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Assessment of the Potential for Reuse of Water in the Supply of the Metropolitan Region of São Paulo

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ABSTRACT

The phenomenon of water scarcity has become a global problem, which among its main causes is the growth of the population that brings as a consequence an increasing demand for potable water, which is an admittedly limited resource. São Paulo, the greatest example of inequality in water distribution in Brazil with 22% of the population and only 1.6% of the country's surface water, faced between 2014 and 2016 one of the biggest supply crises in its history, characterized mainly by the lack of rains. The work evaluated the current situation of reuse water use in the Metropolitan Region of São Paulo (MRSP) and interviews were carried out with specialists in the water resources sector, forming a representative tripod that involves the concessionaire of public water and sewage services, teaching institutions that study and research the topic and civil society entities responsible for managing the water resources that supply the city of São Paulo and 17 other municipalities in its surroundings. The study identified that much still needs to be done, necessarily counting on the active participation of the public power that has the largest structure to manage and encourage the practice of water reuse, that actions will be necessary to improve the legislation, so it is important that there is a permanent dialogue around the theme so that an alternative for water supply is available that meets the needs of society and collaborates with the sustainability of the planet.

KEYWORDS: Water Supply. Water Reuse. Sustainability.

1 INTRODUCTION

In the United Nations Sustainable Development Report (UN, 2015), for a sustainable world, water and related resources are valued in all their forms. Also according to the UN (2015), these natural resources are managed according to human well-being, with effluents being treated correctly and used as resources in the viability of energy or reused in different ways.

The problem of water scarcity has become a phenomenon that affects the entire planet and one of its main causes is population growth, which ends up putting pressure on the limited natural resources available, according to Kummu et al. and, in addition, Zhang et al. (2017) add that the volume of usable fresh water available in nature is insufficient to meet the needs of the demand generated by the growth of the human population.

Despite its abundance in relation to the availability of water resources worldwide, Brazil does not have an adequate distribution of these resources, according to Martirani and Peres (2016). The authors cite that the greatest example of this inequality is the state of São Paulo, where 22% of the Brazilian population lives, but only 1.6% of surface water is available. Between 2014 and 2016, the southeastern region of Brazil faced one of the biggest water crises in its history, which according to Cavalcanti and Marques (2016) was characterized by a lack of rainfall, association with historical factors and planning issues.

The Cantareira System, which supplies approximately nine million people in the Metropolitan Region of São Paulo (MRSP), had a drastic reduction in its level of supply (SABESP, 2016). Due to this, the State government, through the Basic Sanitation Company of the State of São Paulo (SABESP), started to carry out works of emergency nature, such as pumping the emergency technical reserve (dead volume) and the construction of the São Lourenço Production System and thus, increasing by more than six thousand liters/second the supply of water to the Metropolitan Region of São Paulo (MRSP), according to the report Water Crisis, Strategy and Solutions by Sabesp (CHESS, 2015).

It is known that water scarcity is associated with public health problems and can also lead to violent conflicts around the world, related even to food insecurity as described by Marcantonio et al. (2018). In the fight against this problem of water scarcity, many projects are being implemented in several countries to increase the water supply with alternative sources of supply, including water reuse, according to Peters and Goberdhan (2016).

It is necessary to demonstrate that among the most advanced alternatives regarding the management of water resources are the treatment and reuse of sewage generated in predominantly urban areas to complement the main supply system, as described by Hespanhol (2015). It should also be noted that the use of reused water is one of the goals of SDG 6 of the UN 2030 Agenda, being part of the municipal agenda of the city of São Paulo.

Given the above, this work aimed at the discussion of the practice of reuse as an alternative for supply where there is no need for water with superior quality, allowing potable water to be prioritized for human consumption

1.1. Objetive

This article evaluated the scenario of the use of reused water in urban activities in the Metropolitan Region of São Paulo (MRSP).

2 THEORETICAL REFERENCE

2.1 Potable water

Water is a primordial element for the survival of all species. The human body is composed of about 80% water, and researchers indicate that the daily consumption of treated water is important for the protection of our body and maintenance of human health (PENA, 2015).

Still according to Pena (2015), Brazil has the privilege of holding more than 50% of the freshwater source of the South American continent and of having the largest river in the world, the Amazon, in its territory. The author reports that as water distribution is irregular (68% in the North region, 23% in the Center-South region, 6% in the Southeast region and only 3% in the Northeast region), some regions are affected by water scarcity.

According to data from the National Sanitation Information System of the Ministry of Cities (SNIS, 2013), Brazilians consume an average of 166 liters of water per day from local companies, but there is great variation considering each one of the states. Still according to SNIS (2013), the Southeast region is the one with the highest consumption index per inhabitant per day, in addition, São Paulo, which experienced a serious water shortage crisis, presents a consumption of 188 liters per inhabitant per day, being in sixth place in water consumption in the country.

According to the Food and Agriculture Organization of the United Nations (FAO, 2013), agriculture is among the activities with the highest consumption of water, second is industrial activity and lastly domestic activity. The organization highlights the discussion on replacement alternatives for potable water, mainly in various activities in the industrial sector, where in theory the demand for higher quality water would be lower.

In urban areas in general, more than 50% of total water consumption is represented by residential consumption and this number reaches 84% of the total in the MRSP, including in this total the consumption of small industries, according to Gonçalves (2009). The author differentiates this residential use into an internal one related to cleaning and hygiene activities and an external one related to irrigation, vehicle washing, swimming pools and the garden. Still according to Gonçalves (2009), most of the volume of water consumed in homes refers to showers and toilets and about 25% corresponds to non-potable uses.

2.2 Water of Reuse

NBR 15900-1 (2009) defines water of reuse as water treated by a sequence of processes, including filtration and flotation, in sewage treatment facilities, from effluent already treated for non-potable uses. To support the understanding and perception of the theme of reused water, Metcalf and Eddy (1991) presented a set of definitions of terms associated with the reuse of water, as shown in figure 1.

The parameters necessary to guarantee the quality of water for consumption are defined as specified in the Resolutions of the National Council for the Environment (CONAMA 357/05, 396/08 and 430/2011), which deal with the classification and environmental guidelines for classifying water underground and surface. Also according to the National Council for the Environment (CONAMA), the most important water quality indices are divided by physical (color, turbidity, etc.), chemical (pH, alkalinity, etc.) and biological (indicator organisms and bacteria).

Figure 1. Terms and Definitions Applied to Reuse

Terms	Definitions
Reuse of water	It is the use of reclaimed wastewater for purposes such as irrigation and Exchange heat in industry.
Planned reuse of water	It means the deliberate, direct or indirect, use of reclaimed Wastewater including physicochemical and bacteriological control of water during its supply for use.
Indirect reuse of water	Known as natural reuse, it assumes the use of water from springs to which already used waters were previously released.
Potable reuse	It is the form of reuse that involves the public supply through introduction of reclaimed wastewater that are normally treated to a high level to ensure protection of public health.
Direct potable reuse	It is a form of reuse that involves the introduction of reclaimed Wastewater directly into a system public supply, allowing the mixture of wastewater recovered with water normal system supply.
Indirect potable reuse	It is the potable reuse that involves the introduction of reclaimed wastewater in a source of raw water, thus, before the water uptake, dilution occurs, assimilation and self-purification of water residues in the receiving Body.

Source: Adapted from Metcalf and Eddy, 1991.

With regard to reuse water, Santos (2018) describes that because it has lower quality compared to drinking water, reuse water is not directly directed to human consumption, but in activities that do not require water with superior quality. such as washing vehicles, cooling machines, cleaning public roads, etc. Santos (2018) also reports that reuse is a way to seek sustainability with regard to water resources, it reduces the release of sewage into water bodies and guarantees drinking water in sufficient quantity for activities that really need it. According to NBR 13969 (1997) reuse water is divided into four classes, as shown in figure 2.

Figure 2. Reuse Water Quality Parameters

Classes	Parameters	Comments
Class 1 - Car washing and others that require the user to have direct contact with water.	* Turbidity < 5 UNT * Thermotolerant Coliforms < 200 NMP/100ml * Total Dissolved Solids < 200 mg/L * pH between 6 and 8 * Residual chlorine between 0.5 mg/L to 1.5 mg/L	At this level, aerobic treatments will generally be required (submerged aerobic filter or LAB) followed by conventional filtration (sand and activated carbon) and finally chlorination. It is also possible to replace conventional filtration with a filtering membrane.
Class 2 - Washing of floors, sidewalks and irrigation of gardens, maintenance of lakes and landscape channels, except fountains.	* Turbidity < 5 UNT * Thermotolerant Coliforms < 500 NMP/100ml * Residual chlorine greater than 0.5 mg/L	At this level, an aerobic biological treatment (submerged aerobic filter or LAB) followed by sand filtration and disinfection is satisfactory. It is also possible to replace filtration with filtering membranes.
Class 3 - Discharges into toilets.	* Turbidity < 10 UNT * Thermotolerant Coliforms < 500 NMP/100ml	Normally, washing machine rinsing water meets this standard, requiring only chlorination. For general cases, an aerobic treatment followed by filtration and disinfection meets this standard.
Class 4 - Irrigation of orchards, cereals, fodder, pasture for cattle and other crops through surface runoff or punctual irrigation system.	* Thermotolerant Coliforms < 500 NMP/100ml * Dissolved oxygen > 2.0 mg/L	Applications must be interrupted at least 10 days before harvest.

Source: Retrieved from NBR 13,969, 1997.

To identify the quality characteristics required for reuse water, it is necessary to know which are the main polluting agents of water and which of them are worrisome for the process, as reported by Sousa (2008).

For the urban sector, water reuse can have a very promising potential. However, in most cases, demand requires high quality water that requires more advanced treatment technologies, according to Hespanhol (2002).

The high cost of water for the industrial sector in general, associated with the growing demand for this input, has made companies evaluate the possibility of internal reuse and the purchase of treated sewage directly from public service concessionaires, which would reduce the price compared to drinking water, is reported by Hespanhol (2002).

2.3 Legal Aspects

Brazil has consolidated legislation regarding the quality and classification of drinking water through Ordinance MS No. 2914/2011, and the release of effluents into water bodies with CONAMA Resolutions No. 357/2005 and No. 430/2011. In NBR 13,969, which deals with local reuse as an alternative to disposal in the environment, the Brazilian Association of Technical Standards (ABNT) determines that all sewage of domestic origin or with similar characteristics may be reused for non-potable purposes, after adequate treatment and provided that is sanitary safe (ABNT, 1997).

In São Paulo, the Joint Resolution by the State Department of Health, the Department of the Environment and the Department of Sanitation and Water Resources, SES/SMA/SSRH nº 01/2017 can be considered a milestone, as it is the first and perhaps the only legislation that

really creates standards and establishes guidelines for the practice of water reuse (BALASSIANO, 2018).

In February 2020, the 2017 resolution was revised, giving rise to a new joint resolution between the Secretary of State for Health and the Secretary of Infrastructure and Environment (merger between the Secretary of the Environment and the Secretary of Sanitation and Water Resources), SES /SIMA nº 01/2020, which presented improvements in some quality standards, frequency of analysis, category and format of signaling stickers.

2.4 Environmental Aspects

In 2015, almost 200 countries adopted the resolution that approved the 2030 Agenda for Sustainable Development (UN, 2018). The new agenda that continues what had been proposed in the 2000s by the Millennium Development Goals (MDG, 2015) is composed of seventeen Sustainable Development Goals (SDG), with 169 goals and the year 2030 as a time horizon (UN, 2018).

In order to achieve the goal of guaranteeing water availability and sanitation for all, as provided for in SDG 6 (water and sanitation), actions will be necessary to ensure access to water and sanitation even for that portion that cannot pay for these services in accordance with Castro (2016). This SDG has eight goals, the last two of which are more linked to the means necessary to achieve the others, and among them is Goal 6.a, which mentions the reuse of water, as described in figure 3.

Figure 3 Goals of the SDG 6.

> **Meta 6.a:** by 2030, expand international cooperation and capacity building support for developing countries in activities and programs related to water and sanitation, including water harvesting, desalination, water use efficiency, effluent treatment, recycling and reuse technologies.

Source: Retrieved from nacoesunidas.org/pos2015/ods6, 2019.

3 METODOLOGY

The study is characterized as a qualitative research of an exploratory nature. Qualitative research is essentially interpretive, meaning that the researcher interprets the data by developing a description of a scenario to identify themes or categories to reach conclusions about their meaning (CRESWELL, 2007).

Data collection was carried out through semi-structured interviews with specialists in the water resource sector, which according to Triviños (1987) are data collection instruments that value the researcher's presence, allow the spontaneity and freedom necessary to reach new perspectives and enrich the investigation. For the development of the work, professionals with experience and knowledge on the subject were linked, forming a representative tripod, which includes:

- ✓ The concessionaires that provide public water and sewage services and produce reused water, represented by the Basic Sanitation Company of the State of São Paulo (SABESP) and by Aquapolo Ambiental S/A;

- ✓ Teaching and academic research institutions, represented by the University of São Paulo (USP) and Nove de Julho University (UNINOVE) and;
- ✓ Civil society, represented by the Alto Tietê Hydrographic Basin Agency Foundation (FABHAT).

The interviews were scheduled at places and times indicated by the experts. They were carried out in person with the audio recording verbally authorized by each interviewee and lasted an average of 30 minutes. The interview questions were presented in the order in which they were described in the script and the interviewees were able to speak freely and spontaneously about the theme of reused water. Eight interviews were conducted in total. For the purpose of identifying the interviewees in the body of the work, the following caption was created:

- ✓ ECS_1 → 1st representative of the concessionaires
- ✓ ECS_2 → 2nd representative of the concessionaires
- ✓ EAC_1 → 1st representative of academic teaching and research institutions
- ✓ EAC_2 → 2nd representative of academic teaching and research institutions
- ✓ EAC_3 → 3rd representative of academic teaching and research institutions
- ✓ EAC_4 → 4th representative of academic teaching and research institutions
- ✓ ESC_1 → 1st representative of civil society
- ✓ ESC_2 → 2nd representative of civil society

After conducting each interview, the audios were transcribed, read and interpreted for the preparation of a preliminary analysis spreadsheet using the Microsoft Excel tool and for the development of the analysis, the model based on the original idea of Bardin (1977) and described by Silva and Fossá (2015) as the division into phases of the qualitative data analysis process. In this study, two phases were carried out: a preliminary phase with the transcription, reading and listening of the data and the preparation of the material, and a final phase that considers the treatment of the results.

The preparation of the preliminary analysis worksheet focused on grouping the data and simplifying the analysis of the answers, in which the following data were recorded: number and description of the question, name of the specialist, identification code, institution, representativeness tripod, main point of the response and literal snippet of the response.

4 ANALYSIS AND DISCUSSION OF THE RESULTS

4.1 Aspects of Water Scarcity and Supply

4.1.1 Water Availability in Brazil

With regard to water availability in Brazil, there was consensus on the aspect that Brazil is privileged due to the amount of fresh water in its territory and that the big problem is the imbalance between distribution between geographic regions and population density. This can be seen in the personal accounts:

- ✓ EAC_1, ECS_1, ECS_2 e ESC_2 → They consider that the availability of fresh water in the Brazilian territory is good, but the distribution among the regions is not adequate.

- ✓ EAC_3 → He considers water scarcity in the northeast region, which is attributed to climate issues, unlike the southeast region where this scarcity is caused by the imbalance between availability and the number of inhabitants;
- ✓ ESC_1 → He considers the use of historical hydrological series to monitor the incidence of rainfall, but that today these series are outdated as in the case of the water crisis.

The considerations indicate convergence in relation to the greater difficulty of the Southeast region with regard to water availability and the need for actions to minimize this problem. The same understanding was exposed by Oliveira et al. (2016) when mentioning that it is likely that Brazil has, in its territory, the largest water reserves in the world, but these reserves are distributed throughout all regions and have their highest percentage in the Amazon region, however, this does not prevent the country from suffering from the lack of water, as has happened to MRSP, which is facing the biggest water crisis in its history.

4.1.2 Supply Situation in São Paulo

In this question, each specialist presented his point of view on the water supply in São Paulo and the consequences of the water crisis that the MRSP faced. These points of view highlight different aspects as can be seen in the accounts:

- ✓ EAC_1 → He points out that, after the crisis, there was a reduction in consumption by the population and that this is an important gain that can be improved with effective communication;
- ✓ EAC_2 → He points out that we still face problems both in the rainy season and in the dry season due to the pattern of use and occupation adopted in São Paulo that prioritizes waterproofing;
- ✓ ECS_1 → He highlights the concessionaire's effort to prevent the population from being affected by periods of shortages similar to those experienced in 2014.
- ✓ ECS_2 → He emphasizes that the intensity of the water crisis caught those responsible for supply in São Paulo by surprise, as the structure was not prepared and it was necessary to interconnect systems that were previously isolated;
- ✓ ESC_2 → He highlights the positive aspect that was the direct involvement of all sectors — government, concessionaire and population — was fundamental during the crisis period, but one cannot imagine that this will no longer happen.

It is possible to see that despite the accounts presenting specific points, the fear of suffering from a new crisis was mentioned by EAC_4 and ESC_2, in contrast to what was said by ECS_1, who understands that this risk was overcome by the actions taken by the concessionaire during and after the crisis.

Another aspect mentioned by EAC_3 is the discussion about the redundancy of the supply system to minimize the effects of periods of severe water shortage: “Before the water crisis in an area the size of São Paulo, I had never seen the discussion about reduction in consumption, about having springs, having supply alternatives that remain on stand-by and that are used in times of crisis”.

4.1.3 Use of Reuse Water

In this question, it can be seen that there is empathy on the part of the specialists for what reuse water means, however, all showed some resistance in relation to its unrestricted application, as follows:

- ✓ EAC_1 → He is favorable to its use, but draws attention to the lack of guidance from the population on how to reuse water correctly;
- ✓ EAC_2 → He sees the reuse as an additional contribution only for places where there is an established scarcity, but points out that measures to encourage rational use must come before the reuse;
- ✓ ECS_2 → He considers it important, but clarifies that the volume produced is still small if we consider that not all sewage treatment plants produce reused water, despite having the technical capacity to do so;
- ✓ ESC_1 → He considers the reuse a fundamental solution from the point of view of an alternative supply, but it should be considered as a complementary solution and not as a single solution;

Experts agree that the reuse can be an alternative for supply, but measures such as proper implementation planning and population guidance on health care must be observed. Among the answers is one that reflects the current reality of the use of reused water presented by ESC_1: “It is fundamental, but it is not a solution that replaces, but a solution that complements”.

Along the same line is what Ferreira da Silva et al. (2018) reports, regarding the fact that the understanding that water reuse is a relevant component of water resource management has already been described in the literature by several specialists in the subject and, according to the authors, this practice is recent in Brazil and its regulation is still incomplete. Another appreciation of water reuse is found in the text by Oliveira et al. (2016) when citing that, considering the importance of water as a natural resource, environmental awareness and water reuse can mean improvements for society and the planet.

4.2 Technical Aspects

4.2.1 Challenges for Reuse Feasibility

The experts presented a series of challenges on this issue that could make water reuse projects unfeasible. For three of these specialists, the need to find demand niches is a relevant factor, as demonstrated by the statements:

- ✓ EAC_1 → It presents as a challenge the fact that the concessionaire that provides water and sewage services in MRSP is a state-owned company with shares on the stock exchange and that sometimes has to prioritize the shareholder's investment;
- ✓ EAC_2 and ECS_2 → Considering domestic reuse, they point out that it is necessary to find a safe way for people to reuse the water in their homes without the potential danger of disease proliferation;

The challenges presented by the specialists demonstrate that for the viability of large projects, the planning stage is essential, since the current layout of the reuse production plants and the fact that the industrial poles are reducing in size do not favor these investments.

Deindustrialization is mentioned in ESC_1's report: “The perspective of using Aquapolo was one when it was conceived 15 years ago. Today, 15 or 20 years later, you had a very strong de-industrialization in the ABC region, Ford left and other industries left and you have no replacement for industrial activities that use the same volume of water”.

This finding is confirmed by Veríssimo (2019) who describes São Paulo as the one with the highest participation of industry in GDP and which is also the one that saw this participation decrease the most, with a drop of 8.9%, from 27.3% in 2002 to 18.4% in 2015.

4.2.2 Risks Associated with the Reuse

At this point, the concern that there are risks related to human health became clear, especially with regard to the reuse by people in general, in the case of industrial reuse, there is less concern and the main barrier mentioned was the lack of information and knowledge of the population, as can be seen in the statements:

- ✓ EAC_1, EAC_2, EAC_4 and ESC_1 → They are concerned about health risks, especially in the case of potable reuse;
- ✓ EAC_1, EAC_3 and ESC_2 → They highlight the lack of information to the population as an important barrier that can prevent the implementation of good projects;

In addition to the issue of health risks due to the inadequate implementation of the reuse, which can be caused by lack of information, another important aspect raised is the control that the legislation imposes on those who produce reused water.

In the same context in which the lack of information can become a barrier to the reuse of water, the opinion of Hespanhol (2008) who states that the community's perception of reuse is based on the level of information to which they have access, trust in the interlocutors for whom they are presenting the project, and the way they relate to water sources

4.2.3 Technical Capacity of the Concessionaires

On this issue, there was a general consensus that the main concessionaires have the technical capacity to produce reuse water and that, in the event of an eventual demand, the issue of technology would not be an obstacle, as observed in the statements:

EAC_1, EAC_2, EAC_3, EAC_4, ECS_1, ECS_2, ESC_1 and ESC_2 → They understand that the technological issue has already been overcome by the main concessionaires. In addition to the observed consensus, there are also comments that express concern about specific aspects.

The form of distribution in the case of potable reuse is mentioned by EAC_2: “The basic question is, as I said, how am I going to supply this reused water, how am I going to distribute it? Sometimes, reuse ends up being limited by the way I was able to distribute this water. So, when a station produces water of reuse and you go there and fetch it with a water truck, it is expensive water compared to the other one and its use is very punctual, you can have that use at one situation, but not at another. This makes not only a project unfeasible, but also a business, and, at the end of the day, everything is money”.

The economic and financial viability of industrial reuse is ECS_2's concern: “Ah! Yes, the point is to make a business plan. In fact, that's how it is, it has to be viable. Like today, Aquapolo is standing because there are those who pay for Aquapolo”.

4.2.4 Potential Use of Reuse Water

Regarding the potential use of reuse water, it was clear from the experts' statements that the industry should be the main focus of actions:

- ✓ EAC_1, EAC_2, EAC_4 and ECS_2 → They consider that the product would be more viable in the industry, as it is the sector with the greatest capacity to absorb this offer;
- ✓ EAC_3 → He considers it difficult in urban areas to grow this potential without complex actions, because everything that was easy here at MRSP has already been done;
- ✓ EAC_1 and ECS_1 → they consider a public policy that offers incentives for companies to use reused water to be necessary;

One point that was possible to observe is that the implementation of new projects along the lines of Aquapolo is not unanimous, in the manifestations of three specialists there are those who consider it feasible, those who have doubts and those who consider it unfeasible.

In his report, EAC_4 is favorable and believes it to be viable: “I think that we have to find the niches, this is a key thing, to find the niches, where there is viability. For example, as we have Aquapolo here in São Paulo, I could do other Aquapolos”.

ESC_1's response considers that, due to deindustrialization, the MRSP does not support another Aquapolo: “It is no longer the case, here in the metropolitan region of São Paulo, due to deindustrialization, you can compare the participation of industry in the GDP of the Metropolitan Region of Sao Paulo".

4.2.5 Population Reaction on the Use of Reuse Water

The way in which the population would react to the availability of the reuse water is an important aspect and specialists say that the main point is how this will be communicated to society, as can be seen in the demonstrations:

- ✓ EAC_1, EAC_2, ECS_2 and ESC_2 → They emphasize that at first there could be some resistance, but everything could be circumvented with an adequate communication strategy;
- ✓ EAC_3 and ESC_1 → They emphasize that the great difficulty would be with the reuse for drinking, because for other uses there would be no problem;

In the context of this issue, ESC_1 highlights that we still have alternatives before thinking about direct potable reuse: “I tell you, for human consumption I believe there would be a repulsion. We have not reached such an extreme situation that there is this need, there are still possible alternatives”.

With regard to acceptance by the population, it is worth including in the discussion Ferreira da Silva et al. (2018) who described that society's perception of reuse is a determining factor for its acceptance, which is directly linked to the population's degree of confidence in the institutions responsible for its management, to the way projects are presented and perceived by society : good communication between the sectors involved is fundamental. However, serve as a warning that the reuse without planning occurs in a systematic way as a determination of socioeconomic and environmental conditions in the outskirts of large Brazilian cities.

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4.3 Integrative Analysis of Results

The general objective of the study was to analyze the scenario of the use of the reuse water in urban activities in the Metropolitan Region of São Paulo (MRSP), with the intention of bringing to the discussion the practice of the reuse as an alternative for the supply where there is no need for superior quality of water, allowing drinking water to be prioritized for human consumption and discuss the responses of these specialists considering the theory on the subject.

The study presented the current situation of the use of the reuse water from the perspective of specialists in the water resources sector of São Paulo and it was possible to observe different points of view during the interpretation of the data. There was no consensus on the most complex issues even between actors from the same group and sometimes actors from different groups joined in the speeches. This scenario formed by the analysis and interpretation of the interviewed experts' point of view can be seen in figure 4, which should be read clockwise from the top.

Figure 4. Illustration of the Current Scenario of Reclaimed Water Use.

Source: Prepared by the Authors, 2020.

For each statement in Figure 4, there is at least one related question in the interview script to support it, as can be seen in the detail that was developed.

As for the statement that **"IT IS POSSIBLE"**, the basis is question nº 8 which is related to the ability of the concessionaires to meet the demand and there was a consensus among the specialists that they have the technical capacity to produce water of reuse, for example, EAC_3 said what:

"Any medium-sized concessionaire has the capacity to produce reuse water".

When referring to the statement that **"IT MAY BE FEASIBLE"**, the basis is question No. 4, which deals with the use of reuse water in general, and No. 9, which refers to the potential use of the reuse water. In this regard, it was possible to observe that specialists consider the reuse water an important alternative for supply, but the search for demand niches is essential for the viability of the projects. It is worth quoting what EAC_4 said:

> "I think that we have to find niches, this is a key thing, find niches where there is viability. For example, as we have Aquapolo here in São Paulo, I could do other Aquapolos".

The statement that **"IT HAS LIMITATIONS"** is based on question nº 5, which talks about the challenges for making water reuse projects viable and where it was clear that the specialists understand that the lack of public policies for the subject, the ETE far from the points of demand and the still timid legislation are limiting for the reuse. ECS_1's speech states this:

> "By making a comparison with Israel, you can bring a little here, there it is a matter of public policies".

With regard to the statement that **"IT REQUIRES CARE"**, it is based on question nº 6, which deals with the risks and barriers associated with the reuse of water and in this aspect, experts agree that the main care is related to human health as was reported by EAC_2:

> "The reuse project has to be well conducted to avoid these types of problems or risk of contamination of the population or the person who is doing the reuse practice".

As for the statement that **"IT NEEDS COMMUNICATION"**, the foundation is in question nº 13, which refers to the reaction of the population regarding the use of the reuse water. On this point, the specialists are clear in saying that the form of communication with society can establish the success or failure of the reuse projects, which is why good communication is paramount, as ESC_2 said:

> "I think it would be a backlash and so if you put it out there without the media working out what it is, what it looks like, and what it means, just forget about it."

The statement that **"IT BRINGS RESULTS"** is based on at least three questions that refer to the social, environmental and financial aspects of the results brought about by the use of the reuse water. In question nº 7, which deals with successful cases of reused water use in Brazil and around the world, when specialists cited success cases that brought social results, such as the one in Australia that brought EAC_2:

> "Australia, two years before we had our water crisis, Australia had it, and they also went into the practice of direct potable reuse and this use became so widespread that the WHO itself created a guideline that establishes criteria for implementation of direct potable reuse programs".

In question nº 12, which refers to the relationship between the reuse and the Sustainable Development Goals, bringing environmental results, as EAC_1 said:

> "Adherence is total, I mean, you reuse, reuse of water has total adherence to the sustainable development project".

And in question nº 8, which deals with the capacity of the concessionaires, there is an example of a financial result supported by the reuse of water, as reported by ECS_2:

> "Ah! Yes, the point is to make a business plan. In fact, that's how it is, it has to be viable. Like today, Aquapolo is still standing because there are those who pay for Aquapolo".

To summarize the essence of the developed scenario, EAC_3's report can be used in his additional comment on the reuse:

> "At the time of the water crisis, this was questioned a lot. Why hadn't you implemented the reuse? Why wasn't the supply made from the reuse? This clarification that the reuse is possible, yes, it is feasible, but it has limitations. This disclosure is very important to be done".

5 CONCLUSION

In the development of the work, the formation of a representativeness tripod composed of specialists from the concessionaires, teaching and academic research institutions and civil society was important for the construction of an information base that included different points of view and perspectives that enriched the research.

The scenario analysis was elaborated from the interviews with the specialists and showed the reality of reused water as part of the supply solution, but it is not the only solution. The set of words described in this analysis is formed by **"it is possible"**, **"it may be feasible"**, **"it has limitations"**, **"it requires care"**, **"it needs communication"** and **"it brings results"**, indicating that integrated actions among all interested parties can increase the volume used contributing to the sustainability of the planet.

From the results obtained, it was possible to identify that much still can and needs to be done, necessarily counting on the active participation of the public power, which is the entity with the greatest structure to manage and encourage the practice of water reuse. Actions will be needed to improve the legislation, it is worth mentioning the revision made to the joint resolution SES/SIMA in February 2020, which was another step towards the ideal, but which still needs adjustments and needs to stop being a privilege of São Paulo City and be taken to the rest of Brazil.

Seeking water supply solutions, beyond traditions, at a time when the scarcity of good quality water is knocking on our door, has become an essential measure and the practice of water reuse is an alternative, which if well worked on, can meet this need.

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