to have more conscious and beneficial attitudes for their properties.

Consequently, this exchange of experiences can positively contribute both to the environment and to the quality of life in these rural areas. Complementing, Wang et al. (2018) also point out that it is of great value that producers have the ability to dedicate themselves to environmental protection.

Several studies have already used different methodologies to analyze the environmental perception of populations with different habits in relation to water resources, and these acquired habits are interrelated with the characteristics of the places where they live. Vélez-Nicolás et al. (2021) used questionnaires to assess the perception and knowledge of citizens who use water in the Barbate river basin, in the south of the Iberian Peninsula, mainly in terms of refers to groundwater resources in the region. The results of this survey showed different opinions and perspectives, but the majority of the population that responded to the questionnaire understands the need for stricter control of water resources by public managers.

The conflict between the local community and the managers of the Passo Fundo National Forest conservation unit, in Rio Grande do Sul, led the authors Galvão and Tedesco (2022) to qualitatively analyze the environmental perception of this community. This was done in order to be able to develop socio-environmental projects for communities residing close to Conservation Units, in order to guide managers to improve the relationship with local communities.

When evaluating the environmental perception of a group of people inserted in a certain hydrographic basin in the state of Paraná, through a questionnaire, Filho and Braga (2007) identified the population's interest in information about environmental issues. However, there was a lack of information on this topic, inadequate actions and activities in relation to the environmental area, that is, the residents were not included in the environmental problems.

Gao et al. (2018) also assessed residents' environmental perceptions of local water quality issues in a river in Indiana and found that public awareness and personal sense of responsibility among residents who participated in the research increased over the past ten years. They showed interest in the protection water resources.

Another analysis on environmental perception was done by Alam (2011). He analyzed the perception of Dhaka city residents, in Blangadesh, about a river in the municipality and its restoration priorities, the results of which showed that a large part of the participants were concerned with the state of pollution of the river. For this conclusion, the author realized that the research participants had adequate knowledge of the current environmental threats on this river; however, about 45% of respondents were not concerned, which, according to Alam, is a worrying result, due to the high pollution and ecological deterioration of the river. Prouty and Zhang (2016) also concluded in research that members of a Ugandan community have different perceptions about water quality, depending on the type of water they use (rainwater, artesian wells, protected springs, surface water or tap water).

According to Doria (2009), the analysis of how water quality is perceived by the population is a very diverse theme and difficult to synthesize as a global theory. In addition, some important factors that interfere in the adoption of individuals' behavioral practices are, according to Gao et al. (2018), public awareness and a sense of responsibility in relation to water resources and their quality.

In this research, the residents' environmental perception was analyzed according to their view of each item analyzed in the springs, based on the sixteen questions presented in Frame 2. As the answers were followed by the researchers, as well

as visits to all springs, it was possible to notice that the owners alleviate some problems in relation to the springs' conservation and maintenance, which can compromise their quality and the quantity of water flow. Some items that were neglected by the owners were the vegetation status around the springs, the presence of erosion, use by animals, use by humans and local protection.

When discussing the variables that involve public perception about the quality of drinking water, Doria (2009) states that this perception is the result of the interaction of several factors, such as the perception of risk in relation to water quality, attitudes about the use of chemicals in the water, problems related to past experiences, such as migration and growing urbanization, information provided by the media and interpersonal sources, among others.

In addition, Prouty and Zhang (2016) highlight the importance of springs as a source of drinking water, concluding in a research that the environmental impact of the use of spring water is considered the smallest in relation to its use in artesian wells, rainwater, surface water and tap water, since their protective structures are built with basic materials and locally sourced.

Wang et al. (2018) indicate in their studies the importance of implementing extra infrastructure for the environmental protection of water resources; moreover, they pointed out that more efficient and safe agricultural production technology seminars should be offered in rural areas. Regarding the extra infrastructure for the conservation of springs, we can highlight the enclosure and the presence of vegetation cover.

As the activities developed on the properties discussed here are livestock and agriculture, Shoemaker, Ervin and Diorio (2017) state that changes in land use related to agricultural production result in the degradation of aquatic environments worldwide. And for Alves-Pinto et al. (2017), the sustainable growth of livestock productivity, for example, can be considered a solution for different land uses, as well as contributing to a better conservation of biodiversity and the provision of ecosystem services. According to Doria (2009), involving the population from an early age with education related to fresh water is important and should focus on primary local issues, considering the ones involving use of piped water and also other water sources.

Understanding the various forms of links with a location and the attitudes of residents towards environmental improvement can be a useful step in understanding these attitudes, in addition to contributing with information to the decision-making processes. It is noteworthy that policy makers also need to understand how people value and use the resource and what restoration options they consider important (Alam, 2011). Doria (2009) also states that policies aimed at development must consider the population's perceptions on the elaboration of policies that involve drinking water infrastructure.

The involvement of several non-profit and non-governmental organizations that contribute to the management of water resources is necessary, since these entities include public participation in decisions, as well as meet the demands of the population. Thus, it is important that these groups are better understood, both in relation to their interests, activities, geographic reach, structure, and in relation to their function (Larson & Lach, 2008). Therefore, the role of environmental education is therefore highlighted, knowing the values and actions of individuals in relation to the environment, which can help in the formulation of proposals that reach a large part of the population, motivating effective changes to improve the socio-environmental sustainability issue (Oliveira & Corona, 2008).

However, Oliveira and Corona (2008) affirm that studies of environmental perception allow to determine precisely how environmental education can contribute to the subject's awareness and seek to understand the difficulties or doubts of individuals concerning environmental issues. Therefore, these authors argue that educational processes are extremely important during the development of strategies and initiatives to properly understand environmental problems and ways to solve them.

The application of different methods and through a more in-depth questionnaire can also contribute to improving the understanding of the environmental perception of rural producers, as well as detailing their conservation attitudes, their involvement and attachment to the place where they live. This is due to the fact that, according to Doria (2009), the factors that

are used to analyze perceptions of drinking water quality vary in each study, that is, several studies consider variables different from the original methods. This is believed to occur so that the methodology used meets the objectives of each research.

Although a new approach was used to assess the perception of rural producers in relation to the conditions of their springs, some limitations of this study must be observed. Initially, the efficiency in explaining the environmental perception was partially low. This is due to the questionnaire having included only the physical characteristics and the conservation status of the area around the springs. In particular, the small sample size cannot statistically represent the environmental quality of the region, nor can comparisons be made between the environmental perceptions analyzed. However, it allows perceptions to be captured that can be considered in the adoption of environmental policies in the region. As indicated in the research by Prouty and Zhang (2016), future studies should collect qualitative and quantitative data, using, for example, water quality analysis.

Furthermore, demographic variables were not used in the questionnaire, because they are not the focus of the interpretation of environmental perception in this study. In other words, a qualitative approach was used based on the general view of rural landowners on the environmental condition of springs.

In future studies, it is suggested that these variables be added to the questionnaire so that the environmental perception of rural producers is better understood and compared, since, according to Wang et al. (2018), the environmental behavior of farmers can also be influenced by factors such as family income and cultural differences. The results consider that perceptions and opinions of local residents can be essential to direct education and awareness programs, in addition to defining priorities and policy formulation (Alam, 2011). According to Doria (2009), studies and qualitative methods can improve the services provided and also inform about specific policies.

It is worth highlighting some challenges of this research. Among which, making contact with more rural producers in the study area, the long distance between the properties and some possible properties that contribute to the research not having springs.

4. Conclusion

This research sought to expand the analysis of environmental perception of rural producers in a way that involves them more, considering the way they see the surrounding of springs on their properties. In other words, this research is the beginning of an observation of the relationship of the rural population with a specific area of the environment in which they live. In addition, this questionnaire can indirectly supply the lack of information on water quality and the conservation of springs in this area, as it was noticed the lack of environmental protection infrastructure in rural properties that were the research corpus.

The regular databases available for studies applied in a more comprehensive way are insufficient. Therefore, local scientific studies that consider the geographic and demographic characteristics of a location are important and more realistic for the application of public policies, environmental education and the recovery of degraded areas.

It is worth emphasizing the importance of government incentives to offer better guidance and information to rural landowners and to alert them to the consequences of their environmental behavior. In addition, local public managers can design more efficient and continuous projects to better manage water resources and must implement Payments for Environmental Services (PSA) policies for the recovery of springs, taking into account the relationship and customs of the rural producer with the environment they live in. Projects with this purpose can benefit the hydrographic basin of the Middle Paraíba do Sul, which is extremely impacted by human activities, and guarantee, in the long term, the water flow from rivers and streams in the region. This study must also be taken into account for application in other rural areas and watersheds, and can be used for similar studies.

Acknowledgments

We are grateful to CAPES, for supporting the research with the granting of the master's scholarship to the first author, to the rural producers who contributed to this research and to the Rural Union of Barra Mansa-RJ, for mediating contact with these producers.

Reference

Alam, K. (2011). Public attitudes toward restoration of impaired river ecosystems: Does residents' attachment to place matter? *Urban Ecosystems*, 14 (4), 635–653. https://doi.org/10.1007/s11252-011-0176-5

Alves-Pinto, H. N., Latawiec, A. E., Strassburg, B. B. N., Barros, F. S. M., Sansevero, J. B. B., Iribarrem, A., Crouzeilles, R., Lemgruber, L., Rangel. M. C. & Silva, A. C. P. (2017). Reconciling rural development and ecological restoration: Strategiesand policy recommendations for the Brazilian Atlantic Forest. *Land Use Policy*, 60, 419-426. https://doi.org/10.1016/j.landusepol.2016.08.004

Azevêdo, E. L., Alves, R. R. N., Dias, T. L. P., Álvaro, É. L. F., Barbosa, J. E. L., & Molozzi, J (2022) Perception of the local community: What is their relationship with environmental quality indicators of reservoirs? *PLoS ONE*, 17 (1), 1-25. https://doi.org/10.1371/journal.pone.0261945

Boni, V., & Quaresma, S. J. (2005). Aprendendo a entrevistar: como fazer entrevistas em ciências sociais. *Revista Eletrônica dos Pós-Graduandos em Sociologia Política da UFSC*, 2 (1), 68-80. https://periodicos.ufsc.br/index.php/emtese/article/view/18027/16976

Castro, C. M., Mello, E. V., & Peixoto, M. N. O. (2002). Tipologia de Processos Erosivos Canalizados e Escorregamentos – Proposta Para Avaliação de Riscos Geomorfológicos Urbanos em Barra Mansa (RJ). *Anuário do Instituto de Geociências – UFRJ*, 25, 11-24. https://doi.org/10.11137/2002_0_11-24

Del Rio, V., & Oliveira, L. (1999) *Percepção Ambiental: a experiência brasileira*, (2a ed.) Studio Nobel.

Dias, H. C. T., Silva, A. P. S., Tonello, K. C, Araujo, C. C., Alves, M. R.., & Oliveira, J. C., Jr. (2011). *Proteção de nascentes*. 3 ed. Brasília, DF: SENAR.

Doria, M. F. (2009). Factors influencing public perception of drinking water quality. *Water Policy*, 12 (1), 1–19. https://doi.org/10.2166/wp.2009.051

Felippe, M. F., & Magalhães, A. P., Jr. (2012). Impactos ambientais macroscópicos e qualidade das águas em nascentes de parques municipais em Belo Horizonte- MG. *Geografias Artigos Científicos*, 8 (2), 08-23. https://doi.org/10.35699/2237-549X.13336

Filho, L. V. S., & Braga, M. C. B. (2007, novembro) Qualidade da água e percepção ambiental na bacia hidrográfica do rio Passauna. In XVIII *Simpósio Brasileiro de Recursos Hídricos* (pp.1-19), Campo Grande, MS.

Frasson, V. R., 2011. *Análise da percepção ambiental de atores sociais do Município de Balneário Camboriú – SC* (Master thesis). Universidade Federal de Santa Maria, Santa Maria, RS.

Frozza, A., Verona, R., Lajús, C., Luz, G. (2016). Percepção dos agricultores familiares do município de Nova Erechim (SC) em relação à legislação ambiental. *Revista Brasileira De Ciências Ambientais (Online)*, (39), 70-79. https://doi.org/10.5327/Z2176-9478201611514

Galvão, J. R., & Tedesco, C. D. (2022) Contributions of environmental perception to sustainability in the buffer zone of a protected area. *Ambiente & Sociedade*, 25, 1-20. http://dx.doi.org/10.1590/1809-4422asoc20180262r5r1vu2022L4OA

Gao, Y., Church, S. P., Peel, S., & Prokopy, L. S. (2018). Public perception towards river and water conservation practices: Opportunities for implementing urban stormwater management practices. *Journal of Environmental Management*, 223, 478–488. https://doi.org/10.1016/j.jenvman.2018.06.059

Gomes, P. M., Melo, C., & Vale, V.S. (2005). Avaliação de impactos ambientais em nascentes na cidade de Uberlândia-MG: análise macroscópica. *Revista Sociedade & Natureza*, 32 (17), 103-120. https://doi.org/10.14393/SN-v17-2005-9169

Gonçalves, B. V., & Gomes, L. J. (2014). Percepção ambiental de produtores rurais na recuperação florestal da sub-bacia hidrográfica do rio Poxim – Sergipe. *Desenvolvimento e Meio Ambiente*, 29, 127-138. https://doi.org/10.5380/dma.v29i0.32327

Mendonça, I. S., Santos, A. J., Hoeflich, V., Fernandes, A. P. D., & Freitas, B. M. S. (2022). Percepção dos atores sobre programas de pagamento por serviços ambientais: um estudo de caso do projeto produtor de águas Pipiripau-DF. *Brazilian Journal of Aquatic Science and Technology*, 26 (1), 39-48. https://doi.org/10.14210/bjast.v26n1.17924

Moimaz, M. R., & Vestena, C. L. B. (2017). Fenomenologia e percepção ambiental como objeto de construção à educação ambiental. *Revista Brasileira de Educação Ambiental*, 12 (2), 67-78. https://doi.org/10.34024/revbea.2017.v12.2225

Kohler, F. F., Marchand, G., & Negrão, M. (2015). Local history and landscape dynamics: A comparative study in rural Brazil and rural France. *Land Use Policy*, 43, 149–160. https://doi.org/10.1016/j.landusepol.2014.11.010

Larson, K. L., & Lach, D. (2008). Participants and non-participants of place-based groups: An assessment of attitudes and implications for public participation in water resource management. *Journal of Environmental Management*, 88 (4), 817–830. https://doi.org/10.1016/j.jenvman.2007.04.008

Leal, M. S., Tonello, K. C., Dias, H. C. T., & Mingoti, R. (2017). Caracterização hidroambiental de nascentes. *Revista Ambiente & Água*, 12 (1), 146-155. https://doi.org/10.4136/ambi-agua.1909

Melazo, G. C. (2005). Percepção ambiental e educação ambiental: uma reflexão sobre as relações interpessoais e ambientais no espaço urbano. *Olhares & Trilhas*, 6 (1), 45-51. https://doi.org/10.14393/OT

Mombach, G., Wahrlich, J., Clauberg, A. P., Beninca, L., & Simioni, F. (2018). Valoração ambiental de um rio urbano: uma aplicação do método de valoração contingente em Lages, Santa Catarina. *Revista Brasileira De Ciências Ambientais (Online)*, (47), 116-129. https://doi.org/10.5327/Z2176-947820180272

Oliveira, K. A., & Corona, H. M. P. (2008). Percepção ambiental como ferramenta de Propostas educativas e de políticas ambientais. *Revista Científica ANAP Brasil*, 1 (1), 53-72. https://doi.org/10.17271/198432401120084

Oliveira, J. A., Teixeira, V. L., Alves, S., Valim, J. L. S., Azevedo, J. S., Pires, F. C. A. C., & Barbosa, L. G. (2017). Atlas da Região Hidrográfica Médio Paraíba do Sul. *Comitê Médio Paraíba do Sul*. Available. Volta Redonda: AGEVAP.

Oliveira, N. R., Santos, C., & Turra, A. (2018). Percepção ambiental como subsídio para gestão costeira da Baía do Araçá, Litoral Norte do Estado de São Paulo, Brasil. *Desenvolvimento e Meio Ambiente*, 44 (ed. Especial), 140-163. https://doi.org/10.5380/dma.v44i0.53825

Organização das Nações Unidas para a Educação, a Ciência e a Cultura (UNESCO). (2015). *Relatório Mundial das Nações Unidas sobre Desenvolvimento dos Recursos Hídricos - Água para um mundo sustentável*. http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/images/WWDR2015ExecutiveSummary_POR_web.pdf

Pouey, N., Ferrero, B., Omelianiuk, S., Tavares, R., & Zanucolli, M. (2007, novembro). La percepción ambiental como instrumento de gestión para la protección y desarrollo sostenible del sistema acuífero guaraní: aplicación piloto en Federación, Entre Ríos, Argentina. In *XVII Simpósio Brasileiro de Recursos Hídricos*. São Paulo, SP.

Prouty, C., & Zhang, Q. (2016). How do people's perceptions of water quality influence the life cycle environmental impacts of drinking water in Uganda? *Resources, Conservation and Recycling*, 109, 24–33. https://doi.org/10.1016/j.resconrec.2016.01.019

Ribeiro, W. C., Lobato, W., & Liberato, R. C. (2009). Notas sobre fenomenologia, percepção e educação ambiental. *Sinapse Ambiental*, 6 (1), 42-65. http://www1.pucminas.br/graduacao/cursos/arquivos/ARE_ARQ_REVIS_ELETR20090930145705.pdf?PHPSESSID=e280489021e6f4f827811e7f3fc4624c

Schiavinato, V. M. S., & González, Z. M. D. (2020). Degradação de áreas de nascentes na sub-bacia hidrográfica do córrego das Pitas-MT: o que pensam os pequenos produtores rurais? *Caminhos de Geografia*, 21 (74), 295–312. https://doi.org/10.14393/RCG217448882

Shoemaker, C. M., Ervin, G. N., & Diorio, E. W. (2017). Interplay of water quality and vegetation in restored wetland plant assemblages from an agricultural landscape. *Ecological Engineering*, 108, 255–262. https://doi.org/10.1016/j.ecoleng.2017.08.034

Soares, M., Silva, W., Silva, L., & Silva, T. (2014). Percepção ambiental e educação patrimonial: estudo de caso sobre a conservação do patrimônio paleontológico. *Brazilian Journal of Environmental Sciences (Online)*, (33), 100-117. http://www.rbciamb.com.br/index.php/Publicacoes_RBCIAMB/article/view/238

Souza, L. B. (2017). Percepção ambiental e fenomenologia: possibilidades de adaptação do método e alguns exemplos de pesquisas. *Desenvolvimento e Meio Ambiente*, 40, 297-314. https://doi.org/10.5380/dma.v40i0.44699

Tanner, A. M., & Johnston, A. L. (2017). The Impact of Rural Electric Access on Deforestation Rates. *World Development*, 94, 174-185. https://doi.org/10.1016/j.worlddev.2016.12.046

Toledo, L. O., & Pereira, M. G. (2004). Dinâmica da deposição de serrapilheira em florestas secundárias do município de Pinheiral, RJ. *Floresta e Ambiente*, 11 (1), 39-46. http://www.floram.org/article/588e2207e710ab87018b460b

Tuan, Y. F. (1980). *Topofilia: um estudo da percepção, atitudes e valores do meio ambiente*. Difusão Editorial.

Vélez-Nicolás, M., García-López, S., Pacheco-Orellana, M.J., Ruiz-Ortiz, V., & Fernández-Poulussen, A. (2021). Public Perceptions and Attitudes Towards Groundwater and Climate Change: The Case of the Barbate River Basin. In Abrunhosa, M., Chambel, A., Peppoloni, S., Chaminé, H.I. (eds) *Advances in Geoethics and Groundwater Management: Theory and Practice for a Sustainable Development. Advances in Science, Technology & Innovation. Springer, Cham* (pp.43-46). https://doi.org/10.1007/978-3-030-59320-9_10

Wang, Y., Yang, J., Liang, J., Qiang, Y., Fang, S., Gao, M., Fan, X., Yang, G., Zhang, B., & Feng, Y. (2018). Analysis of the environmental behavior of farmers for non-point source pollution control and management in a water source protection area in China. *Science of The Total Environment*, 633, 1126–1135. https://doi.org/10.1016/j.scitotenv.2018.03.273