EVALUATION OF CONSUMPTION AND CHANGES IN WATER USE DURING THE COVID-19 PANDEMIC IN THE POPULATION OF ARACAJU

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ABSTRACT

Objective: To evaluate changes in water use during the covid-19 pandemic in the municipality of Aracaju, SE.

Theoretical reference: This study was conducted based on theoretical foundations, highlighting how the new coronavirus pandemic affected people's lives and the importance of using water in combating the pandemic and maintaining water supply services for the population of Aracaju water, especially for people who are in a vulnerable state.

Method: A methodology explored the hypothetical-deductive with a qualitative-quantitative approach. To meet the proposed objectives, data was collected from the supply company DESO, using macro meters, for an analysis of the volumes distributed and consumed, during the covid-19 pandemic.

Results and conclusion: Among the neighborhoods surveyed, José Conrado de Araújo was the one with the highest volume of water distributed. The 13 de Julho neighborhood had the largest volume micromemured, that is, consumed. A questionnaire was administered on the understanding of water use and sustainable practices during the pandemic, and it was found that those interviewed knew the importance of its reuse, although in practice they did not do so.

Implications of the research: In the face of pandemic situations, with the imposition of social isolation and protective measures linked to the use of water, the interruption of daily activities in businesses, schools and services considered non-essential, the confinement of people in their homes and encouraging the use of water for hand hygiene led to a notable increase in residential water consumption in the metropolis of Aracaju compared to 2018 and 2019.

Originality/value: The study has environmental, social, economic and scientific value with proven information and the originality of the expositions based on the understanding of aspects related to water use is important to add relevant information on ensuring a water supply system continuously and sustainably, in the face of a pandemic.

Keywords: Covid-19, Water Consumption, Indicators, Sustainability Index.

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AVALIAÇÃO DO CONSUMO E ALTERAÇÕES NO USO DA ÁGUA DURANTE A PANDEMIA DA COVID-19 NA POPULAÇÃO DE ARACAJU

RESUMO

Objetivo: Avaliar as alterações no uso da água, durante a pandemia da covid-19, no município de Aracaju, SE.

Referencial teórico: Esse estudo foi conduzido a partir de fundamentações teóricas, destacando como a pandemia do novo coronavírus afetou a vida das pessoas e qual a importância do uso da água no combate à pandemia e na manutenção dos serviços de abastecimento de água para a população de Aracaju, principalmente para as pessoas que se encontram em estado de vulnerabilidade.

Método: A metodologia explorou o hipotético-dedutivo com abordagem quali-quantitativa. Para responder aos objetivos propostos, foi realizada a coleta de dados junto à companhia de abastecimento DESO, através dos macromedidores, para uma análise dos volumes distribuído e consumido, durante a pandemia da covid-19.

Resultados e conclusão: Dentre os bairros pesquisados, o José Conrado de Araújo foi o que teve maior volume de água distribuído. Já o bairro 13 de Julho teve o maior volume micromedido, isto é, consumido. Foi aplicado um questionário sobre o entendimento do uso da água e de práticas sustentáveis durante a pandemia, e constatou-se que os entrevistados sabem da importância da sua reutilização, embora na prática não o façam.

Implicações da pesquisa: Diante das circunstâncias de uma pandemia, com a imposição do isolamento social e das medidas protetivas ligadas ao uso da água, a interrupção das atividades cotidianas em indústrias, comércios, escolas e serviços considerados não essenciais, o confinamento das pessoas em seus lares e o incentivo ao uso da água para higienização das mãos trouxeram uma majoração acentuada no consumo de água residencial na metrópole de Aracaju em relação aos anos de 2018 e 2019.

Originalidade/valor: O estudo possui valor ambiental, social, econômico e científico com informações analisadas e pela originalidade das discussões apresentadas a partir da compreensão de aspectos relacionados ao uso da água é importante para agregar informações relevantes visando garantir um sistema de abastecimento de água contínuo e de maneira sustentável, diante de uma pandemia.


1 INTRODUCTION

With the emergence of the new coronavirus, the World Health Organization (WHO) decreed COVID-19 as a global pandemic in March 2020. The disease is caused by SARS-CoV-2 virus, a rapidly spreading severe acute respiratory syndrome. Without the presence of an effective vaccine, several emergency measures were taken to deal with the fight against the new coronavirus. In this sense, the WHO recommended social distancing and quarantine, as the best way to "flatten the curve" to contain the spread of the coronavirus. With the exception of those activities considered essential, thousands throughout the world had their secular activities interrupted, and Brazilians, as well as people in so many other countries, would spend endless days indoors.

As well as social isolation, another sanitary measure capable of reducing the contamination of the virus is directly related to the use of water. Water is considered essential for the maintenance of human life and is a strategic resource for sustainable development. Taking into account that during 2020 millions of people were driven into the home, and access to domestic water is indispensable for the promotion of public health, especially in combating...
contagious diseases, the WHO has moved to an intensification of hygiene care as a safety measure to decrease the risk of covid-19 contamination.

In view of this, scientific studies have shown that, in order to eliminate the contamination of the virus, it would be necessary to wash your hands thoroughly with soap and water for at least twenty seconds, several times a day or whenever you come into direct contact with people or objects. Any product brought into the house should also undergo a cleaning process with soap and water or with gel alcohol.

According to the United Nations (UN), the amount of water consumption considered sustainable for human use is 110 liters per inhabitant per day. However, data from the National Sanitation Information System (SNIS, 2019), a body linked to the Ministry of Regional Development, indicate that in 2018 each Brazilian spent on average 154 liters of water every day; 40% above what is established as sustainable.

In light of the behavioral changes that have been implemented - home confinement and the adoption of intensified hygiene measures -, analyzing the effects that the covid-19 pandemic has brought about in relation to water use during the implementation of preventive measures to combat the new coronavirus is of significant importance to enable a stable and continuous consumption of water for the population of Aracaju.

Although the cost of the water bill has become more expensive for a large part of the population, there is concern about the use of water resources in a conscious and sustainable manner. Water is an important but scarce resource. Because of the need to ensure its use as a universal right, water should not be wasted or contaminated. In this context, the current study aimed to assess changes in water use during the COVID-19 pandemic in the Aracaju population, as well as to quantify water consumption by the population, based on the population’s understanding of water use.

2 THEORETICAL FRAME

COVID-19 was declared by the World Health Organization (WHO) in March 2020 as a new pandemic, and because it is a disease of dizzying spread that caught the attention of researchers, scientists and academics, it is already becoming evident not only the current significant impacts, but also the future ones. At this moment, scientific production is crucial for a better understanding of the disease and its effects, and for seeking solutions. Researchers and scientists throughout the world, in many cases based on good government coordination, have mobilized themselves to estimate both the effects of the disease on the health of the population and its economic and social impacts. (NEGRI et al., 2020)

One aspect to be emphasized in times of pandemics is the role of water. According to the World Health Organization, for the prevention of coronavirus it is necessary to "sanitize hands using alcohol in gel or soap water several times a day" (UNESCO, 2020). However, although gel alcohol is important for the use of hygienization, this is a complementary or alternative measure, and becomes mandatory only in the absence of soap and water. The U.S. Centers for Disease Control and the World Health Organization point to frequent hand washing at the top of their COVID-19 prevention advice for the public. (UNESCO, 2020).

The incentive to wash your hands with soap and water is given as if it were right there, within everyone's reach. A certain scientific authority said that such a practice "is simple. It's right there and it costs nothing." Unfortunately, however, for a section of the world's population, this statement is not true. Access to drinking water is not that simple. In fact, for the most vulnerable population, access is suffered and costly. In some developing countries, you have to walk miles to get access to clean water. The strong demand for drinking water and the lack of hydraulic infrastructure compel the population to use non-drinking water for human consumption.
According to Oliveira (2021a), the role of water supply in preventing diseases is not limited to those diseases transmitted by ingestion; it involves adequate quantities for bathing, washing clothes and utensils, and other hygienic purposes. Water can have significant effects on a number of ailments, particularly those preventable by hand washing. Many intestinal and skin infections can be significantly reduced by improving domestic hygiene and water supply. Thus, it can be said that there will be improvement in the health conditions of the population with the adequate and safe water supply.

Solutions to combat the spread of infectious diseases, including COVID-19, should consider domestic water insecurity depending on the availability, quality and accessibility of water. Understanding the impact of disease containment actions on water consumption provides information for policymakers to plan and prioritize right to successfully overcome the challenge. (KALBUSCH et al, 2020).

According to the World Health Organization (WHO), about 80% of all diseases affecting developing countries come from poor water quality. In this way, access to and treatment of water are essential factors in the prevention of diseases. According to the WHO, health is defined as the state of complete physical, mental and social well-being, and not only the absence of diseases. A stable supply of drinking water plays an important role in ensuring the health of a population, especially during the outbreak of epidemic diseases (UNESCO, 2015).

An important step would be behavioral change in the rational use of our water resources. Issues related to water consumption are a growing sustainability challenge, especially in developing countries, although achieving sustainable development of water resources is a matter of global importance. Although the issue of the cost of the water tariff may be a driver that makes us reconsider the perception as to the rational consumption of water, this should not be the main motivation.

However, while there is talk about the continued use of water for prophylaxis, water supply has increasingly worried environmental managers and global public organizations, because lack of access to water is a risk factor for health, as well as being limiting to development.

The 2015 United Nations World Water Development Report, entitled ‘Water for a Sustainable World’, demonstrates how water resources are essential to achieving global sustainability. Water is at the heart of sustainable development. It supports economic growth, poverty reduction and environmental sustainability. Therefore, progress towards the achievement of most of the Sustainable Development Goals requires a significant improvement in water management worldwide. (UNESCO, 2015)

Another important factor, considering Brazil’s health situation, is that only 46% of the sewage generated in the country is treated, according to the National Sanitation Information System (SNIS, 2020). The link between lack of access to water and sanitation, development goals and solutions to water scarcity are cost-effective. Studies show that every dollar invested in sanitation has an average return of nine dollars. These benefits are felt most intensely by poor children and disadvantaged communities (UNESCO, 2015).

### 2.1 Water consumption and the perception of society

Brazil is known worldwide for being a country abundant in natural resources. And with regard to water resources, it is no different. We can say that its condition is geographically comfortable. According to the National Agency for Water and Basic Sanitation (ANA), Brazil, with its hydrographic cut-outs, concentrates the largest reserve of fresh surface water on the planet. About 12% of the world total runs in Brazilian lands, to 3% of the world population.
This share rises to 18% when one considers only surface water, excluding reserves in underground aquifers, the groundwater. (ANA, 2019).

However, although the situation is apparently calm, the distribution of water resources in Brazil is uneven. Much of the available water is in the Amazon, a region with less than 7% of the population. Of the waters, 15% are in the Central-West, 6% in the South and the Southeast, and only 3% in the Northeast Region. In compensation, the Northeast has only 5% of Brazilian waters. (ANA, 2019)

According to the UN, the amount of water required for human use considered sustainable is 110 liters per inhabitant per day. However, data from the National Sanitation Information System (SINS) indicate that in 2019 each Brazilian had an average consumption of 154 liters of water per day, 40% higher than recommended. These values can vary, since in large urban centers the average consumption of water can exceed 200 liters a day, without taking into consideration the losses in the distribution systems.

According to the National Sanitation Information System (SNIS, 2019), in Brazil, 39.2% of drinking water is lost or unaccounted for. The reasons range from leaks in the network of pipes, "cats", or even errors in the reading of hydrometers. A study conducted by the Instituto Tratora Brasil in partnership with Water.org showed that the waste of water each year is only increasing. In 2014, the country recorded a loss of 36.7% and in 2019, it reached 39.2%. (SNIS, 2019)

So there is a question mark here. Can we reduce our average daily consumption from 154 liters to the recommended 110 liters? Experts point out that it is possible to live with this quantity, enough to meet a person's basic needs. But for this to happen, we need to rethink our old water consumption habits. (UNESCO, 2020) Conscious consumption is related to a way of life that values environmental responsibility, which considers the impacts that a product can exert on the environment. The focus is on preserving and maintaining the social environment with higher quality of life.

Cultivating interest in sustainable practical actions regarding water use becomes increasingly necessary. Small attitudes, such as rainwater abstraction, non-drinking water use for washing, among others, both in the industrial area and in commercial and residential areas, can lead to a reduction in the amount of water used (SANTOS et al. 2006).

3 METHOD

The study area is the municipality of Aracaju, capital of the state of Sergipe, located in the coastal strip of northeastern Brazil. Aracaju occupies an area of 182 km², with an estimated population of 664,908 persons and a population density of 3,140 inhabitants/km². Over the last three decades, the municipality has been showing a population growth of 1.20% per year (IBGE, 2020). The urban area in the municipality of Aracaju totals approximately 50 km². (SEMARH, 2017). The study area was concentrated in Aracaju due to the great advance of coronavirus contamination in the municipality. According to data from the State Health Secretariat (SES), after a year of pandemic, the Sergipana capital had already counted more than 82,000 confirmed cases. (SES, 2020).

The hypothetical-deductive method was used, due to the existence of a problem raised, to which possible solutions are offered and which must pass some tests to conclude its truthfulness or falsity. The research has an applied nature, since it has the capacity to generate new scientific knowledge applicable to the phenomenon studied, with the purpose of clarifying the objectives that guide the project of interest. As for the approach, the research characterizes itself as qualitative-quantitative.

Methodological procedures, with regard to the proposed objectives, are exploratory and explanatory, because the interest in investigating the relationship between the covid-19

pandemic and water consumption is still recent (Marconi & Lakatos, 2011). Considering the objective of this study, the collection of primary and secondary data was performed as the first stage of the investigation, according to the following technical research procedures: indirect documentation or bibliographic and documentary research.

In relation to the documentary survey, a technical search was carried out consisting of a bibliographical survey on digital and printed materials, through Capes journals, depositaries of UFS theses and dissertations, belonging to the Central Library of the University of Sergipe (BICEN), journals from the Library of the Post-Graduate Program in Development and Environment (PRODEMA) and scientific articles found in the Google Academic, Scielo, Science Direct and Elsevier databases, related to water resources, sustainability, water supply, as well as published articles related to the theme of the covid-19 pandemic.

To obtain data, it was initially sought in the Sanitation Company of Sergipe (DESO) the survey of data on the water supply for the population of Aracaju. The measurement system used by DESO has as its technical basis the use of macrometers, with the capacity to carry out measurements of a large flow of water in a given area. They are usually installed in strategic points distributed between the neighborhoods of Aracaju. Its function is to measure the volume of water distributed and the volume of water actually consumed by the population in a region or sector.

In order to construct a systemic analysis, the data was organized into spreadsheets, with the daily values of the macrometers and micrometers of each district mentioned above, in the period from March 2018 to March 2021. After this, the rate of loss of water consumption was applied:

\[
IP = \frac{mm}{Mm} - 1 (100\%) \ 
\]

Where:

\[
IP = \text{Loss Index} \ (%) \ , \ mm = \text{volume of the micrometer} \ , \ Mm = \text{volume of the macrometer}.
\]

With the aim of ascertaining the existence of changes in the use of water by the population during the spread of COVID-19, as well as analyzing practical actions regarding water reuse from the point of view of the resident, this research sought a subjective analysis by means of field research with the inhabitants of the worked neighborhoods. To do so, a semi-structured questionnaire was formed with twenty key questions, in a direct and concise manner, so that the interviewee would not waste much time in answering them. At first, the questionnaire was created to be answered online, by Google Forms. However, to speed up the collection of the data, the choice was also made to apply the questionnaire in a face-to-face manner. Any resident of the district, within the conditions of inclusion in the survey, who wished to participate would be interviewed.

The choice of the residents participating in this survey was carried out by random probabilistic sampling. That is, from a list of the population elements included in the criteria already established, the sample was drawn by lot, without restriction. To arrive at the number of interviewees who would participate in this sample, it was necessary to apply the calculation following the statistical precepts proposed by Barbetta (2006).

Considering the experimental error of 5%, the sample size would be 390 interviewees. But the collection had a reach of 420 participations, through the online platform, through Google Forms, and in person with an interview with the inhabitants. Of the 420 questionnaires, 20 were disregarded for not belonging to the proposed spatial cut-off and not having completed the research in full. In total 400 interviews were accepted, 50 of which were distributed to the eight neighborhoods surveyed. Residents of both sexes, above 18 years of age, were invited...
with the requirement to agree to participate and sign the Free and Informed Consent Term (TCLE), online or in person.

The application of the questionnaire was carried out between September and December 2021. In the neighborhoods Coroa do Meio, José Conrado Araújo, Olaria and Siqueira Campos, interviews took place during the week, in the late afternoon, between 16h30 and 18h. At these times, the presence of the inhabitants, who were sitting on the sidewalk of their home or circulating in the district during a moment of relaxation, willing to answer the questionnaire, was greater. To ensure that all the rights of the subjects of the research would be respected, a Free and Informed Consent Form (TCLE) was delivered in two ways for signature.

4 RESULTS AND DISCUSSIONS

In order to discuss the changes in water consumption and elucidate its relationship with the COVID-19 pandemic during the most intense period of social isolation, from March/2020 to March/2021, it was necessary to obtain the monthly water consumption data of the macrometers from the concessionaire DESO, including data on the volume distributed for each district and the volume consumed by the population of that region over each month.

After receiving the necessary information, the data was cross-checked and the process of analysis of the samples per neighborhood. The data from the districts were part of this collection: Coroa do Meio/Atalaia, July 13, Jardins, Salgado Filho, Grageru/Luzia, José Conrado de Araújo, Olaria and Siqueira Campos. Table 1 shows the values of the distributed volume (macromeasure) and the consumed (micromeasure) of each locality, in the previously established time-scale.

<table>
<thead>
<tr>
<th>Bairro</th>
<th>2018 Distribuído (m³)</th>
<th>2018 Micromedido (m³)</th>
<th>2019 Distribuído (m³)</th>
<th>2019 Micromedido (m³)</th>
<th>2020 Distribuído (m³)</th>
<th>2020 Micromedido (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coroa do Meio/Atalaia</td>
<td>496.669</td>
<td>388.949</td>
<td>503.547</td>
<td>381.221</td>
<td>522.352</td>
<td>413.019</td>
</tr>
<tr>
<td>13 de Julho</td>
<td>646.428</td>
<td>527.239</td>
<td>633.870</td>
<td>499.347</td>
<td>724.624</td>
<td>531.733</td>
</tr>
<tr>
<td>Jardins</td>
<td>260.397</td>
<td>213.197</td>
<td>283.486</td>
<td>238.784</td>
<td>353.625</td>
<td>301.884</td>
</tr>
<tr>
<td>Salgado Filho</td>
<td>264.085</td>
<td>174.638</td>
<td>229.474</td>
<td>178.465</td>
<td>268.077</td>
<td>187.946</td>
</tr>
<tr>
<td>Grageru/Luzia</td>
<td>628.383</td>
<td>510.116</td>
<td>626.518</td>
<td>484.574</td>
<td>612.577</td>
<td>442.923</td>
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<td>718.044</td>
<td>484.502</td>
<td>640.895</td>
<td>405.351</td>
<td>725.778</td>
<td>455.456</td>
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<td>Olaria</td>
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<td>262.690</td>
<td>174.949</td>
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<td>Siqueira Campos</td>
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<td>373.862</td>
<td>560.840</td>
<td>349.984</td>
<td>588.081</td>
<td>394.896</td>
</tr>
</tbody>
</table>

Table 1. Annual measurement of macro and micro measured water volume

Source: Prepared by Lima (2022)

As regards the volume of water distributed by DESO, looking at the macro-measured figures in the neighborhood Coroa do Meio, a progressive rise is noted from 2018 to 2020. The volume of 503,547 m³ in the year 2019, compared to 2018, grew by 1.38%, and in 2020, the year marked by the health crisis of the covid-19 pandemic, this growth in consumption went from 1.38% to 3.73%. In relation to the volume consumed by the population in the region of the neighborhood Coroa do Meio, the percentage rate of the volume 381,221 m³ in 2019 showed a reduction of 1.99% compared to 2018. In the subsequent year, 2020, the measured volume in micrometers fell 8.34% from the previous year.

These values have become relevant and coherent when we consider that the region of Coroa do Meio/Atalaia is inserted in an area of tourist concentration in the South Zone, which demands continuous supply. Following the adoption of social restriction measures due to the pandemic, several shops were closed. The volume distributed has been slightly increased, but, in compensation, the micro-measured volume in the year 2020 has suffered an increase in the
cubic meter consumed, caused by the behavioral change in the region, very noticeable in the utilization rates in the period 2018 to 2020. In 2018, it was 78.3% of 496,669 m³, in 2019, 75.7% of 503,547 m³, and in 2020 took 79.07% of 522,352 m³.

July 13, considered its good infrastructure and high population density in its verticalized units in the South Zone of the city, July 13 was the neighborhood with the highest measurement in water consumption in relation to the others researched, during the pandemic. It should be noted that between 2020 and 2021, water consumption increased by 6.61% compared to what was micro-measured in 2019. This assertion can be proven in the rate of utilization between the micro-measured volume and the distributed volume. In 2019, a volume of 678,951 m³ was distributed, of which 77.93% was used. In subsequent years, in 2020, 75.79% of the 651,880 m³ distributed was used, and in 2021, the utilization was 74.73% of the 704,836 m³ distributed (Table 02).

According to Dias et al (2010), socioeconomic characteristics of the population are associated with the value of the water tariff. For this reason, in regions with a high income population, consumption is high, but not to the point of directly feeling the financial weight of consumption, given that its purchasing power in relation to the consumption of water reverts to the elasticity of the cost-benefit. With a greater concentration of people in the home and the hygienic care as to the use of water, what is actually expected is an increase in the consumption of water.

When taking as a basis the data in Table 1, it is noted that the Jardins district appears with the lowest demand indices, both in the distributed and the micro measured, in relation to the other districts of the sample. In the year 2019, micromeasurement had a 12% increase compared to the previous year. In 2020, with a year of social isolation, there was an increase in consumption of 26.43%. As for the percentage of increase of the volume distributed, according to the macro-meter, in 2019 there was an increase of 8.87%, and compared to 2021, jumped to 24.74%.

Salgado Filho stood out for being the neighborhood with lower volume supplied and lower consumption, in the years 2020 and 2021, compared with the other neighborhoods. The volume of 229,474 m³ distributed in the year 2019 represented a reduction of 13.11% compared to the year 2018. In 2020, despite the 16.82% increase, it remained the neighborhood with the lowest volume of consumed.

Unlike the neighborhood Coroa do Meio/Atalaia, which over the three years of the time cut-off only increased in demand for water, the region of the neighborhoods Grageru/Luzia showed a reduction in both the volume of supply and also in the consumption of water, from 2019 to 2021. Compared to 2018, the 2019 supply decreased by 0.30%, and between 2020 and 2021, there was a decrease again, this time by 2.23%. In terms of volume consumed Table 1 shows a reduction of 5.01% between 2018 and 2019, and moving to 2020, the indicated value was 8.60%.

Although the Grageru/Luzia region showed a decrease in consumption in the macro and micro meters, it was characterized as one of the districts with the highest rate of water consumption in the periods analyzed. Its rates above 20% loss ranged from 81.18% (2018-2019), 77.34% (2019-2020), to 72.30% (2020-2021).

Being the neighborhood José Conrado Araújo is located in the West Zone and is considered a low income region, with predominance in residential units and presence of few commercial activities (IBGE, 2010). The volume of drinking water provided in 2019 has decreased by 10.74% compared to 2018. In the period of Social Isolation from the COVID-19 pandemic, the supply rate dropped from 10.74 percent to 13.24 percent. In parallel to this, the volume consumed decreased by 16.34% between 2020 and 2021. But, in the following year, there was an increase of 12.36% from 2019 to 2020.
However, the volume of water consumed shown on the micrometer is quite destoining. This is noticeable when analyzing the loss rate of 37% in the year 2020. According to DESO, there are still areas in Aracaju with water diversions, equipment breakdowns or difficult access for maintenance. About this, in its 2019 report, SNIS reported that several factors may be related to the high rates of loss: distribution that does not reach consumers, leaks in the old pipes of the distribution network and the large number of clandestine connections (SNIS, 2019). Thus, in spite of the José Conrado Araújo neighborhood having the largest volume of water distributed, the volume consumed by the population is around 65%.

The quantitative data of the macromeasured volume in the neighborhood of Olaria represented a drop of 4.53% in supply in 2019 compared to 2018. However, during the pandemic, with social isolation, the water supply increased by 16.98 percent between March 2020 and 2021. Similarly, the volume consumed in the period 2018-2019 was reduced by 7.33%. In the year of the pandemic, 2020, the volume consumed was increased by 15.81%. Despite a significant increase of 15.81%, the Olaria neighborhood presented the lowest demand among the neighborhoods/region participating in this survey. The result is demonstrated by means of the utilization rates of 68.62%, 66.60% and 65.93%, respectively of the years 2019, 2020 and 2021.

When analyzing the data concerning the Siqueira Campos district, we observe a linear behavior of little variability in relation to the volumes supplied and consumed. In 2019 there was a 2.69% decrease in supply, compared to 2018, while in the year 2020, characterized by the pandemic, there was a 4.86% increase in supply, reaching 560,840m³, and in 2020, a 12.83% increase in consumption, compared to the previous year. The Siqueira Campos neighborhood, located in the west of Aracaju, is commonly classified as a popular neighborhood, an economic hub with commercial sectors inserted in residential areas. BASTOS, 2006. It is worth pointing out that, in spite of following a regular behavior in the distributed volume, the Siqueira Campos neighborhood, for concentrating a population of medium/low income, had an index of utilization of the distributed volume of around 65% in the periods analyzed.

According to the data presented, in a comparative analysis, the largest volumes of water distributed were those of the neighborhoods José Conrado Araújo, with 725,778m³ and July 13 with 724,624m³. However, the micro-measured volumes of the two districts set up quite different values. In the region of José Conrado Araújo, the volume consumed represented an utilization rate of 63% in relation to the volume supplied, while in the neighborhood of July 13, the consumption of water measured a total of 531,733 m³, representing an index of 78% utilization.

These different scenarios can be justified by the different demands of consumption and by the relationship of consumption with per capita income. The two districts are inserted in areas with distinct socioeconomic patterns and different urban valuation. For Dias et al (2010), water consumption is closely linked to the socioeconomic conditions of the population supplied and, therefore, its purchasing power in relation to the "treated water" input.

In higher-income neighborhoods, such as July 13, the high water rate does not interfere with higher demand for consumption, because it does not represent a concern. However, in low-income neighborhoods, rational water use is directly linked to purchasing power. In these cases, incentives work well, such as the Social Tariff for low-income families, because consumers, in order not to lose the incentives granted, make more effort to keep consumption low.

On the difference between the volume distributed and the consumed, this can represent the waste of water. Studies show that old and unmaintained pipes, leaks, thefts and clandestine connections are some of the culprits for the high rates of water waste. In 2010, leaks, clandestine connections, lack of measurement or incorrect measurements in water consumption accounted for 37.5% of losses (SENADO, 2014; TRATA BRASIL, 2014). Another neighborhood that
calls attention is the Grageru/Luzia district, for having the highest level of water consumption during the periods analyzed.

4.1 Socioeconomic and Cultural Profile of Respondents

The profile of the residents interviewed in the neighborhoods of the spatial sample was analyzed according to the data obtained by means of a questionnaire. The first three questions related to the personal aspects of the interviewee, such as gender, age range and educational level. According to the data collected in the field survey, the female inhabitants represented the largest portion of the interviewees. The Siqueira Campos neighborhood was the one that had the highest level of female participation in the research. Of the 50 residents participating, 70% were women. In Jardins, this representation was 68%, and 62% in José Conrado Araújo. In the Grageru/Luzia district, 50% of the participants were women. The neighborhood of Olaria was the only one in which there were more male participants (54%).

With regard to the age group, it was possible to identify in all the research districts a good participative diversity of the inhabitants, with a range of from 18 to over 60 years. Of the interviewees at Siqueira Campos, 26% were between 18 and 30 years old. In Pottery, there were more interviewees between 31 and 40 years old (34%). In Grageru and Luzia, 28% were between 41 and 50 years of age, and 24% of those interviewed in the July 13 district were between 51 and 60 years of age. Few respondent residents were over the age of 60, with only 4% of respondents from all neighborhoods surveyed.

In a study about consumer behavior, Lima Filho (1999) pointed out changes in the consumption patterns of families, accompanied by their change in age group. Therefore, this indicator is very contributory and essential, because it can bring information about the insertion into the labor market, besides the perception about the use of water at each stage of life, contributing in the analysis of the data. In that case, we can come to a conclusion that comes closer to the reality of the community. For example, if in a given locality there is recognition of the situation during the pandemic, regardless of the age that the participant has, this shows that the concept for a given subject is the reality experienced by the inhabitants of the neighborhood.

Among the participants living in neighborhoods considered to be middle and upper class, such as Coroa do Meio/Atalaia, July 13, Jardins, Salgado Filho and Grageru/Luzia, was found a predominance of the levels of Superior and Post Graduation. In such cases, there is a greater opportunity to achieve higher levels of schooling. This is what is shown in the July 13th district, in which 44% of the interviewees have a full university degree, and 40% have a post-graduate degree. In Salgado Filho, 66% of the participants have already studied at the university and 18% stated that they are post-graduate students.

Some limitations seem to be related to the level of instruction. In low-income neighborhoods, 27% of the interviewees declared themselves without schooling, that is, they are considered illiterate, 58.9% did not manage to complete elementary school, 3.6% claimed to have completed elementary school, 1.3% did not reach high school, and 9.2% said to have completed high school. In these regions, none of the interviewees reported having a higher level.

Still on the subject of schooling, in José Conrado Araújo and Siqueira Campos, 39.2% and 36.2% of the participants declared that they had completed high school education. In the neighborhood of Olaria, 26% claimed to have completed the fundamental one. Among the residents interviewed, only 4% had the opportunity to do a Postgraduate Course.

In view of the need for social distancing, as recommended by the WHO as a protective measure to contain the spread of the virus, thousands of people had their work activities impacted, going on to work **at home**, that is, at home. Among the eight sample districts, the
percentage of those who continued to work in person varied from 20% to 34%, taking into account that their activities are considered essential. According to the graph, there were 34% of the respondents in Grageru/Luzia and 28% in Siqueira Campos, where there are people with a simpler condition.

According to Bridi (2020), in the context of the COVID-19 pandemic, being in the home-office working condition is a kind of "privilege", as it contributes to social isolation and gives greater protection to the lives of workers (BRIDI et al, 2020, p. 7). In this research, it was found that there is a greater concentration of home-office workers in the high income districts than in the districts with less purchasing power. A little over half of the interviewees in the 13th of July neighborhoods, Jardins and Salgado Filho said they had worked remotely.

In the low income districts, though - José Conrado Araújo, Olaria and Siqueira Campos - 27.5% and 24% of the participants managed to work from home, respectively. In addition, the largest number of people who have indicated that they are unemployed are in the simplest layers of the population. In José Conrado Araújo, 33% of the respondents were in this condition, followed by Siqueira Campos, with 26%. In high-end neighborhoods, the percentage was lower. Only 4% and 6% of the interviewees, on July 13 and Jardins, reported being unemployed.

4.2 Increase in Residential Water Consumption During the Pandemic Compared to Previous Years

Recommended by health authorities, alcohol-based products were the most sought after, considered essential for combating the health crisis. Although water is a more affordable resource than gel alcohol, there has been a run on supermarket shelves due to massive strong campaigns about using alcohol to sanitize hands. Alcohol in gel can be transported easily and can be present in any environment. For this reason, in the low income population, in spite of the inflated cost, many gave priority to alcohol in gel form, particularly at times when it is not possible to wash their hands with soap and water.

Expanding the discussion, as well as the use of water during the pandemic, the research also sought to find out the relationship between the quality of water and the diseases of water circulation. Therefore, it was questioned whether at any time the participants or someone from the family had already contracted some water-borne disease in that locality/residence (giardiasis, verminosis, amebiasis, gastroenteritis, infectious hepatitis, schistosomiasis or cholera).

By having access to water and sewage treatment, the population has the opportunity to extinguish or at least minimize the effects of possible contamination by pathogens, in which the transmitting vehicle is water. It is estimated that around 10% of the overall burden of disease is due to poor water quality and deficiencies in excrete disposition and hygiene. (PRÜSSUSTIN et al. 2008).

A small portion (4 percent) of Middle Crown respondents were able to notice a decrease in their residential unit’s water consumption during the period of social isolation from the COVID-19 pandemic. However, another part of the interviewees noticed an increased water consumption in their tariff bill. In all the districts surveyed, more than half of the inhabitants noticed an increase in their residential water consumption. This was the perception of 90% of the participants in the Salgado Filho neighborhood and of about 60% in the region of the Middle Crown/Atalaia (Figure 1).
Middle Crown / Athalaya

No, my consumption remained the same 60.8%
Yes, my consumption has increased 35.3%
No, my consumption has decreased 3.9%

July 13

No, my consumption remained the same 84%
Yes, my consumption has increased 16%

Gardens

No, my consumption remained the same 88%
Yes, my consumption has increased 12%

Salted Child

No, my consumption remained the same 90%
Yes, my consumption has increased 19%

Grageru / Luzia

No, my consumption remained the same 74%
Yes, my consumption has increased 26%

José Conrado Araújo

No, my consumption remained the same 60.4%
Yes, my consumption has increased 19.6%

Pottery

No, my consumption remained the same 80%
Yes, my consumption has increased 20%

Siqueira Campos

No, my consumption remained the same 70%
Yes, my consumption has increased 30%

Figure 1. Increase in residential water consumption during the pandemic compared to previous years.

Source: Prepared by Lima (2022)

It is worth remembering that the majority of the population of the neighborhoods July 13, Jardins, Salgado Filho and Grageru/Luzia changed their routine, going on to study and work in a home-office regime. Previously, people paid their water bill without realizing what they were consuming. But with the arrival of the covid-19 pandemic, people’s routines changed. The stay of a family with 4 to 6 members, all indoors, caused a "fright in the water bill, at the end of the month", said a resident of the neighborhood José Conrado Araújo.

According to Carmo et al (2020), the COVID-19 pandemic brought three distinct situations regarding water consumption. With social isolation, people had to spend more time at home working in the home office, which consequently generated an increase in residential water consumption (CAR). Another situation relates to service professionals considered to be essential. These, for not having their activities interrupted, had to maintain their usual routine. For this reason, its consumption is almost unchanged. The pandemic has also brought about economic instability. Many Brazilians lost their jobs and had to vacate their properties temporarily, with this their consumption was lower than in inner years.

On the economic aspect, with the purpose of investigating the effects of water consumption on the life of the population, the inhabitants were asked if during the pandemic they had economic difficulties to pay their water bill. The research revealed a heterogeneity in the responses. In the neighborhoods July 13 and Grageru/Luzia, 86% managed to keep their accounts up to date, followed by Jardins and Salgado Filho, with 75.5% and 70% respectively. For middle- and upper-class neighborhoods, despite high rates and declining incomes, the high consumption of residential water did not stop them from paying their water bill.

Considering the population of low income neighborhoods, as is the case of José Conrado Araújo, Olaria and Siqueira Campos, the financial difficulty in keeping the accounts of this service paid was greater, comparing with the middle and high income neighborhoods. In José Conrado Araújo, 69% of the participants said they had experienced financial difficulties to pay
their residential water bill, considering also that during the pandemic 33% of them became unemployed.

The arrival of the COVID-19 pandemic and the imposition of social restriction measures have significantly affected the labor market. The population had a drastic decrease in their family income. Furthermore, as if the loss of human life were not enough, many families ended up losing the members responsible for the family’s financial income. (CAMARANO, 2020)

However, some low-income families, despite having their income reduced and surprises with the water rate at the end of the month, consider the payment of this service as a priority in their domestic budget, otherwise their loss may be even greater. This is what they consider to be 58% of the inhabitants of Siqueira Campos and 46% in Olaria, both low income districts.

Knowing that water is an essential element for life and important in combating the coronavirus, it needs to be of quality and regular access. Lack or precariousness of access to water represents a risk situation that increases the incidence of infectious or chronic diseases (Razzolini and Günther, 2008). With this in mind, it was investigated whether during social isolation there was intermittent water supply, compared to previous years.

It was found that 51% of the respondents in the neighborhood José Conrado Araújo said they had suffered from the lack of water, much greater in some periods of quarantine than in previous years. Residents of other low-income neighborhoods also reported the same disorder during the pandemic. However, in the high income districts, there was no shortage of water to the point of causing great upheaval. This was the perception of all the interviewees on the 13th of July and Salgado Filho, while only 6% of the interviewees did not have this same opinion.

In areas with a high income concentration, there is a greater predominance of high standard condominiums, with access to drinking water with a localized solution, such as artesian wells, besides having a connection to the public network. But in low-income population areas, with residential units predominating, access to drinking water is precarious, with individual solutions, which jeopardizes the quantity and quality stored.

In the quality of the water, important factors of impact are considered: handling - the way how collection, storage and use takes place -, the presence of pathogens in the sources and the routine practices of the population. The presence of pathogens in the sources shows a health risk. The identification of the etiological agent indicates the origin of the contamination. About this, the residents were asked if they considered the water coming into their taps of good quality. There was a major complaint in the Middle Crown/Athalaya: 33.3% of the participants reported that the water is not of good quality, has an unpleasant smell and sometimes becomes cloudy.

Next, in Siqueira Campos 30% and in Olaria 26% stated that they had been drinking water of poor quality. During the data collection with the inhabitants, there was a great complaint about the color and turbidity of the water, and about the excess of chlorine that they felt. According to Giacchini, the qualitative characterization of the water makes it possible to identify the health security necessary for the use of this water, which in turn may be associated with the conditions of storage and hygiene and the frequency in the cleaning of the water reservoir (GIACCHINI, 2010).

In order to investigate practical actions on the use of water, it was decided to ask the inhabitants about the importance of the reuse of water, especially inside the home. Generally speaking, there is no discrepancy in the responses given by the inhabitants in the eight districts surveyed. When discussing the alternatives for this questioning, it is noted that, generally speaking, the population believes that the reuse of water is important. However, due to cultural issues, they do not realize the benefits of doing so. Therefore, although they say that the recycling of water is important for the survival of the planet and of human beings, they admitted that they do not have the custom of doing so, regardless of what social class they are.

This reality is perceived in neighborhoods with high purchasing power, and with a high degree of education about this kind of subject. This is the case of the interviewees of the
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neighborhoods July 13 (48%), Jardins (46%), Coroa do Meio/Atalaia (35.3%) and Salgado Filho (24%). This is also the case among the inhabitants with a simpler condition, as is the case of the Grageru/Luzia district (32%), Olaria (42%) and Siqueira Campos (40%). These portions of interviewees admitted not to have such a practice. José Conrado Araújo had the lowest percentage, with 19.6%. This is because 31.4% of the 50 inhabitants believe that the reuse of water is important more for an economic than an environmental reason, that is, reuse is important for reducing the tariff bill.

Thus, it can be seen that the financial factor is one of the determining points for the population to give importance to the reuse of water, even if this does not condition it to do so. Just as in José Conrado Araújo, the other neighborhoods also had the same thought. Those with the highest percentages are to be found in the middle Crown/Atalaia (41.2%), Salgado Filho (40%) and Siqueira Campos (34%).

Thus, some respondents consider the reuse of water consumption to be important, although they say they only do this when there is a lack of water in their home. For the 50 interviewees in the July 13 neighborhood, 18% considered reusing because they were under an emergency situation, while in Salgado Filho the percentage of responses in this direction was 28%. This understanding was felt among low-income residents: 25.5% of those interviewed at José Conrado de Araújo and 18% at Olaria stated that on days of shortage, they use the water tank or, in the worst of situations, they can only "wait for the water to return", as a resident of José Conrado answered.

A consideration here is for those who have put the reuse of domestic water as a sustainable practice, even if it may still be very timid. In this respect, Olaria stood out with 26% of respondents who said they reused the house water, because they understand the importance of this for the environment, as well as due to the incentives offered by DESO. Many of these families are enrolled in the Social Tariff program, and receive discounts on the water bill. That is why, in their statements, they try to reuse water from the washing tank, or even to use rainwater in emergency situations. In the Salgado Filho, though, of the 50 interviewees, only 4% said that they had acquired the practice of reuse, and in the Siqueira Campos it was even lower, only 2%.

In the conception of Spanish, in terms of water resources management, one must abandon outdated orthodox principles and adopt a new paradigm, based on the key words "conservation" and "reuse of water". Therefore, it is fundamental for us to think about the practice of water reuse, especially in urban centers, which have been suffering more and more from swelling in the cities. (SPANISH, 2008)

5 FINAL CONSIDERATIONS

This research was conducted to contribute to knowledge about the correlation between the population’s water use and the COVID-19 pandemic. To this end, the data collected from the water consumption in the macrometers, between the years 2018 and 2021, served to quantify the volume distributed and consumed in each researched neighborhood. In this regard, the study revealed the divergences in the demand for water in each district, influenced by the profile of the inhabitants of the region, by family income and by the culture of access to drinking water in abundance.

The survey found that during the time-out period chosen for this survey, DESO sanitation company maintained a regular supply in the analyzed regions, especially in 2020-2021, when the population was most impacted by the COVID-19 pandemic. However, it is worth pointing out, based on an analysis made on the measured data, that both the volume distributed and the consumed differed from region to region. The neighborhoods July 13, Grageru/Luzia were the ones that showed the highest consumption of water. In contrast, José
Conrado Araújo stood out with the highest rate of loss in water distribution, despite the volume of water distributed by DESO.

In the socioeconomic aspect, the research highlighted that, after the imposition of social restrictions, there was a flattening of the family income, mainly for low and middle income families, who had their salaries reduced and/or became unemployed. Family members were forced to spend more time indoors. In this aspect, the district most affected was José Conrado Araújo.

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