The perception of the population regarding the water supply in Piteşti City, Argeş County, Romania

Mihnea-Ştefan COSTACHE [1]

[a]*University of Bucharest, Faculty of Geography, „Simion Mehedinţi" Doctoral School, No.1, Av. N. Bălcescu, Bucharest, Romania*

Abstract: Water, as the vital resource for life, is subject of several challenges in the contemporary world. One challenge is to complete supplied it in the best parameters for the entire world population, from crowded cities to remote areas. An assessment upon the state of population water supply is fundamental for establishing and adopting measures and policies for a sustainable management of this resource. Therefore, the aim of this study is to explore the population's perception regarding the water supply in Piteşti city, Argeş county, Romania. For this study, a cross-sectional survey was used, disseminated online to the Piteşti residents. The results showed both the strengths and some weaknesses of the water supply of Piteşti city. About 60% of those surveyed have a very good and good opinion about the quality of water supply services in Piteşti City, while the remaining 40% are more reserved about it. The study could help local authority to establish a sustainable water management for urban residents.

Key words: *Piteşti City, water supply, public perception, survey research*

1. Introduction

Water represents one of the most important resources of the Earth, ensuring through its circuit the natural function of all environmental components, but, in the same time is a vital source for population and implicitly for household, but also for all economic activities. However, this resource has been considerably at risk in recent decades as a result of climate change and fast urbanization, placing more emphasis on its sustainable and rational use, especially in large cities (Heidari et al., 2021). It is estimated that by the year of 2050, 68% of the population will be urban, that will increase pressure on the water supply of the cities (Pluchinotta et al., 2021). The cities affected by rural-urban migration (Simukonda et al., 2018) or urban sprawl which is associated in many cases with unplanned constructions within the city (Suditu et al., 2010) face the increase of population's ask more buildings, houses, and hence the need to resize water supply according with the new sizes. Furthermore, limited natural water resources is another factor influencing its supply in cities. Even if, for inland rivers, Romania uses less than 40% of the available freshwater (Ene & Teodosiu, 2009), there is a need to adopt several strategies for sustainable management (Voskamp et al., 2021), and, also to plan the water reuse (Ormerod et al., 2019). So, taking into consideration the local characteristics of the city and its buildings, the community, local policies, decision makers and administrative systems (Dias & Ghisi, 2024) could develop or adopt certain systems for rational usage of the water (Wong & Mui, 2008) to be prepared to use modern technology, in line with the sustainable development, which could be safest way in case of water crisis. Moreover, the involvement of governments is crucial both for the

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distribution of the required water and for maintaining its quality at normal levels (Massoud et al., 2013).

Numerous studies (Seelen et al., 2019; Rodger et al., 2021; Rodger & Papies, 2022) have emphasized the need to enhance public awareness regarding the adverse effects of inadequate water consumption, and, also, to establish-healthy water consumption and habits which involves education since early age to form attitudes and beliefs as citizens. In this regard, the perception of the population study emphasis different aspects. Thus, in Canada, Turgeon et al., (2004) researched the satisfaction and risk perception upon drinking water in Ontario, while Jones et al., (2006) analysed perception of consumers for private water supply. Ohers perceptions' studies refer to areas with water scarcity in Brazil (Vinturini et al., 2020), Africa (Kumpel et al., 2016), Indonesia (Zikrina et al., 2024) or in cites with water quality affected by salt intrusion in Near East (Alameddine et al., 2017). In Romania, research based on perception exploration become more and more relevant in relation with environmental issues as water pollution by mining (Dogaru et al., 2009) or water waste often underestimated (Blidar et al., 2023). As beneficiaries of water supplies services, the opinions of the inhabitants of a city may contribute to the adoption of management measures by the water providers to improve the network systems (Sajjadi et al., 2016).

In this brief described background, the purpose of this study is to estimate the population's perception regarding the water supply of Piteşti municipality, Argeş county. Consequently, the phases of research are followings: i) carrying out a survey regarding the water supply of Piteşti city, Argeş county; ii) questioning a sample of the population from Piteşti, regarding the water supply of the city; iii) graphical representation, analysis and interpretation of the questionnaire answers.

The objectives of this research are: 1) estimation of the population's awareness regarding the water supplies; 2) examination the perception of water quality in the urban system; 3) assessment the water supply management of the city; 4) evaluation citizens' satisfaction on water supply services. Moreover, a SWOT analysis has been carried out for a potential direction of development and improvement of the water supply system of the city.

2. Study area

Piteşti city is located in the central-southern part of Romania, in Argeş county (Figure 1.A), on the border of the Getic Plateau and the Romanian Plain. The city has developed on four successive terraces of the Argeş River: Trivale (333 m) which is the highest one, Exerciţiu (300 m), Centrul Civic (277 m), but also the lower one, on the floodplain of the river (252-255 m) (Popa et al., 1986). The potential of water resources is given by the city's location at the confluence of the Argeş River with the Doamnei River, as well as the Budeasa, Bascov, Piteşti (Lânăriei) and Goleşti reservoirs, in the eastern and northern part of the settlement (Figure 1.B). Furthermore, within the analysed area, there are also some streams such as Gemanăna Mică, Trivale and Bascov. However, they have low discharge rates and dry up multiple times throughout the year, diminishing the suitablility for water supply purposes. To ensure the dinking parameters, the city is equipped with one Water Treatment Plant at Budeasa, five storage-repumping complexes (Războieni, Schitului, Semura, Mărăcineni and ZIN) and one wastewater treatment plant near Goleşti reservoir, on the right bank of the Argeş River (Dinu & Brezeanu, 2014). Moreover, the city benefits of slightly mineralized natural wells, which have their source in the upper layers of the terrace sectors of the Argeş Valley (Popa et al., 2008). According to the National Institute of Statistics, the population of the city in 2023 was 166,931 inhabitants, 99.9% of them being connected to the water supply system. Piteşti has underground aquifers as its main sources of supply, both for drinking water and for industry, but also the Argeş River, through the reservoir of Budeasa, adding, for exceptional circumstances (drought periods), the Bascov reservoir (Ion et al., 2016).

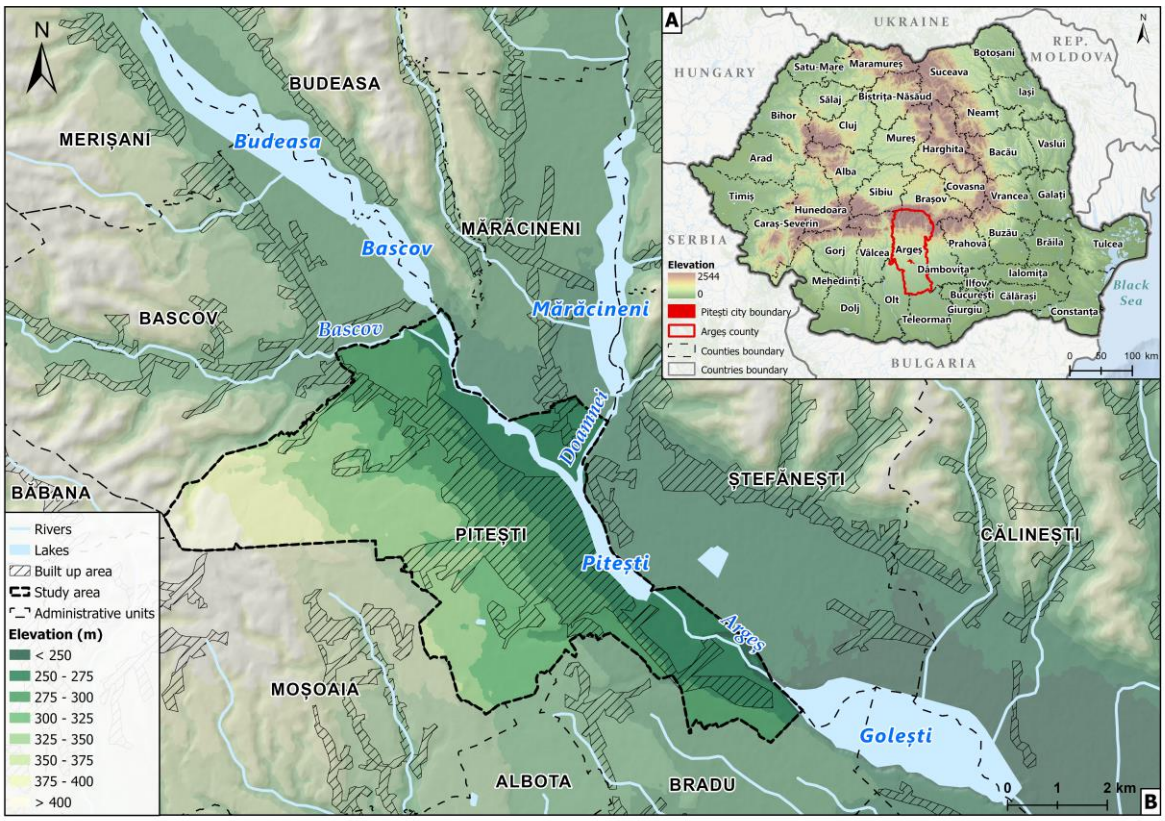

Figure 1. The city of Piteşti. A) Location map at country level; B) The reservoirs of the city
Data source: EU-DEM 25 meters

3. Materials and methods

This study is based on the survey method, created using Google Forms, and then distributed in the online environment through different social networks to the inhabitants of the Piteşti city. It was accessible online between May and June 2023. Keeping it as cross-sectional survey, the sample method was somewhat convenient. The survey had 15 questions, three of them collect the socio-demographic profile of the respondents, twelves were close-ended questions, related to the way in which the inhabitants are supplied with water in the municipality of Piteşti, one based on 4 Likert scale (1 unsatisfactory till 4 very satisfied) named 'forced' Likert scale, in order to obtain a fairly results, out of neutral opinions (Bäckström & Björklund, 2024). Data were processed in Microsoft Excel 2021 software for the graphics' representation of the results. Ethically, in the introduction, the questionnaire mentioned that it by its completing, every participant consent to take part in research, the fact that it does not involve personal data, its purpose being purely scientific. This explains somewhat the small dimension of sample, respectively 175 responses, which allowed an exploratory analysis.

4. Results

4.1. The socio-demographic characteristics of the sample

Regarding the socio-demographics profile of the sample, the largest part of residents who agreed to answer the survey were aged between 40-60 years (45.7%), followed by the age group between 20-40 years (34.3%), the category of those under 20 being represented by 16% of all, while aged over 60 were only 4% form total. Structure by age group and gender can be seen in Figure 2, with the following values: 80 persons for the 40-60 years age group, 60 persons for the 20-40 years age group, 28 persons for the under 20 years age group and just 7 persons for over 60 years category. About 65% of the respondents were female, with the highest values for the 40-60 years group (56), while 35% of

them were male, with the highest presence in the same category (24). Another socio-economic variable relevant to this study was the type of housing. Thus, 69.7% of respondents declare that they live in apartments, while 31.3% declare that they live in houses.

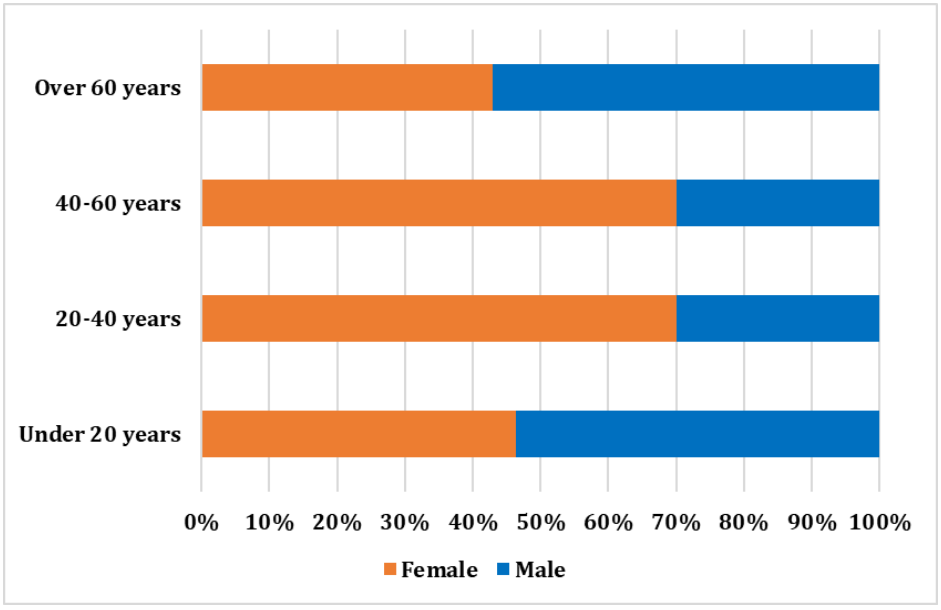

Figure 2. Sample structure by age group and gender

4.2. The awareness for water supplies

The origin of the city's water supply is acknowledged by 78.3% of respondents, while 21.7% are not interested in the water origin they consume daily.

The accessibility to a public water source near home seems to be similarly perceived, no matter the type of habitation. Thus, 82 % of blocks of flats residents (67.9%) and 80% of those living homesteads (32.1%) admitted that they have fairly access.

The potability of the water provided by the city system, although being ensured according to the regulations and the Romanian Waters Administration (Law 106/1996), only 28% use as it is, 46.3% have replaced it with purchased bottled water, and 25.7% are supplied with water from local springs and pumps. Results show differences by genders among consumers (Figure 3). The option for drinking water from bottles shows the that females (65%) tend to consume it, in comparison with males (35%). The use of tap water for drinking purposes is a routine for males (33%) and less for females (23%).

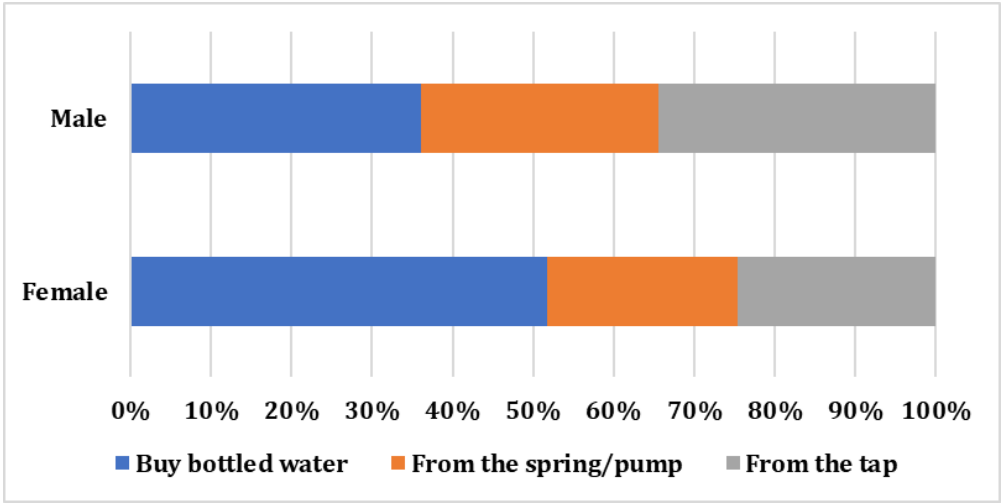

Figure 3. Type of drinking water, by gender

4.3. Water quality

Examining the perception of water quality (Figure 4) in the urban system at the end of the pipe (tap) shows that 48% of respondents have noticed often abnormal physical and chemical properties (colour, taste or odour), while 37.7% observed these irregularities only occasionally. 14.3% of surveyed people did not experience this issue, almost they being connected with residency of housing estates. Furthermore, only 28.6% of respondents inquired about the water quality indicators to the Environmental Agency, while over 71% have not. Concerns about water quality were identified in people aged over 60 years (41%), followed by those of 40-60 (36%). The lowest worries for water quality belong to young people under 20 years old (15% of them), and to 23% of respondents in the 20-40 age group.

As a preventive measure and to augment water quality, especially for drinking purposes, the use of water filtration equipment in house is unsatisfactory. Thus, 81% of the surveyed persons do not use water filtration equipment, especially in the age categories under 20 years and between 20-40 years, where less than 15% have such equipment. The percentage increases in the age categories 40-60 years and over 60 years, where approximately 25% of them use filter systems at home.

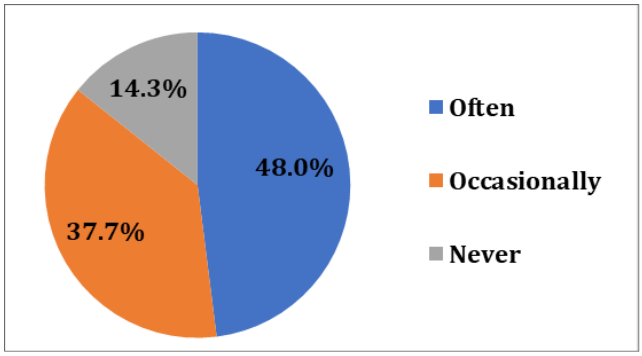

Figure 4. Perception of tap water quality

4.4. Water supply management

Water disconnections are frequent in the Piteşti city. In the analysed sample, 48.6% reported at least one water shutoff every few months, while 44.6% reported that they have always had access to drinking water. Additionally, 5.1% are affected by this issue multiple times in a month, whereas 1.7% are affected multiple times per week. Regarding water disconnections by types of housing (Figure 5), usually, people living in houses faced the issue more frequently. Approximately 60% of respondents recognized that they deal with this issue once every few months. On the other hand, in apartments, the disconnections are isolated cases (10 individuals), but the occurrences were multiple times a week.

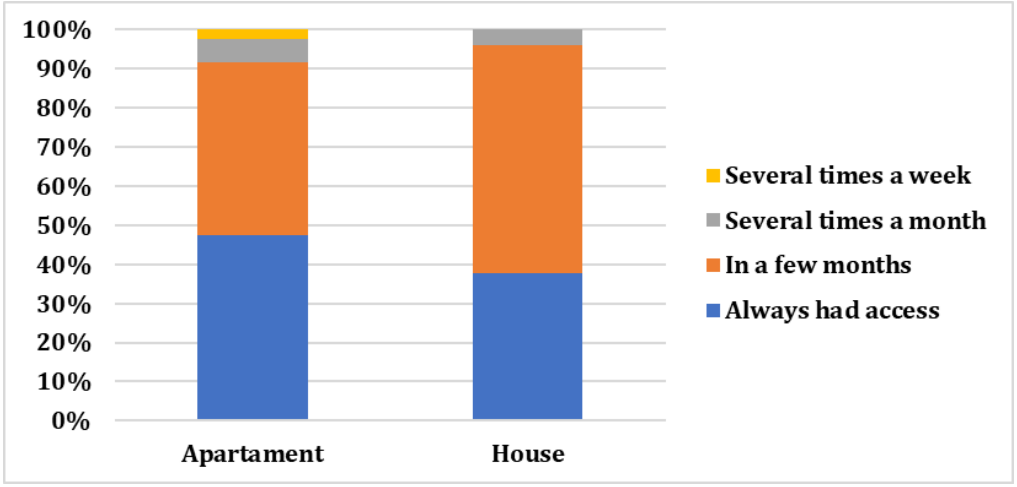

Figure 5. Water disconnections by types of housing

In the case of water supply disconnections, only 24% of respondents reported about consistently notifications, while 15% stated they were never announced. An additional 43% of respondents were occasionally informed, while 18% did not experience such incidents. The most frequent causes of water supply interruptions, according to 49% of respondents, were pipe failures near their residence, while 48% reported as a primary cause some modernization works and interventions on the municipal street water supply network. Additionally, rarer causes were reported by a small part of respondents, such as urban flooding or other natural risk events that impacted the water distribution network (2.3%) or financial issues such as debts, non-payment of services by property owners or local water suppliers (1 person).

Concerning the resilience to water supply disconnections situations, half of the respondents (50.3%) wait for the supply to resume, while 45% always keep some water reserves in houses. Additionally, 4.6% still use rudimentary methods of rainwater conservation in various containers. Figure 6 represents adaptation for water supply disconnections by age groups. It seems that the population over 60 years old is the most patient, with 70% of respondents waiting for the water supply to resume. Additionally, 50% of the young population under 20 years old are oriented to make their own reserves (Figure 6). Storing rainwater in various ways is reported by people under 60 years old.

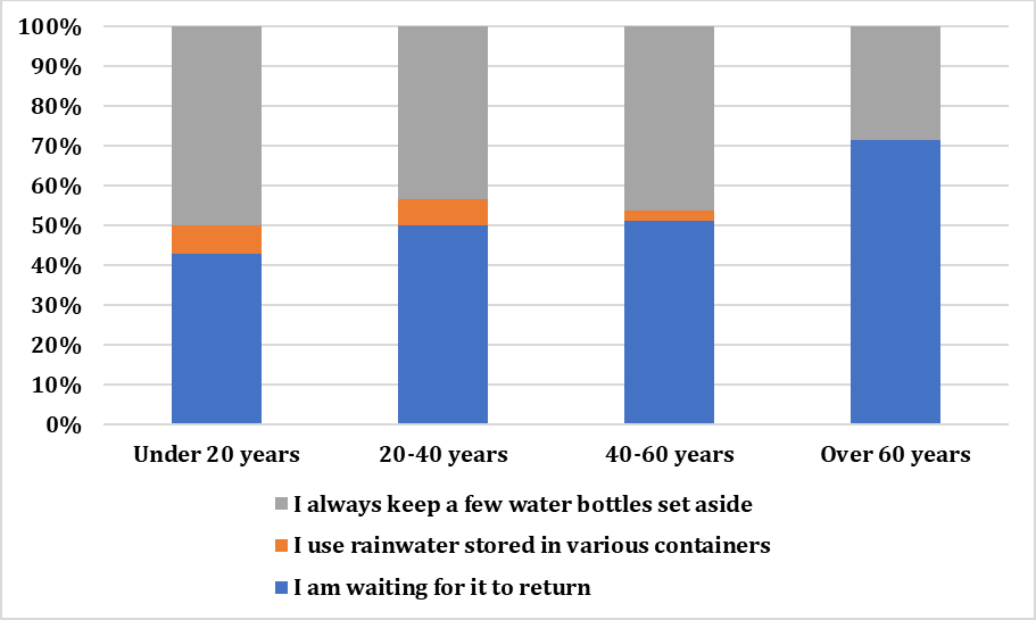

Figure 6. Adaptation for water supply disconnections by different age groups

4.5. Satisfaction on water supply services

Overall quality of the water supply services in the city of Pitești is perceived as good. Thus, 14% of respondents are very satisfied with, 45% appreciated as good, 34% consider them to be merely satisfactory, while 7% deem them unsatisfactory. By age groups (Figure 7), those with a high degree of satisfaction are individuals over 60 years old (71%), as well as individuals under 20 years old (65%). The opinion of the 20-40 age group is rather reserved, with nearly 50% of respondents considering the quality of services to be merely satisfactory, and 7% deeming it unsatisfactory. Similarly, in the 40-60 age group, approximately 12% of respondents consider the city's services to be unsatisfactory, while 25% consider them satisfactory.

Figure 7. Quality of water services by different age groups

5. Discussions

The results of the survey initially indicate a generally favorable perception of the water supply services in the city of Piteşti. However, in order to establish a clear direction for the development of these resources, it is necessary to analyse both the strengths and weaknesses, as well as the opportunities and threats that may arise, with the aim of improving the services. As such, in Table 1, a SWOT analysis regarding the quality of the city's water supply has been conducted.

Table 1. SWOT analysis regarding water supply quality from the resident's perception

Strengths	**Weaknesses**
Awareness of water supply sources of inhabitants, that suggest a moderate level of public knowledge	A significant portion of residents experiences frequent water disconnections, indicating inconsistencies in the water supply reliability
Diverse sources for drinking water across the city (tap water, pumps, springs, bottled water)	A large number of respondents do not inquire about the water quality indicators
The majority of respondents have access to a public water source near their household	Many respondents do not use water filtration equipment, which may pose health risks due to potential impurities in tap water
Strong resilience to water supply disconnections through different methods	Trust issues regarding the tap water, especially for females, suggesting concerns regarding the reliability and safety of the public water system
Opportunities	**Threats**
Improving public awareness about water quality indicators through educational campaigns	The sedimentation of reservoir and their poor management (aged infrastructure) can lead to the loss of water storage
Promoting water filtration systems and pro-environmental methods	Drought periods that can lead to a reduction in water resources in the reservoirs
Funding for infrastructure modernization, such as water supply network	Environmental risks through pollution upper the rivers and aquifers

Therefore, based on SWOT analysis, Pitești's water supply services have a strong foundation, with good access to water sources and a relatively high level of public preparedness for disconnections. Several requirement need attention: improving communication regarding water quality, and the issues leading to frequent water disconnections. Furthermore, supporting water filtration and transparency of water quality indicators and eco-friendly methods for storing it could improve the overall safety and satisfaction of citizens with the city's water services.

On the other hand, the numerous strengths of these services may lead to the appearance of weaknesses. One example would be the accessibility to various water sources within the city, where many respondents have access. It is about caution of some outputs as not all provide drinking water, such as artificial springs located in the Trivale neighbourhood (Figure 8). These springs is in an early stage of degradation, and in addition, the display panels indicates that the water is not safe for consumption due to ammonium levels exceeding the accepted limits of 0.5 mg/l (Vasilache et al., 2012). It isi well known that these high concentrations can have a detrimental effect on the water supply (Kurama et al., 2002). For these issues, the responsible entities are the local authorities, who must propose frameworks that, on one hand, frequently monitor these public supply sources, and on the other hand, improve their quality in order to prevent the emergence of infection outbreaks (Petrie et al., 1994).

Furthermore, very few survey respondents use rainwater in the event of a water supply interruption, storing it in various containers or barrels (Figure 9). However, in recent years, it has been regarded as an environmentally friendly method for water reuse, being easy to implement for any category of the population (Noorazuan and Shamsuddin, 2018). In fact, its use is implemented on a small scale, primarily for domestic purposes or gardening activities, with a need for greater promotion.

Figure 8. Artificial springs and warning panel (right) in the city, Source: Costache, 2024

Figure 9. Storing rainwater in barrels in some households. Source: Costache, 2024

6. Conclusions

In conclusion, the results of this study show both the strengths and the problems of the water supply system of Pitești municipality. The first issue is related to public awareness and trust in water supply, many residents of Pitești being aware of their water supply sources, but there is a notable distrust in the quality of tap water as a result of the alteration of its physical and chemical properties, something noticed by 85% of the respondents.

The low usage of water filtration systems among respondents (just 19%), especially in younger age groups, suggests that there is a gap in the population's preparedness to ensure water safety. This, combined with the lack of interest in monitoring water quality indicators (29%), points to a critical

area for intervention, such as promoting water filtration systems and encouraging more active involvement in monitoring water quality.

A significant portion of respondents experiences frequent water disconnections (53%), particularly in houses. These disruptions indicate potential issues with the city's aged infrastructure and highlight the need for timely and effective communication from local authorities regarding water supply interruptions. There is a need to invest in infrastructure modernization and also promoting eco-friendly water-saving methods like rainwater harvesting.

Generally, the water supply services in Piteşti are regarded positively (60% of respondents considers good and very good), having some strengths, such as good access to water sources and strong public adaptation to disconnections, but there are still critical challenges that need to be addressed to ensure safe, sustainable, and equitable access to water for all residents.

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