e-ISSN:2316-9834

GeAS

Revista de Gestão Ambiental e Sustentabilidade
Journal of Environmental Management & Sustainability

Received: 07 Dec. 2022 - **Approved:** 06 Oct. 2023
Responsible Editor: Andreza Portella Ribeiro
Evaluation Process: Double Blind Review
Section Editor: Donizete Beck
https://doi.org/10.5585/2024.23417

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Water supply service through the user's perception: the case of the municipality of Conceição das Pedras, State of Minas Gerais

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The authors have no conflicts of interest to declare.

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Cite as - American Psychological Association (APA)

Reis, E. R., Raimundo e Almeida, M. R., & Martins, M. V. L. (2024). Water supply service through the user's perception: the case of the municipality of Conceição das Pedras, State of Minas Gerais. *J. Environ. Manag. & Sust., 13*(1), 1-33, e23417. https://doi.org/10.5585/2024.23417

Abstract

Objective: The article aims to diagnose the water supply system of the municipality of Conceição das Pedras – State of Minas Gerais, from the evaluation of the user's perception, in order to evaluate the quality of the service provided.

Methodology: The population's perception was raised through the application of a data collection form on the water supply system, containing 17 closed questions and 3 open questions. The form was applied via Google Forms in March 2022 and 108 responses were obtained.

Relevance: The users' perception is essential for the management and planning of actions to meet the water supply. Still, the provision of public sanitation services, especially in municipalities operated by local institutions, needs research and greater attention.

Main results: Important information was collected, such as notes that water sometimes has color, taste and odor. There are also complaints of greasy water. From the users' perception, the system has a low number of interruptions in the water supply and a brief resolution of the issue. With this, it can be pointed out that, even with the water supply system presenting some possible problems, the majority of the population considers the water quality to be good or regular, which is extremely important for the population's quality of life.

Contributions: We hope that the information gathered by this research can contribute to a better management of the city's water supply system, as well as the applied methodology can serve as a guide for other papers.

Keywords: water quality, sanitation, service quality, consumer

O serviço de abastecimento de água pela percepção do usuário: o caso do município de Conceição das Pedras - Minas Gerais

Resumo

Objetivo do estudo: Diagnosticar o sistema de abastecimento de água do município de Conceição das Pedras - Minas Gerais, a partir da avaliação da percepção dos usuários, a fim de avaliar a qualidade do serviço prestado.

Metodologia: Foi levantada a percepção da população por meio da aplicação de um formulário de coleta de dados sobre o sistema de abastecimento de água, contendo 17 perguntas fechadas e três abertas. O formulário foi aplicado via Google Forms em março de 2022 e foram obtidas 108 respostas.

Relevância: A percepção dos usuários é imprescindível para a gestão e planejamento das ações para atendimento ao abastecimento de água. Ainda, a prestação do serviço público de saneamento, principalmente em municípios operados por instituições locais, carece de pesquisas e maior atenção.

Principais Resultados: Foram levantadas informações importantes como apontamentos de que a água, às vezes, apresenta cor, gosto e odor. Também há reclamações de água gordurosa. Pela percepção dos usuários, o sistema apresenta um baixo número de interrupções no fornecimento de água e uma breve resolução da questão. Com isso, pode-se apontar que, mesmo o sistema de abastecimento de água apresentando alguns possíveis problemas, a maioria da população considera a qualidade da água boa ou regular, o que é extremamente importante para a qualidade de vida da população.

Contribuições: Espera-se que as informações levantadas por esta pesquisa possam contribuir para uma melhor gestão do sistema de abastecimento de água do município, bem como a metodologia aplicada possa servir de orientação para outros trabalhos.

Palavras-chave: qualidade da água, saneamento, qualidade do serviço, consumidor

El servicio de abastecimiento de agua a través de la percepción del usuario: el caso del municipio de Conceição das Pedras - Minas Gerais

Resumen

Objetivo del estudio: Diagnosticar el sistema de abastecimiento de agua en la ciudad de Conceição das Pedras - Minas Gerais, a partir de la evaluación de la percepción de los usuarios.

Metodología: Se elevó la percepción de la población a través de un formulario de recolección de datos sobre el sistema de abastecimiento de agua, con 17 preguntas cerradas y tres abiertas. El formulario se aplicó a través de Google Forms en marzo de 2022 y se obtuvieron 108 respuestas.

Relevancia: La percepción de los usuarios es fundamental para la gestión de actuaciones para atender el abastecimiento de agua. Aun así, la provisión de servicios públicos de saneamiento, especialmente en ciudades operados por instituciones locales, necesita investigación.

Principales resultados: Se recopiló información importante, como notas de que el agua a veces tiene color, sabor y olor. También hay quejas de agua grasosa. Desde la percepción de los usuarios, el sistema tiene un bajo número de interrupciones en el suministro de agua y una breve resolución del problema. Con esto, se puede señalar que, aún con el sistema de abastecimiento de agua presentando algunos posibles problemas, la mayoría de la población considera que la calidad del agua es buena o regular, lo cual es importante para la calidad de vida de la población.

Contribuciones: Se espera que la información recabada por esta investigación pueda contribuir a una mejor gestión del sistema de abastecimiento de agua de la ciudad, así como la metodología aplicada pueda servir de guía para otros trabajos.

Palabras-clave: calidad del agua, saneamiento, calidad de servicio, consumidor

Introduction

The uninterrupted supply of drinking water must be seen as a fundamental right and need for people (Vargas, 2006). A water supply system (WSS) consist of services, infrastructure and equipment, comprising its entire process, from water capture to building connections,

including the measurement system (Brasil, 2007). The WSS aims to meet demand, with the supply of water in sufficient quantity and quality to attend consumption needs (Maia et al., 2016) and an inadequate system can cause harm to the health of its users, as the impact of water supply on human health is very large (Saldanha et al., 2016).

As part of the world's population is facing problems of scarcity, urban water services, including supply, face substantial challenges in managing water resources (Risch et al., 2014). It is estimated that the lack of sanitation is responsible for around half of child mortality and occupancy of hospital beds worldwide (Vargas, 2006). Therefore, it is necessary that the WSS is correctly built and operated (Tancini, 2011), and ensuring good sanitation management is a matter of survival for environmental and social sustainability, in order to reduce costs, as pollution and related diseases generate a major impact on the administration's budget (Marchi, 2015).

In this way, the improvement in public water supply services reflects an improvement in the population health (Libânio et al., 2015). Therefore, the supply service provides a series of benefits, such as increased life expectancy, reduced mortality, especially among children, and reduced water-transmitted diseases (Funasa, 2018).

One of the tools used to evaluate the quality of water distributed is the users' perception. Perception is understood as the response of feelings to environmental stimuli, bringing an understanding of the environment in which the individual is inserted (Tuan, 2012). It is a process of organizing and interpreting the sensations received so that awareness of the environment develops through what surrounds us (Davidoff, 1993), and is inherent to each human being, who perceives, reacts and responds differently to both interpersonal relationships and actions on the environment (Faggionato, 2009).

While not all contaminants can be identified by odor and taste, user perception can help guide solutions for water improvements (Weisner et al., 2020). Therefore, users' perception can show the population's satisfaction with the system and, with that, influence those responsible for

making decisions about improvements (Nnaji et al., 2013; Andrade et al., 2019). Consequently, knowing consumer satisfaction in relation to sanitation services is a tool capable of helping to manage these services (Lima et al., 2017). Furthermore, users' attitudes, information and expectations are fundamental to ensuring sustainable management of water resources (Vargas & Paula, 2003). That being said, the perception, combined with the improvement actions carried out by those responsible, is essential to the management, planning and credibility of the water supply system (Gonçalves et al., 2015).

This type of methodology has already been used in many papers (Dietrich et al., 2014; Gonçalves et al., 2015; Lima et al., 2017; Maia et al., 2016; Menezes Filho & Rodrigues, 2017; Silva & Silva, 2021). Rodrigues et al. (2012) indicate that the use of community perception can act as a tool to support environmental management, and support a participatory process for shared management between public authorities and society.

Weighing the users' perception in terms of public policies, the Brazilian Basic Sanitation Policy, Federal Law No. 11,445/2007, has as its principle the participation of the population in the process of preparing Municipal Basic Sanitation Plans, making them through public hearings or consultations (Brasil, 2007). Therefore, it is in the discussion processes that citizens find the opportunity to express their points of view and aspirations, and they can contribute with their culture and knowledge in search of solutions that can improve the living conditions of everyone (Aguiar et al., 2012). In this sense, the result generated in this article is a reliable document to be presented in these public hearings and consultations.

Given this context and considering that the provision of public sanitation services, especially in municipalities operated by local institutions, requires research and greater attention (Lima et al., 2017), the present study aims to diagnose the WSS in the municipality of Conceição das Pedras – State of Minas Gerais. The diagnosis is based on the evaluation of user perception, in order to evaluate the quality of the service provided.

Material and methods

Initially, the municipality of study is presented, as well as the general characteristics of the water supply system. Next, the methods applied for data collection and analysis are described.

Study area

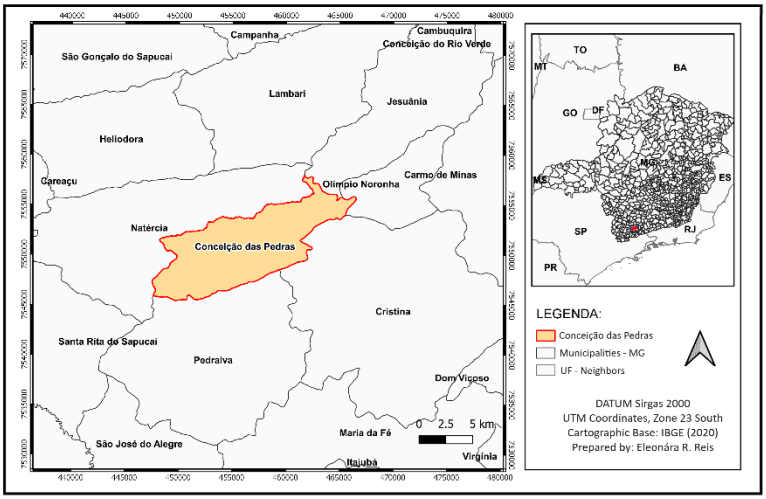
The study was carried out in the municipality of Conceição das Pedras, located in the south of the state of Minas Gerais (Figure 1), at coordinates 22°10'5" south and 45°28'31" west and at 1,063 m altitude (Cidade Brasil, 2021). In 2021, the municipality had a population of 2,814 inhabitants, of which 1,544 (54.9%) lived in the urban perimeter and 1,269 (45.1%) in rural areas (IBGE, 2022).

The Conceição das Pedras WSS currently consists of the water cathment at the Boa Vista stream, raw water pipeline, semi-buried raw water reservoir, compact type pressurized water treatment plant (WTP), treated water pipeline, three reservoirs and water distribution network. Water treatment involves the processes of flocculation, decantation, filtration and disinfection. In addition, another catchment point is being implemented and another compact open type will replace the WTP.

The municipal authority of Conceição das Pedras carries out the supply service. It supplies water to the two neighborhoods in the urban area, called Centro and Rancho Alegre. The population does not pay any tariffs for the service, just a fixed fee included in the Property Tax (IPTU in the Portuguese acronym).

Figure 1

Location of the municipality of Conceição das Pedras, state of Minas Gerais



Source: Author's own elaboration

Collection and analysis of user perception

For data collection, a form with 17 closed-ended and 3 open-ended questions, one of which was optional, was applied, with the aim of understanding the problems faced by the population in relation to the WSS. The questions sought to identify the socioeconomic profile of the respondent (age, gender, education, among others) and their residence (location, length of residence, water source, among others), characteristics of the water supply and its quality (interruptions, pressure, color, flavor, odor, among others) and willingness to pay for the water service.

The form was applied in three stages and complied with the ethical precepts established by National Health Council Resolution No. 510/2016 (CNS, 2016), being approved by the Research Ethics Committee (CAAE process 55997422.6.0000.5094).

In Stage 1, we met with the municipal authorities to inform and present the research, show the data collection form and inform how its application would be carried out.

In Stage 2, dissemination material for the research was placed in the municipality main establishments and the creation of promotional material to invite the population to participate in the research (Figure 2), which was published on social networks (Facebook, Messenger, Instagram and WhatsApp).

Figure 2

Research dissemination folder

Source: Author's own elaboration

Later on, the form was applied through Google Forms between March 22nd and 29th, 2022. The inclusion criteria to participate in the research were: living in the urban perimeter of

Conceição das Pedras and using the public WSS. Furthermore, with the answers obtained, the location of each participant was identified, with the help of Google Earth Pro, to see if the data collection form covered all regions of the municipality's urban perimeter and responses that had the same address were excluded. The form did not have a filter to eliminate these responses, and the deletion was done manually.

The calculations related to sample size and associated errors were performed based on Equation 1. Where: n = sample size, in residences; σ^2 = chosen confidence level, expressed in numbers of standard deviations; p = percentage with which the phenomenon occurs; q = complementary percentage, that is, 100-p; N = population size, in residences; and e^2 = maximum error allowed. The variable "p" is previously estimated and corresponds to the percentage of the product in which the phenomenon occurs (Gil, 2008). In this case, it was not possible to estimate it, with "p" being considered equal to 50%, which is the maximum value.

$$n = \frac{\sigma^2 * p * q * N}{e^2 * (N - 1) + \sigma^2 * p * q} \quad (1)$$

According to the municipal authorities, the municipality has 916 water connections, which is the number of properties that cover the research population. Application of the form resulted in 131 responses, 23 of which were discarded. Therefore, 108 responses were used. This value, with a 90% confidence interval, is equivalent to an error of 7.46%. The error found can be considered high, but it was considered in accordance with the exploratory purposes of the research and not with statistical representation.

Finally, in Stage 3, the results were analyzed in Tableau visual analysis platform (available at https://www.tableau.com/pt-br). The information collected was the basis for the creation of analytical panels, developed so that both the population and managers had access to data in an easy and understandable way.

Results e discussion

Initially, according to the analysis carried out in the Google Earth Pro tool, it was possible to identify that, in the urban perimeter of the municipality of Conceição das Pedras, around 66% of residences are located in the Centro neighborhood and around 34% in the Rancho Alegre neighborhood. Comparing this distribution with the distribution achieved by the form, there are 81 responses in the Centro neighborhood (75.0%) and 27 responses in the Rancho Alegre neighborhood (25.0%). Therefore, the number of responses obtained in each neighborhood was, to a certain extent, proportional to the distribution of residences in them. When analyzing how many respondents in each neighborhood compared to the total number of existing resistances, it is clear that, in the Centro neighborhood, the percentage was 16.2% and, in the Rancho Alegre neighborhood, the value was 10.6%.

Another interesting fact that was possible to observe was that the number of women who responded to the form was greater than that of men (75.0% versus 25.0%); but, in 2010, the percentage of population in the municipality was 46.6% women and 53.4% men (IBGE, 2022). Therefore, the responses obtained have a female bias. The studies of Costa et al. (2016) and Andrade et al. (2019) also had this bias. In the first case, 60% of the sample population was female; and, in the second, the value reached 77%.

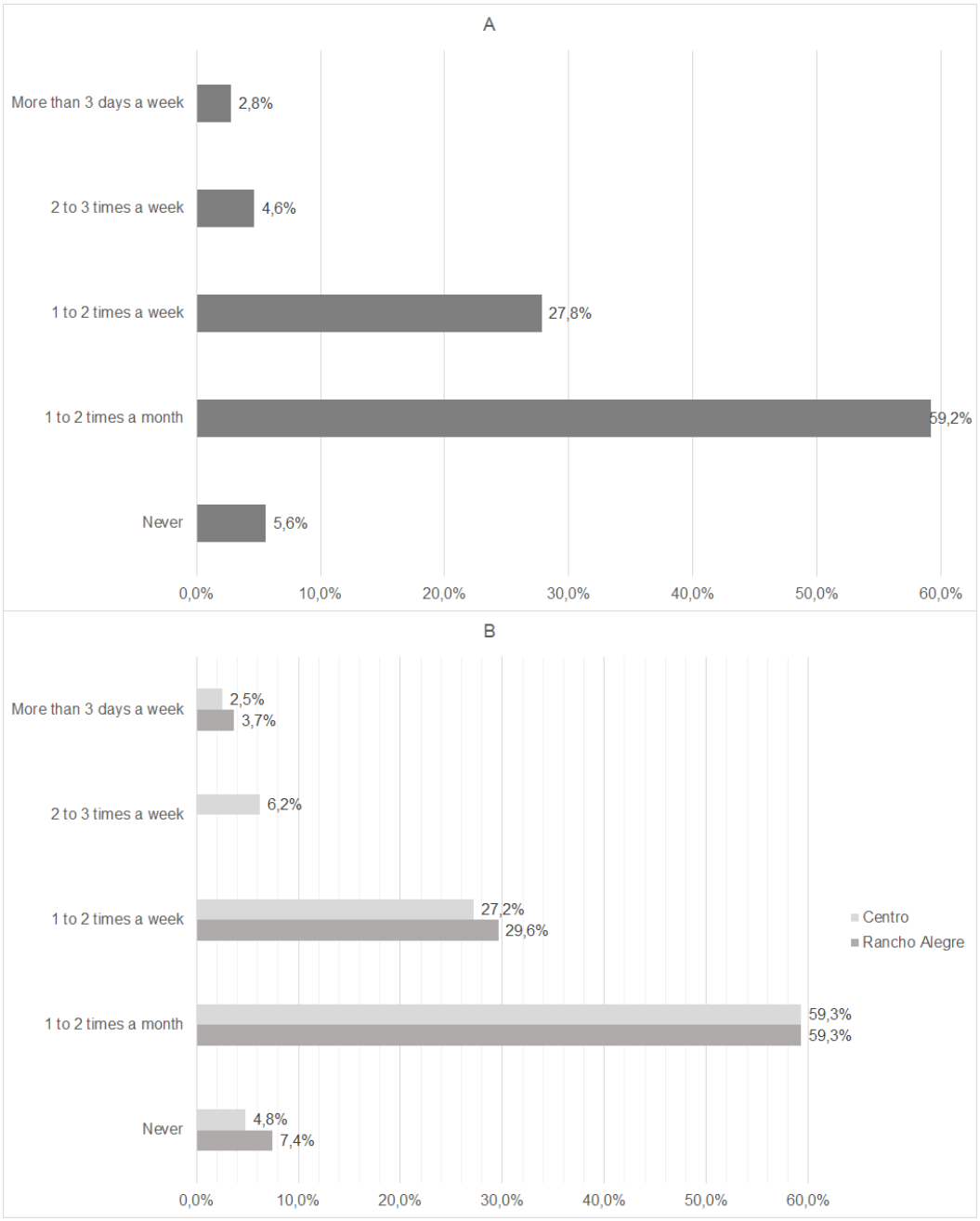
Regarding length of residence in the municipality, most respondents (94.4%) have lived in the municipality for more than five years. Therefore, they were able to evaluate the water supply system based on the form applied.

Next, the data refers to the population's perception regarding the quality of the service provided. With regard to interruptions in water supply (Figure 3A), most respondents state that water shortages occur 1 or 2 a month. When analyzing this information separating it by neighborhoods (Figure 3B), the respondents from both neighborhoods still show that interruptions in the water system occur more frequently 1 or 2 a month. Therefore, even in a

small municipality in the southeast region, where the municipal government provides the water supply, water shortages are infrequent.

Figure 3

Percentage of responses in relation to the frequency of interruption of water supply in general (A) and by neighborhood (B)



Source: Author's own elaboration

At this point, it is interesting to discuss regional disparities in Brazil in access to water. Freitas et al. (2009) pointed out, in the WSS in an Amazonian community, that the primary concern was the fact that many places in the city did not receive drinking water in their taps. For Barcarena – State of Pará, it was found that a large portion of respondents (66%) do not have access to or do not use the public WSS, with individual wells being the solution used (Gonçalves et al., 2015). Furthermore, with regard to water supply, it was found that only in 6% of the sampled residences there was no interruption in the water supply, while in the majority (60%) there was a periodic lack of water (Gonçalves et al., 2015). Still in State of Pará, when diagnosing the WSS in the urban area of Tucuruí, residents of the three neighborhoods reported that interruptions occur daily, with a frequency of 59.9% of responses (Silva & Silva, 2021). In Corrente, State of Piauí, 78% of respondents indicated a lack of water occasionally and 22% frequently (Costa et al., 2016). Another study, carried out with a residents' association in a neighborhood of Itapororoca, State of Paraíba, identified that the majority of respondents only have access to drinking water twice a week, representing 42% of the total respondents (Andrade et al., 2019). On the other hand, Lima et al. (2022) evaluated the perception of the inhabitants of a neighborhood in the municipality of Guarujá, state of São Paulo, regarding the provision of basic sanitation services and identifying demands and priorities for improving these services. They found that, despite the high heterogeneity in perception about the service and quality of sanitation services, water supply was the only service assessed as adequate.

Federal Law No. 14,026/2020, which deals with updating the legal framework for basic sanitation, has as its main objective the universalization and qualification of services provided in the sector and stipulates as a goal that 99% of the Brazilian population have access to drinking water by December 31, 2033 (Brasil, 2020). Therefore, the challenges to achieving this goal are great, especially in the north and northeast regions.

As shown in Figure 4A, the average delay for the Conceição das Pedras WSS to respond to problems is less than 1 day. When analyzing this information by neighborhood (Figure 4B), it is clear that, in the Centro, problems are resolved in less than a day; but, in Rancho Alegre, the percentage of responses between less than 1 day and more than 1 day was very close. Therefore, according to users' perception, we inferred that the time to respond to problems is longer in Rancho Alegre. This neighborhood is a more recent occupation; it is growing and it is further away from the WTP, which may justify the longer delay in addressing the problems. However, we inferred that the frequency and time of interruption in the water supply are small and do not cause major inconvenience to its users. The results obtained at the neighborhood level make it possible to diagnose sanitation, pointing out neighborhoods with deficiencies that require interventions to improve service provision (Menezes Filho & Rodrigues, 2017).

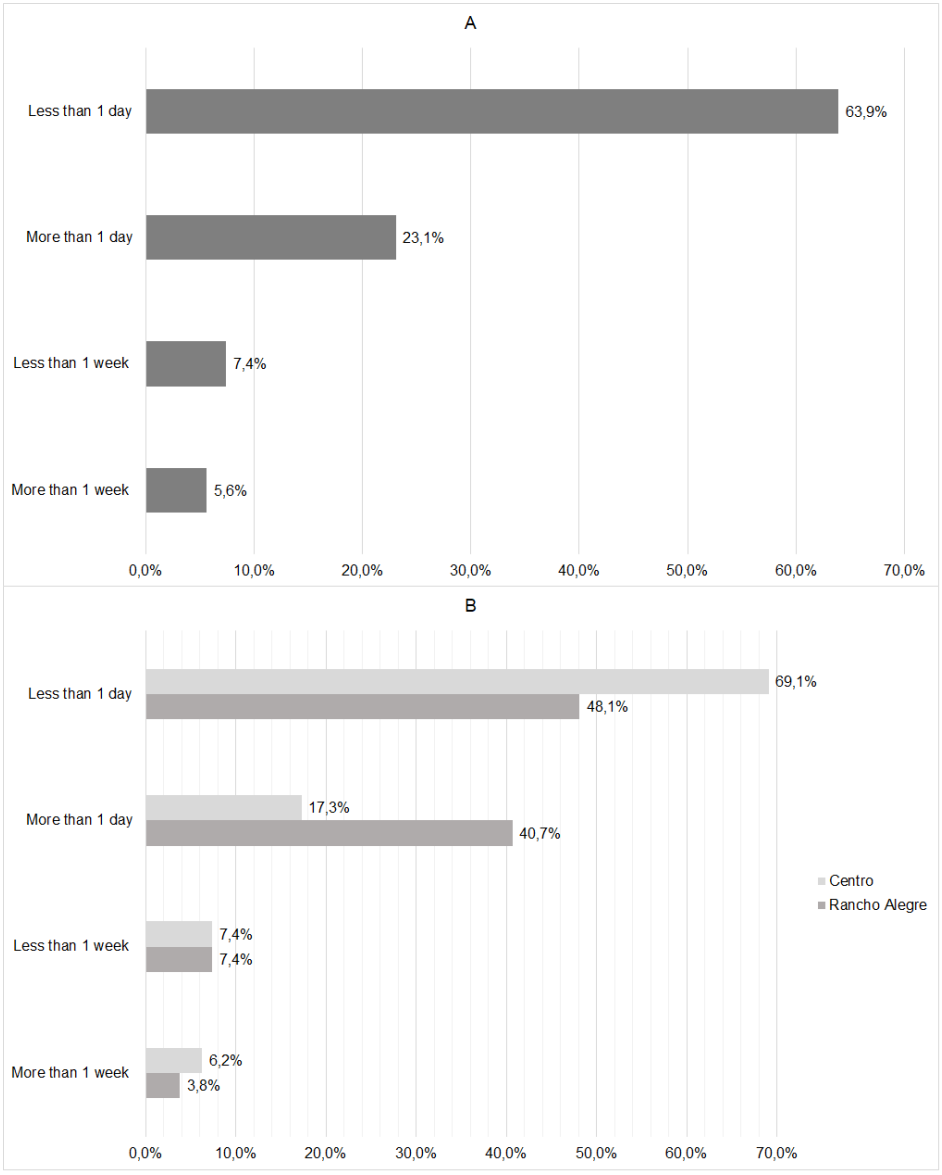
The frequency of water supply interruptions affects the population according to the water storage capacity of their residence; this is decisive in the different levels of rationing impacts, with higher class homes tending to have greater storage capacity, which means that their users maintain their water use routines practically unchanged (Grande et al., 2016). Therefore, interruptions in water supply affect low-income populations more (Grande et al., 2016).

For the purpose of WSS interrupting in a planned manner, there are legal provisions that allow for the interruption of the water supply, such as Federal Law No. 8,987/1995 (Brasil, 1995) and Federal Law No. 11,445/2007 (Brasil, 2007). They allow for the interruption of supply due to the need to carry out repairs, modifications or improvements of any nature to the systems. Furthermore, the laws make it clear that the interruption cannot start on Friday, Saturday or Sunday, on a holiday or the day before the holiday. In the case of Conceição das Pedras, interruptions occur due to supply problems, mainly due to the need to expand the system to meet demand, that is, without planning.

When evaluating the responses regarding the pressure at which water is made available by the supply service, the majority of people (75.9%) consider the water pressure satisfactory, 14.8% low and 9.3% high. When analyzing the neighborhoods individually, it is also clear that in both, the majority consider the pressure as satisfactory.

Figure 4

Percentage of responses in relation to the time to respond to problems in the general water supply (A) and by neighborhood (B)



Source: Author's own elaboration

With regard to pressure in the water distribution network, it is known that the smaller the difference in topographic elevation of the homes in relation to the reservoirs and the greater the distance between the home and the reservoir, the lower the water pressure in the system (Grande et al., 2016). The urban perimeter of Conceição das Pedras is small and each neighborhood has a supply reservoir, making the distances short. In addition, the geometric gradients between the water reservoir and the water distribution points vary from 10 to 56 m, favoring an adequate delimitation of the pressure zones. These factors justify most respondents considering the water pressure satisfactory. Besides, there is no residence in the urban perimeter that is not served due to a lack of pressure from the distribution network, which means that residents are not sensitive to this issue.

In the research, some questions were asked regarding the quality of the water distributed. They were asked whether the water had an unpleasant taste or odor, as well as color. In the case of the frequency of the unpleasant taste or odor, 50.9% responded “sometimes”, 29.6% “never”, 10.2% “often” and 9.3% “always”. As for color, the frequencies were 62.0% “sometimes”, 17.6% “often”, 12.0% “always” and 8.4% “never”. Therefore, in both questions, the majority of answers were “sometimes”.

In cases where there is color in the water, it was also asked what it would be, where the majority of respondents (50.0%) stated that the water was yellowish, followed by whitish (19.4%), brown/muddy (16, 7%) and has no color (12.1%). Two respondents (1.9%) who chose the “other” option, they made the comments “In the rainy season it is always dirty”, and “It seems to have an oil”.

In the opinion of users of the study by Gonçalves et al. (2015), the water presented undesirable characteristics, such as color and flavor, a factor that caused the consumption of packaged water to be high in the location. However, Lima et al. (2017) evaluated sanitation as a whole in 21 municipalities in State of Goiás operated by local institutions and respondents were satisfied with the taste and smell of the water in general.

The perception of water quality is driven by several reasons, such as taste, odor and color, which are relatively associated with diseases, which may not be true (Silva et al., 2019). Furthermore, users' perception of water potability is predominantly related to physical and organoleptic characteristics and not to sanitary characteristics (Rocha et al., 2006). Thus, the color and turbidity that drinking water presents may be reasons for rejection, even if it meets quality parameters (WHO, 2004). This can cause consumers to start using water without knowing its quality, but which has acceptable characteristics and also shows that drinking water must not only be drinkable, but it must also be acceptable in aesthetic and organoleptic terms (WHO, 2004).

In this research, we can observed that the majority of respondents state that sometimes the water is colored, so it is likely that this parameter is above the maximum permitted value (15uH), that is, unsuitable for consumption. Therefore, an analysis of the quality of this water must be carried out to certify its compliance with Ministry of Health Ordinance No. 888/2021 (MS, 2021). In Conceição da Pedras, the WTP is not meeting the demand for water quantity and a new one is planned to be implemented. However, until the expansion is completed, it may occur that, during peak demand, the quality of the water distributed is inadequate.

Another factor that contributes to the lower quality of the water distributed is the operation of the WTP during rainy periods, as, with the change in turbidity in the water collected, it is necessary to just the dosage of the products used in its treatment. However, in most treatment plants, especially in small municipalities, controlling the dosage of chemical products is ineffective (Franco, 2009). Inadequate dosages are frequent in WTPs because of the few studies on the precise dosage of coagulants, with no effective values being previously determined that result in the best quality of treated water, avoid waste of reagents and reduce waste production and treatment water costs (Franco, 2009). The low level of education of operators contributes to this, as the vast majority have insufficient education (Panini, 2009).

The population was also asked how often to clean the property's water supply tank, as this may interfere with the quality of the water that reaches their taps and is not a problem with the supply system. The number of people who responded that cleaning is done every 6 months, every year and more than a year was 25.0%, 28.7% and 31.5%, respectively. Furthermore, 13.9% of respondents do not clean and 0.9% said they do not have a water tank. According to the National Health Surveillance Agency (ANVISA, 2011), specifically for homes, it is recommended to clean the tank at least every 6 months. Therefore, it can be said that only 25% of users clean within the time interval defined by National Health Surveillance Agency Resolution No. 63/2011.

Individuals' level of awareness regarding water quality is closely linked to how they interact and experience water, such as drinking water from a tap (Barnett et al., 2018). Therefore, it was questioned whether the population drinks water directly from the tap. When considering the answers "yes" (19.4%) and "sometimes" (41.7%), it means that the majority of respondents drink water directly from the tap at some point. Even though some respondents stated that water sometimes has a taste, odor or color, only 38.9% never drink water directly from the tap.

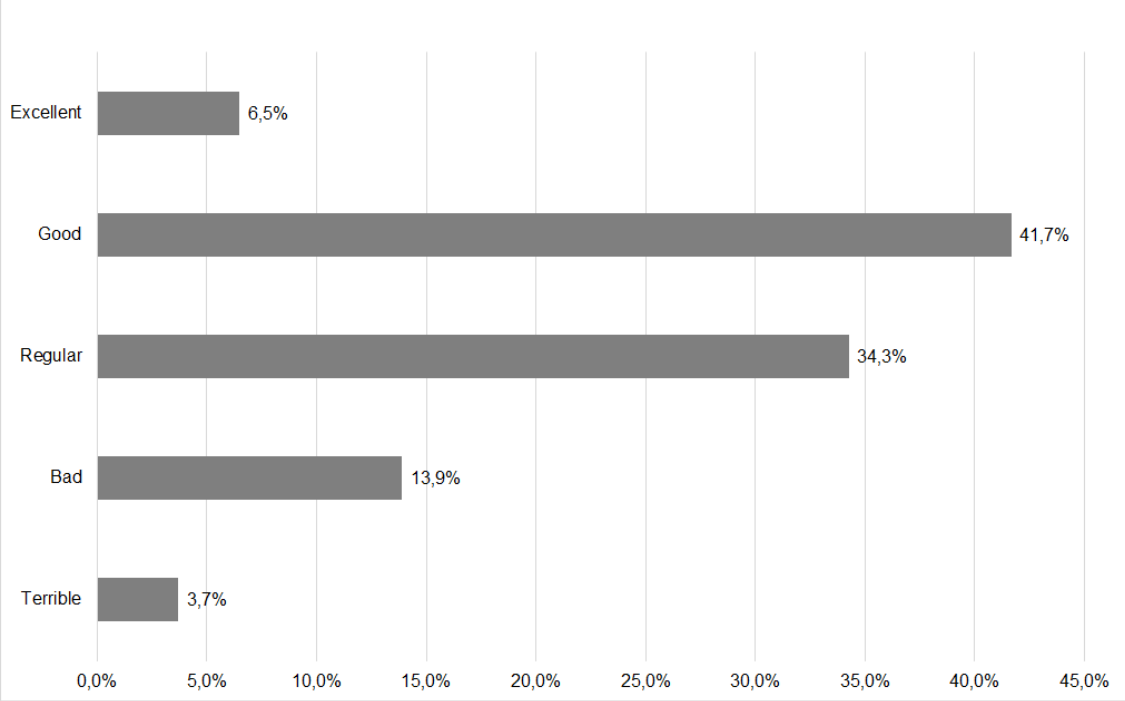
The issue of drinking water directly from the tap is addressed in several studies, including international ones. In Flanders, bottled water consumption is widespread and largely this is caused by negative perceptions about tap water, where many consumers consider it unhealthy, unsafe and prefer the taste of bottled water (Geerts et al., 2020). In addition, in a semi-urban Nigerian city, most people prefer to drink bottled water if it is not out of their financial reach (Nnaji et al., 2013). In the study of Hamed et al. (2022), most people believed that tap water was of unacceptable quality, while physicochemical tests showed otherwise.

In an overview of the quality of the water provided by the WSS (Figure 5), the majority of responses were of good (41.7%) or regular (34.3%) quality. Bearing in mind that the people who said that sometimes the water has an unpleasant taste, odor and some color were also the ones

who responded that the quality of the water is between good and regular. Furthermore, the majority of people who responded that water shortages occur once or twice a month consider that the water quality is good. Therefore, we can assume that, even though the WSS presents some possible problems, the majority of the population considers the water quality to be good or regular.

Figure 5

Percentage of responses in relation to perception of water quality



Source: Author's own elaboration

The variability of responses on water quality, from excellent to very poor, shows a considerably sharp divergence of opinions, which may be linked to the location of residences and the sanitation infrastructure (Andrade et al., 2019).

The perception of water quality in other studies is also divergent from the results found when observing the north and northeast regions of Brazil. In the Olaria neighborhood, municipality of Corrente, State of Piauí, 40% of those interviewed indicated the quality of the

water supply as poor and only 5% of these indicated it as excellent (Costa et al., 2016). Furthermore, 47.19% of the inhabitants of Tucuruí, State of Pará, classified the quality of water in the public supply system as poor (Silva & Silva, 2021). Indicating, once again, the regional differences in water quality in Brazil.

In a North American international context, according to American Water Works Association (AWWA, 2020), seventy-seven percent of people with water supply services rated water quality as excellent or good; with the two biggest drivers of water quality among people with water service being “my tap water is safe to drink” and “my tap water does not smell”. In the Hainan Province, China, 80.3% of respondents were satisfied with water quality, with age and gender not playing significant roles in the public’s level of satisfaction (Wang et al., 2018). According to Crampton & Ragusa (2016), the consumers in most developed countries, including Australia and New Zealand, assumed their water was safe. In Guatemala, few respondents (3.2%) believed that tap water was completely safe to drink (Vásquez, 2017).

Therefore, perceptions related to water are context-specific and are related to personal characteristics (Skuras & Tyllianakis, 2018). They result from a complex interaction of several factors, being mainly influenced by satisfaction with organoleptic properties (especially flavor), risk perception, contextual factors, perceptions of chemical products (lead, chlorine and hardness) (Doria et al., 2009), microbiological and chemical quality, previous experiences, sources of information, trust in water companies and other groups, perceived control, among others (Delpla et al., 2020).

Finally, we asked the population if they would be willing to pay for water treatment. Even reporting some problems with water quality, the most frequent answer was that they would not be willing to pay for the treatment (46.3%), followed by maybe (30.6%) and only 23.1% said yes. In order to be able to charge for water treatment, it is necessary to install water meters in homes, which does not exist in Conceição das Pedras. Although the hydrometering indicator

reports that its index is 100% in the municipality (SNIS, 2022), during a field visit, it was proven that this information is erroneous, with no hydrometering in the municipality.

In a study of Gonçalves et al. (2015) with the population of Barcarena, State of Pará, the majority refuse to accept the installation of water meters in their homes due to the control of the volume used that will be charged. Even though they claim that the water has taste and color, they do not want to pay for improvements to the system. In the same study, the issue was mentioned that water should be free for everyone, without any type of charge for its use, as it is a natural resource. Therefore, we observed that the user is unaware of what he actually pays for, not being the water, but the service of providing treated and piped water to the population (Gonçalves et al., 2015).

In the municipality of Itapororoca, State of Paraíba, Andrade et al. (2019) pointed out that the WSS is managed by the local institutions itself, with no water treatment and, consequently, no charge for it. This study showed that, in general, the population is satisfied with the water distribution service, even though the majority said that there is water in the tap only twice a week. This happens due to the lack of charging for this service, which makes the population settle and not have the right to demand improvements in the WSS (Andrade et al., 2019). Therefore, it is clear that when there is no charge for the water supply service, most of the time, the population prefers to continue with water quality problems rather than paying for an adequate service. We can also think that this refusal to pay may be related to the purchasing power of the population, with insufficient income to pay for basic services that guarantee their health and well-being. It is necessary to reflect on the charging or privatization of water treatment and the universalization of access to sanitation. The issue of adequate charging and user satisfaction are fundamental factors for a balance between environmental issues and the population's quality of life (Arruda et al., 2016).

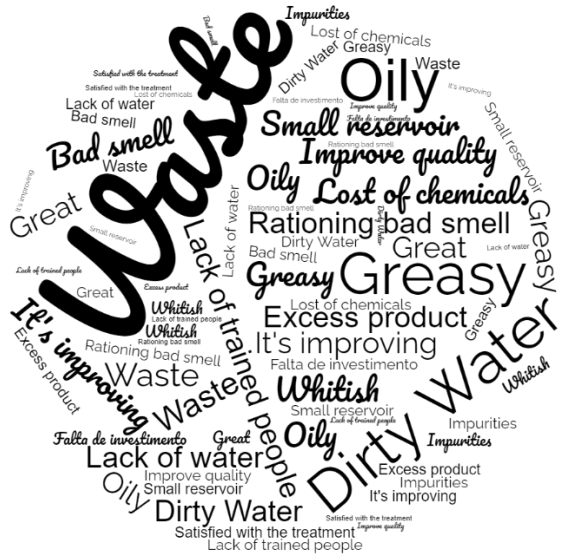
Still, an interesting fact found in a survey carried out in 64 Spanish municipalities, refers that the data analysis, using a regression model, showed that when urban water services are

operated by a private company, the quality of the water distributed, perceived by users, worsens (García-Rubio et al., 2016).

At the end of the form, respondents were given the option to make any considerations. Of the 108 responses, only 19 (17.6%) left comments about the system. Two comments were positive, 13 negative and four about water waste by users. In Figure 6, a cloud of the words or expressions that were most mentioned in the comments is presented. Thus, the most mentioned word was waste, followed by the expressions greasy, lack of trained people and dirty water.

Figure 6

Cloud of words and expressions mentioned in the final comments by respondents



Source: Author's own elaboration

Many comments were about consumers wasting water, probably due to non-payment. According to the indicators in the National Sanitation Information System (SNIS, 2022), the average per capita water consumption of the population of Conceição das Pedras is 409.35 L/inhabitant per day, a very high value when comparing the national average (139.23

L/inhabitant per day) or, alternatively, with the indicated value by the United Nations (110 L/inhabitant per day). Furthermore, the high consumption of water in the city contradicts the concern of the population in the cities of State of São Paulo and Santa Catarina, where the majority of those interviewed indicate water as fundamental for survival, being sufficient currently, but fear its future unavailability (Kuhnen et al., 2009).

The summary of all results found is presented in Table 1.

Table 1

Summary of results found by the research

Information	Main results
Eighborhood of residence	75% of respondents in the Centro neighborhood and 25% in the Rancho Alegre neighborhood
Gender	75% women and 25% men
Time of residence	94.4% have lived in the municipality for more than 5 years
Interruption in water supply	59.2% indicated 1 or 2 times a month
Response time to supply problems	63.9% indicated less than a day (by neighborhood, 69.1% in Centro and 48.1% in Rancho Alegre)
Water pressure	Considered satisfactory by 75.9% of respondents
Frequency of water with unpleasant taste or odor	50.9% said “sometimes”
Presence of color	62.0% said “sometimes” – half of those who mentioned color considered it yellowish
Frequency of cleaning the property’s water tank	31.5% carry out cleaning over periods of more than 1 year
Tap water intake	19.4% said “yes” and 41.7% “sometimes”
Overview of water quality supplied by WSS	41.7% rated it as good and 34.3% as regular
Willingness to pay for treatment	46.3% of respondents are not willing to pay
Other considerations	Two comments were positive, 13 negative and 4 about water waste by users.

Source: Author’s own elaboration.

Conclusions

This research managed to achieve its objective of diagnosing the quality of the WSS in the municipality of Conceição das Pedras, State of Minas Gerais, based on the evaluation of

user's perception. In this sense, important information was collected, such as notes that water sometimes has color, taste and odor. There are also complaints from consumers saying that the water is greasy. However, according to users' perception, the system presents a low number of interruptions in the water supply and a quick resolution of any issues.

With this, we can pointed out that, even though the WSS presents some possible problems, the majority of the population considers the water quality to be good or regular, which is extremely important for the population's quality of life.

It is expected that the information collected by this research can contribute to better management of the municipality's water supply system, managed by the local institutions itself, as well as the methodology applied can serve as guidance for other works. It is worth noting that the research results were made available through analytical panels on the Tableau visual analysis platform, being therefore available to both the population and managers.

Finally, it should be noted that user perception alone is not enough to confirm that the water is of good quality, and further studies are needed to evaluate in the field the potability of water and its real contribution to people's health.

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