Universal access to treated water: challenges in using census data as information

Universalização do acesso à água tratada: desafios dos dados censitários como informação

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Abstract

In Brazil, Federal Law n. 14026/2020 established the goal of universalization of water supply to all Brazilians by 2033. Considering that data from the IBGE Population Census are essential for planning and formulating programs aimed at universalizing access to treated water supply services, this study discusses the role played by the Census from this perspective. Documentary research and field interviews revealed that, despite advances in surveying statistical data on household water supply forms, the current attributes used by the IBGE Census remain insufficient to adequately characterize access to water across the diverse social groups and geographical areas that comprise the country.

Keywords: right to water and sanitation; universal access to treated water supply; IBGE population censuses; public policies; social justice.

Resumo

No Brasil, a Lei Federal n. 14.026/2020 estabeleceu como meta a universalização do abastecimento de água a todos os brasileiros até 2033. Considerando que as informações do Censo Demográfico do IBGE são essenciais para o planejamento e a formulação de programas voltados à universalização do acesso aos serviços de abastecimento de água tratada, o presente trabalho discute o papel do Censo nessa perspectiva. A partir de uma pesquisa documental e de entrevistas de campo, evidenciou-se que, apesar dos avanços no levantamento de dados estatísticos sobre as formas de abastecimento domiciliar, os atuais atributos utilizados pelo Censo do IBGE ainda não são suficientes para caracterizar adequadamente o acesso à água dos diversos grupos sociais e espaços geográficos que compõem o País.

Palavras-chave: *direito à água e ao saneamento; universalização do abastecimento de água tratada; censos demográficos do IBGE; políticas públicas; justiça social.*

Introduction

According to the latest demographic census, conducted in 2022, Brazil has a population of 203,080,756 inhabitants, of which 177,508,417 (87.4%) live in urban areas and 25,572,339 (12.6%) in rural areas. Of the total, 82.89% are supplied with water by the public network, which also includes rural areas (IBGE, 2022).

In 2010, access to water and sanitation was recognized by the United Nations (UN) as a fundamental and inalienable human right, essential for the realization of other human rights (UN, 2010). In Brazil, the universal access to water supply and sanitation services was established as a principle by Federal Law n. 11,445/2007 (Brazil, 2007) and set as a goal to be achieved by 2033 under Federal Law n. 14,026/2020 (Brazil, 2020). However, nearly 35 million individuals, according to 2022 Census data, still do not enjoy this right.

The analysis of official statistics shows that the lack of water supply does not affect Brazilians homogeneously: in the Southeast region, 91.17% of households are connected to the public supply network; in the South, 86.89%; in the Midwest, 85.65%; in the Northeast, 77%; and in the North region, only 56.45%. IBGE data also reveal a racial gap in access to these infrastructures: self-declared white and yellow Brazilians have proportionally greater access to water supply than Black, brown, and Indigenous populations (IBGE, 2022).

The Census is an essential tool for producing specialized indicators and information about populations and their characteristics. It enables the identification of specificities, such as socioeconomic inequalities and deficits in housing and access to infrastructure across different geographic scales. This is fundamental information that supports the formulation of effective public policies for vulnerable social groups in different Brazilian regions (Menezes & Soares, 2019; Ferreira & Barroso, 2019). However, it is necessary for the methodologies used for data collection to be accurate and up to date, so that the statistics and information produced are reliable for decision-makers, both for the formulation and evaluation of public policies and their instruments (Jannuzzi, 2017; Ferreira & Barroso, 2019; Ferreira, Lima & Nobre, 2023).

This paper aims to evaluate the role of the IBGE Demographic Census as a source of information to support the planning and programs for the universalization of access to treated water for all Brazilians, based on three principles: (1) the fundamental human right to safe water and sanitation; (2) the premise that household access to treated water supply is a condition for the exercise of full citizenship, and (3) the principle of universal access by 2033 (according to Law n. 14,026/2020). It also aims to analyze advances and challenges in its methodology for collecting household water supply data and the capacity of official statistics to reveal the heterogeneity of access to water experienced by different social groups and geographic areas of the country.

From a methodological perspective, this study has an exploratory character (Minayo et al., 2005; Gil, 2008), divided into two stages:

- the first, descriptive and document-based, aims to trace to characterize the progression of statistical data collection on household water supply conducted by IBGE's Demographic Censuses since the 1960s;
- the second, based on fieldwork, seeks to verify whether the new attributes used in the 2022 Census are sufficient to describe the existing arrangements in household water access.

Thus, the first two sections provide a brief literature review on the human right to water and sanitation, public policies, and social indicators. The third section presents

the documentary research carried out on the attributes used by IBGE in its censuses to characterize household water access in Brazil. The fourth describes the field research conducted to analyze the capacity of 2022 Census statistical data to portray the different realities of water access in municipalities on the metropolitan periphery of Rio de Janeiro. Finally, the fifth section raises discussions and highlights challenges for future censuses to produce information supporting the process of universalizing access to drinking water in Brazil, followed by the final considerations.

The results aim to provide support for understanding the advances and gaps in the collection and production of official statistical data on sanitation. The study also seeks to elucidate potential social and structural factors within water supply services that require greater efforts to be properly identified, with the goal of reducing inequalities and inequities in the exercise of this fundamental human right. In this regard, the research is expected to contribute to the debates on the social role of the Population Census in Brazil and its improvement, as well as to the formulation of more inclusive public policies for access to treated water, ensuring the full realization of the human right to water and the achievement of universalization by 2033 in a fair and equitable manner for all Brazilians.

The human right to water: theoretical notes

In 2010, the United Nations (UN), through Resolution A/RES/64/292, recognized access to water and sanitation as a fundamental, universal, and inalienable human right for all individuals, necessary for the realization of other human rights. Since then, through different documents, normative contents have been defined to guide the fulfillment of these rights. This study adopts those made explicit in the reports of the Special Rapporteur and systematized by Heller (2022), focusing on water supply.

The first is availability. Water must be provided in sufficient and continuous quantities for personal and domestic uses (drinking, personal hygiene, laundry, food preparation, and household hygiene). However, the amount varies according to socioeconomic factors, particularly income categories and cultural patterns; according to climatic characteristics; and other elements. In Brazil, water-use habits differ between regions and between urban and rural areas. IBGE data indicate that in 2017, the per capita daily water use of Brazilian households was 116 liters. Among the major regions, the Southeast recorded the highest per capita daily use, with 143 liters, while the lowest was recorded in the Northeast, with 83 liters (IBGE, 2020a). Income also influences water consumption. Carmo et al. (2013) show that rising income is associated with greater water consumption. Finally, an important dimension of availability highlighted by Heller (2022) is continuity of access. In Brazil, there are situations where supply is intermittent due to water scarcity or problems in infrastructures, even in major cities.

The second normative content is quality. Water must be safe for consumption and other personal uses, free from microorganisms, chemicals, or radiological contaminants that pose health risks. The third is physical accessibility. There must be enough water facilities within or in the immediate vicinity of each household, and all health or educational institutions, workplaces and other public places to ensure that all the needs of each person are met. For collective piped systems, a water connection provided on the lot is required.

Another fundamental normative content is financial accessibility. The price paid for access to water must be affordable and should not compromise other essential human needs. Families connected to the public system but unable to pay tariffs often resort to irregular supply methods (illegal connections, wells), which have negative consequences both for themselves (e.g., use of contaminated water, irregular supply, environmental insecurity) and for the proper functioning of the systems.

The UN's normative framework also includes acceptability. Water must be culturally acceptable and meet the needs of all genders, ensuring privacy and dignity. Heller (ibid.) notes that the absence of compliance with this principle is more common in rural and Indigenous areas, where technologies adopted are often not accepted by users.

In 1997, the UN launched a reform program for the organization. The proposal was that all its agencies should align their projects with human rights concepts and principles. Neves-Silva and Heller (2016) discuss how these principles are replicated in the Human Right to Water, as key elements that should guide water supply managements services. Among the principles listed are equality and non-discrimination; participation and inclusion; responsibility and accountability; progressive realization; and maximum use of available resources to ensure access to clean water for all. Equality and non-discrimination establish that all individuals are equal before the law and hold the same rights, prohibiting arbitrary differential treatment. Participation and inclusion imply that all people must be able to actively, freely, and meaningfully participate in, and contribute to, decision-making processes that affect them regarding water management. Responsibility and accountability mean that states and other actors in the sector must be responsible and willing to account for their obligations. This requires states to ensure transparency in water services management. Lastly, progressive realization and maximum use of available resources mean that all states must adopt appropriate measures to ensure the full effectiveness of economic, social, and cultural rights, using the maximum resources at their disposal. In the perspective of the Human Right to Water and Sanitation (HRWS), this means ensuring that resources are allocated to achieve water access for all.

The HRWS framework obliges states to progressively eliminate inequalities in access to both water and sanitation – between rural and urban populations, formal and informal settlements, rich and poor. It also indicates that this right should be included in national constitutions. As Heller (2022) points out, the articulated reading of the normative content of the human right to water – equality and non-discrimination, access to information, participation, accountability, sustainability, and progressive realization – forms a complete conceptual and analytical framework for evaluating the implementation of water and sanitation services, as well as for indicating ways forward. Reinforcing Heller's (2022) perspective, Sultana and Loftus argue that the discourses and struggles that mobilize the human right to water have opened new possibilities in water governance, fostering new collective and moral claims for water justice. Moreover, they have enabled changes in laws, policies, and institutions worldwide (Sultana & Loftus, 2020). Indeed, in countries such as France, Belgium, Colombia, and South Africa, the recognition of HRWS has led to changes in legal frameworks and public policies.

As in other parts of the world, Latin American countries such as Uruguay, Bolivia, Ecuador, and Colombia have included the right to water in their constitutions. Unlike these and other countries, the Brazilian Constitution

does not include this right. There is no national law recognizing water and sanitation as human rights. Currently, there are two Constitutional Amendment Proposals (PECs) under discussion, but without a final decision. Federal legislation on basic sanitation, updated in 2020 by Federal Law n. 14,026, has some alignment with the human rights framework but does not explicitly recognize it. Nor does it comprehensively cover the HRWS framework, addressing only selected aspects. For instance, it advances the goal of universal access, setting 2033 as the target year for achieving universal water supply, and gives some attention to populations living in vulnerable situations. However, it is ambiguous about the means of achieving this goal (Brazil, 2020).

To fulfill the universalization of access to treated water in Brazil, it is essential, beyond setting a goal, to define a national policy, programs with intermediate targets, and secure investments. In 2013, the National Basic Sanitation Plan (Plansab) was approved. The national and regionalized objectives and goals required by Law n. 14,026/2020 are included in Plansab through monitoring and evaluation indicators, with established frequency for the four components of basic sanitation (water supply, sanitation, urban cleaning and solid waste management, and stormwater management).

In its 2013 version, the information sources used by Plansab for building the national sanitation diagnosis and indicators included: surveys by the Brazilian Institute of Geography and Statistics (IBGE), including the 2010 Demographic Census, the National Sanitation Survey (PNSB) of 2000 and 2008, and the National Household Sample Survey (Pnad) from 2001 to 2011; the National Sanitation Information System (SNIS) of the Ministry of Cities (2010); Sisagua of the Ministry of Health (2010-2012); and data from the National Secretariat of Civil Defense (Sedec) of the Ministry of Integration and Regional Development (2007-2009). For modeling investment needs in basic sanitation, Plansab used variables from the 2000 and 2010 Demographic Censuses; the 2000 and 2008 National Sanitation Surveys; and the SNIS historical series. The censuses date make possible to project the population for 2023 and to characterize service provision through different sanitation modalities. The plan highlighted that the SNIS was consolidating as an important data source but noted as a limitation that it did not cover all municipalities and contained conceptually different indicators from those used by IBGE, hindering data compatibility (Brazil, 2014).

In its 2019 review, Plansab included twenty-nine indicators, twenty-four specifics to the four components of basic sanitation, and five related to management aspects. This review did not include new IBGE data. The document points out that, while the 2010 Census data were decisive for providing a deep and broad view of sanitation deficits in the country, they also created a mismatch for monitoring purposes, since such data are collected only every ten years (Brazil, 2019).

Understanding the importance of census data for building diagnostics and indicators, the next section deepens this discussion.

Public policy and social indicators

Public policies are conceived as a continuum of governmental decisions designed either to preserve social equilibrium or to introduce deliberate imbalances, with the ultimate purpose of transforming reality in pursuit of collective well-being. They are strategies undertaken by public authorities with various purposes, whose aim is to bring about democracy and social

justice. Technically, they are political decisions aimed at actions or omissions, preventive or corrective, intended to maintain or modify the status quo of one or several sectors of social life by defining objectives, strategies of action, and the allocation of resources necessary for the intended purpose (Saraiva, 2006).

However, although this concept is frequently presented in manuals for the training of public managers, it overlooks the fact that the formulation of public policy is not inherently characterized by manifest rationality. Research in the sociology of public action highlights the constraints that orient, influence, reshape, and, at times, determine decision-making processes, thereby underscoring the inherent limits of rationality in public decisions (Lascoumes & Le Galés, 2011). Saraiva (2006) highlights that, not infrequently, the implementation of public policies becomes a conflictive process due to the imposition of external circumstances upon the implementing agent, which create obstacles to the achievement of projected objectives. Because of the limits imposed in praxis, current literature on the evaluation of public policy effectiveness stresses the need to observe the entire process, from formulation to execution. Bichir (2020) highlights two levels of analysis that must be considered in the evaluation of public policies: (1) top-down; and (2) bottom-up. Evaluation should emerge from the cross-perception between the two levels, which encompass policy formulation and the implementation of legal changes (top-down) and the local processes of implementation and execution (bottom-up) (Lipsky, 1980; Winter, 2006; Hill & Hupe, 2009; Lotta, 2019; Bichir, 2020). As Arretche (2001 apud Bichir, 2020, p. 25) points out:

> [...] it is naïve to expect that there will be no distance between formulation and implementation, if we take seriously the idea that implementation triggers a chain of decisions and transformations carried out by actors different from those involved in the formulation of the policy.

Since the 1980s, there has been an increase in the use of social indicators not only for policy formulation but also for implementation and analysis. Social indicators are measures – generally quantitative – endowed with contextual meaning based on a social theory or programmatic purpose. They derive from public statistics gathered through demographic censuses, sample surveys, or administrative surveys conducted by ministries, states, or municipalities (Jannuzzi, 2017).

Processes of social exclusion and inequality have stimulated the systematic production of public statistics and the development of social indicators aimed at assessing the magnitude of poverty, the persistence of structural deficiencies, and the degree of access to public facilities and services. The Plansab, mentioned earlier, is an example of the use of social indicators in the context of public policy on water and sanitation. In this regard, Jannuzzi (2017, 2018), Ferreira & Barroso (2019), and Ferreira, Lima & Nobre (2023) stress the importance of governments producing accurate social indicators from precise and up-to-date statistical data. Jannuzzi (2018) illustrates how the indicator "urbanization rate" proves to be poorly representative of the reality of emerging countries due to deficient services, population density, social inequalities, and insufficient public finances for investments. Hence, the availability of a comprehensive system of relevant, valid, and reliable indicators significantly increases the prospects of success in the implementation of sectoral policies and programs, by enabling more accurate technical and social diagnoses.

Concerning statistical data on water and sanitation, IBGE and SNIS are the main sources. At IBGE, the Demographic Census and PNAD

provide data on access to water sanitation services. There is also a sector-specific survey, the National Survey of Basic Sanitation (PNSB), conducted in 2000, 2008, and 2017. The censuses will be examined in the next section, but it is important to note that the information sources and data collection methodologies of PNAD and PNSB differ from those of the Demographic Census, which is the most comprehensive household survey.

As shown by IBGE, the National Household Sample Survey (PNAD) was conducted annually until 2016. It used a probabilistic household sample and produced results for Brazil, Major Regions, Federative Units, and nine Metropolitan Regions (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba, and Porto Alegre). It permanently investigated the general characteristics of the population, education, work, income, and housing, and, at varying intervals, other themes. PNAD was replaced, with updated methodology, by the Continuous National Household Sample Survey (PNAD Contínua). PNAD Contínua has broader territorial coverage (Brazil, Major Regions, Federative Units, Metropolitan Regions, the Integrated Development Region (RIDE) of Greater Teresina, and Municipalities of State Capitals).

Since its implementation, PNAD Contínua has progressively expanded the range of indicators it investigates and disseminates. It provides quarterly, short-term information on the labor market, linked to the demographic and educational characteristics of the population. Periodically, additional topics such as household and resident characteristics are analyzed. These include data on water supply, sewage collection, and household waste collection services. Because it is based on a sample survey, PNAD has limited reach for monitoring the progress of these services. The last revision of Plansab in 2019, without access to more up-to-date census data, used PNAD 2017 data. Without a fixed periodicity and with methodological changes, three editions of PNAD Contínua have been published addressing water and sanitation in household characteristics, in 2019, 2022, and 2023 (Brazil, 2019). It is noteworthy that PNAD began to include a question about water supply frequency: ""In the past thirty days, how often has water from the public network been available to this household?", a topic not addressed in the Demographic Census.

Conducted in 2000, 2008, and 2017, PNSB gathers data from municipalities and sanitation service providers. The operational data collected are published at the municipal level, which does not allow for a more detailed view of intra--municipal inequalities. Regarding water supply, access data refer to the number of connections to the network and the number of properties served by the distribution network (IBGE, 2020b).

The National Sanitation Information System (SNIS), created by the Sanitation Law (Federal Law n. 11,445/2007), is part of the National System of Information on Basic Sanitation (Sinisa), with the objective of collecting and systematizing data on the conditions of public water and sanitation service provision. Annual reports are published with indicators and information covering those public services. The information provided comes from the service providers themselves, and the indicators are calculated by SNIS. The number of municipalities with data in the reports has increased each year. The latest report gathers information on the provision of public water supply services in 5,451 municipalities (97.9% of the 5,570 Brazilian municipalities). The sample covers 99.3% of the country's total population (201.7 million) (Brazil, 2023). Despite successive improvements over the years (the first report was in 1995), there are still gaps and inconsistencies in the data provided by some operators. According to Rezende (2014), it would

be necessary to improve the analysis process and verify the consistency of the information sent to SNIS, as well as to audit, based on statistical criteria, the quality of the information.

Thus, Jannuzzi (2017; 2018) and Ferreira, Lima & Nobre (2023) affirm that the IBGE Demographic Census is currently the most reliable data source for public planning. It is the only one that covers the entire national territory with a single methodology (allowing comparability), follows UN recommendations, and provides data disaggregated by major regions, federative units, meso- and micro--regions, municipalities, districts, and census tracts. The detailed level of disaggregation allows the construction of a thematic portrait of social conditions in various territorial scales, such as pockets of poverty, housing shortages, and other inequities, allowing the identification of the most vulnerable groups. This capability guides the proper sizing of urban facilities and services, allocation of investments, and the development of strategies to reduce various public deficits for the population (Jannuzzi, 2018; Menezes & Soares, 2019; Ferreira, Lima & Nobre, 2023).

For water sanitation, IBGE statistical data help reveal regional differences, shortcomings, and gaps in the territorial distribution of sector infrastructure. They also support studies investigating the logic and causes of unjust geographies that culminate in these disparities.

Brazilian censuses and water and sanitation services

The first nationwide direct General Census dates to 1872, conducted by the General Directorate of Statistics. Unlike previous demographic counts, it not only aimed to count the population but also to assess characteristics such as color, sex, status of free or enslaved, marital status, nationality, occupation, and religion of Brazil's inhabitants (Sousa & Silva, 1986).

After the Proclamation of the Republic in 1889, the 1890 Census included a broader range of items as religious affiliation and illiteracy. In 1940, with IBGE already established, the institute carried out its first census with 45 items. In 1950, this was reduced to 25. The 1960 Census introduced data collection by census tracts and sampling. It investigated a varied set of attributes regarding households in the country, including type of housing (urban, suburban, or rural); type of construction; number of rooms; number of bedrooms; and, finally, the existence of sanitary facilities and forms of water supply (IBGE, 2024a).

An advance in obtaining water and sanitation data occurred in 1970, with the measurement of the existence of service pipes and the addition of types of sewage collection. In 1980, another advance was recorded with the investigation of exclusive or shared bathrooms or toilets by one or more households. The Chart 1 presents the evolution of attributes measured on access to water and household sewage in the IBGE Demographic Censuses of 1960, 1970, 1980, 1991, 2000, 2010, and 2022.

Analysis of the table indicates that, in the Censuses conducted between 1960 and 2000, data on water supply were restricted to three categories: general network, wells or springs, and alternative sources. Since 1970, the national census has been concerned with more specific household conditions for water supply: whether they have access or not through piped systems. In 2010 an attempt was made to distinguish between supply from a "well or spring within the property" and supply from a "well or spring outside the property." The options for supply through "rainwater stored in cisterns"; "rainwater stored in other ways"; and through "rivers, reservoirs, lakes, or streams"

Chart 1 – Items used by IBGE from 1960 to 2022
for the survey of household water supply and sanitation conditions

Censuses	Water Supply	Sanitation
1960	1 - General network 2 - Well or spring 3 - Other source of supply - Not declared	1 - Public sewer system 2 - Septic tanks/pits - No sanitary facility
1970	1 - General network 2 - Well or spring 3 - Other source of supply - Not declared	1 - Public sewer system 2 - Septic tank 3 - Rudimentary pit 4 - Other drainage • No sanitary facility - Not declared
1980	• With piped connection • Without piped connection 1 - General network 2 - Well or spring 3 - Other source of supply - Not declared • Private (exclusive to the household) • Shared by more than one household	• Exclusive to the household • Shared by more than one household 1 - Public sewer system 2- Septic tank 3- Rudimentary pit 4- Other drainage - No sanitary facility
1991	• With piped connection • Without piped connection 1 - General network 2 - Well or spring 3 - Other source of supply • Private (exclusive to the household) • Shared by more than one household	• Exclusive to the household • Shared by more than one household 1 - Public sewer system 2 - Septic tank connected to stormwater drain 3 - Septic tank without drainage 4 - Rudimentary pit 5 - Ditch 6 - Other - Unknown
2000	• With internal plumbing • With plumbing limited to the plot/property • Without plumbing 1 - General network 2 - Well or spring within the property 3 - Other source of supply	1 - Public sewer system or stormwater drain 2 Septic tank 3 - Rudimentary pit 4 - Ditch 5 - River, lake or sea 6 - Other drainage - No sanitary facility
2010	1 - General network 2 - Well or spring within the property 3 - Well or spring outside the property 4 - Water truck (tanker) 5 - Rainwater stored in cistern 6 - Rainwater stored by other means 7 - Rivers, reservoirs, lakes or streams 8 - Other source	• Private (exclusive to the household) • Shared by more than one household 1 - Public sewer system or stormwater drain 2 - Septic tank 3 - Rudimentary pit latrine 4 - Ditch 5 - River, lake, or sea 6 - Other form - No sanitary facility
2022	• With internal plumbing • With plumbing limited to the plot/property • Without plumbing 1 - General network distribution system 2 - Deep or artesian well 3 - Shallow, phreatic or dug well 4 - Spring or water source 5 - Water truck (tanker) 6 - Rainwater stored 7 - Rivers, reservoirs, streams, lakes or creeks 8 - Other source of water supply	• Private (exclusive to the household) • Shared by more than one household 1 - Public sewer system or stormwater drain 2 - Septic tank or filter tank connected to the sewer network 3 - Septic tank or filter tank not connected to the sewer network 4 - Rudimentary pit or dug hole 5 - Ditch 6 - River, lake, or sea 7 - Other form - No sanitary facility

Source: the authors, 2025, based on IBGE (2025a, 2025b).

were removed from the "other forms" attribute and given individual status. Thus, the "other forms" option became a more residual category of household access to water.

In 2022, the IBGE Census advanced considerably in its method of data collection and characterization of different household forms of access to water, by considering that more than one form of household supply may coexist. This understanding is reflected in the change in the wording of the census taker's question about access to water. While in the 2010 Census the question posed to the household head was: "The form of water supply used in this household is..."; in the 2022 Census, this was reformulated as: "What is the main form of water supply used in this household?" Following this new perspective on household access to water, the 2022 Census separated the supply option "wells" from the option "spring or source," creating a distinct item for the latter. These two forms of water supply had been measured jointly since IBGE's first census by census tracts in 1960 until 2010. However, it is well known that these two forms represent very different characteristics of access, conditions, quality, and exposure to risks.

Another advance brought by the most recent census was the distinction between "drilled wells" (depths greater than 20 meters) and "dug well or open well" (depths less than 20 meters, more seasonally subject to variations in quantity and more vulnerable to contamination). Finally, for households that reported their supply came from sources other than the public water system, there was a follow-up question as to whether or not they had access to the public system.

The precariousness of supply invisible to statistics

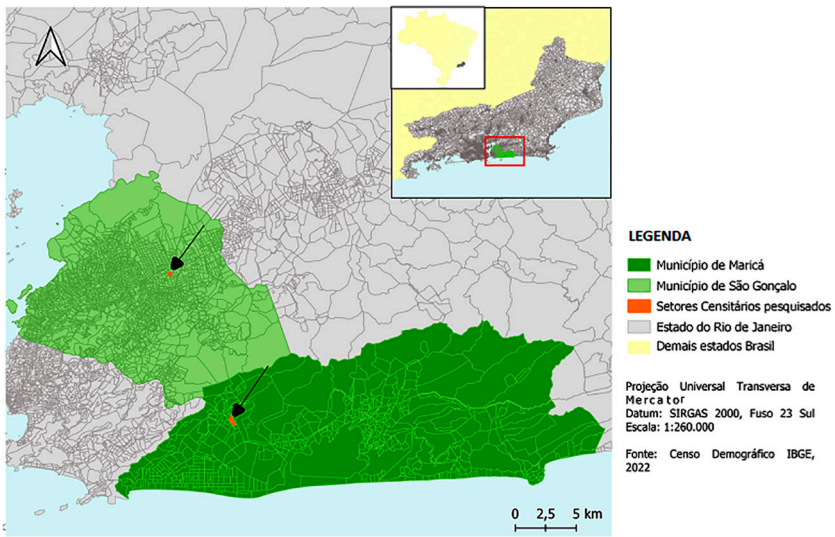
This section sought to investigate whether the current attributes used by IBGE in the 2022 Census are sufficient to portray the multiple realities of household access to water in Brazil. To this end, field research was conducted in two census tracts. The objective was to verify whether the current items characterizing the forms of water supply used by IBGE – especially piped water – reflect the reality of household access, particularly in urban areas. As a case study, two municipalities in the Metropolitan Region of Rio de Janeiro were selected – São Gonçalo and Maricá – and one urban census tract from each was chosen, whose households (or part of them) have access to piped water from public system according to IBGE. Below are some characteristics of the municipalities chosen:

- São Gonçalo is located about 20 minutes from the capital. It is the second most populous municipality in the state, with 896,744 inhabitants, divided into 91 neighborhoods and five administrative districts. "Since the 1970s, the area has undergone an accelerated and unregulated process of land use, occupation, and urbanization, whereby its formerly rural territories were fragmented into allotments primarily designated for the working-class population" (Gouveia, 2022). In 2021, it ranked 7th among the state's Gross Domestic Products (GDPs), but its per capita GDP is well below the national average, at only R$18,504.00 per inhabitant. According to IBGE Census 2022 data, the municipal coverage rate of treated water is 84.57% (IBGE, 2024b).

• Maricá is located 60 minutes from the capital. It has 197,277 inhabitants, divided into 50 neighborhoods and four administrative districts. It was the municipality with the highest demographic growth, 54.8%, between 2010 and 2022 in the state of Rio de Janeiro. Historically, land occupation was primarily oriented toward allotments associated with summer tourism and the proliferation of gated communities. More recently, however, this pattern has undergone a significant reconfiguration, driven by the expansion of the oil economy and the projected development of the Metal-Mechanical/ItaguaíPort Complex. In 2021, boosted by oil royalties, its GDP was the second largest in the state, having increased more than 45 times compared to 2010, and it ranked 8th in Brazil. According to the 2022 Census, the municipal coverage rate of household access to piped water in Maricá is 35.22%. Inoã, the district studied, has the lowest average per capita household income (R$1,273.59 in 2022) and the highest proportion of inhabitants with only elementary education (43.65%) (IBGE Cidades, 2024b).

Figure 1 shows the location of the surveyed census tracts and the municipalities of São Gonçalo and Maricá in the Rio de Janeiro Metropolitan Region.

Figure 1 – Census tracts surveyed in São Gonçalo and Maricá in the Rio de Janeiro Metropolitan Region (RMRJ)



Source: the authors, 2025.

Chart 2 – Characteristics of the surveyed census tracts

Municipality	**Maricá**	**São Gonçalo**
District	Inoã	Monjolos
Neighborhood	Chácaras de Inoã	Laranjal
Census tract code	330270010000004	330490415000625
Water supply system	Integrated System Imunana-Laranjal	Integrated System Imunana-Laranjal
Piped Network Coverage (census tract)	47%	56,33%
Total Population (census tract)	490	572
Total Occupied Households (census tract)	226	213
Total Surveyed Households	22 (10% of total)	21 (10% of total)

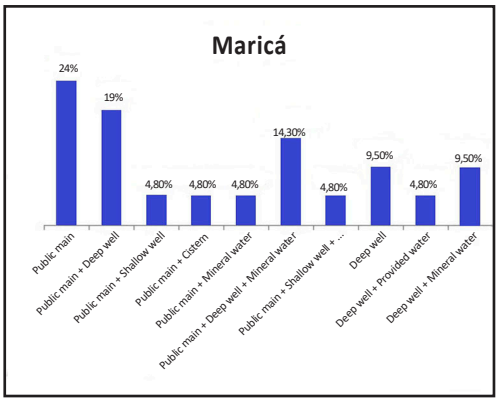
Source: the authors, 2025, based on IBGE (2022).

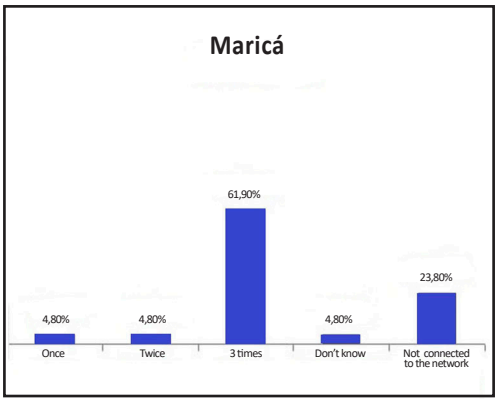
The field research was conducted between January and February 2025. Semi-structured questionnaires were applied, with closed questions related to the forms of access to water; the regularity/frequency of supply; the period of the day (day/ night) during which water from the public supply system is available to the household; and the sufficiency of the water supplied. Finally, respondents were invited to share personal observations about their household water access routines. The interviews were carried out in 10% of the households in each tract. The Chart 2 presents a summary of the characteristics of the surveyed tracts.

The on-site survey regarding forms of water access in Maricá found that only 23.8% of households in the surveyed census tract reported using water exclusively from the public system. The remaining 76.2% either combined the public system with alternative sources or relied solely on wells. The types of water access identified were: 19% through the public system and wells; 4.8% through public system and shallow wells; 4.8% through the public system and cisterns; 4.8% through the public system and bottled water; 14.3% through the public system, wells, and bottled water; 4.8% through public system, shallow wells, and bottled water; 9.5% solely through wells; 4.8% through wells and water provided by neighbors; and 9.5% through wells and bottled water (Graph 1).

The frequency of water supply for the 76.2% of households connected to the public system is as follows: 4.8% once a week; 4.8% twice a week; 62% three times a week; and 4.8% did not know how to respond. The remaining 23.8% of households were not connected to the general network (Graph 2).

Graphs 1 and 2– Water supply sources & Frequency of treated water supply – Maricá/RJ

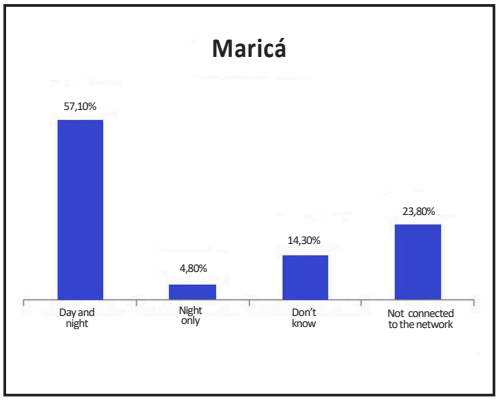


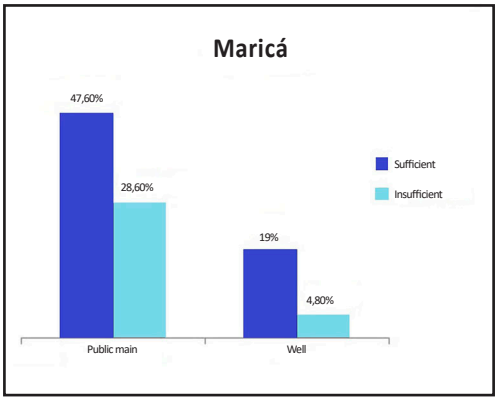


Source: the authors, 2025.

Still according to the households connected to the public system, 57.1% reported that water access occurs throughout the day and night on supply days; 4.8% reported that it occurs only at night; 14.3% did not know how to answer; and the remaining 23.8% are not connected to the network (Graph 3). Finally, respondents were asked whether they consider the water accessed sufficient for their domestic needs. Of the 76.2% of households connected to the network: 47% considered it sufficient, and 28.6% considered it insufficient. Of the 23.8% supplied by wells, 19% consider the water accessed sufficient, and 4.8% consider it insufficient (Graph 4).

Graphs 3 and 4 – Water supply period & Sufficiency for household demands – Maricá/RJ



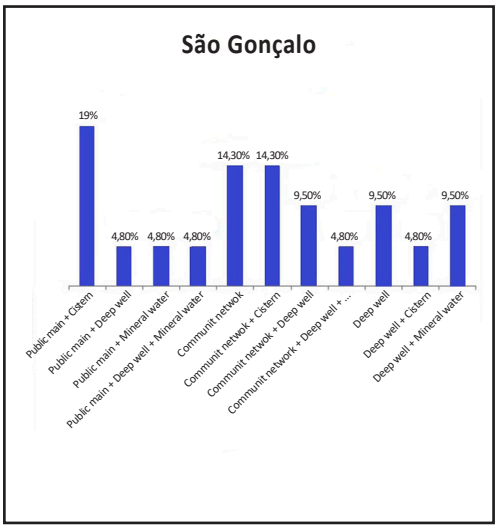


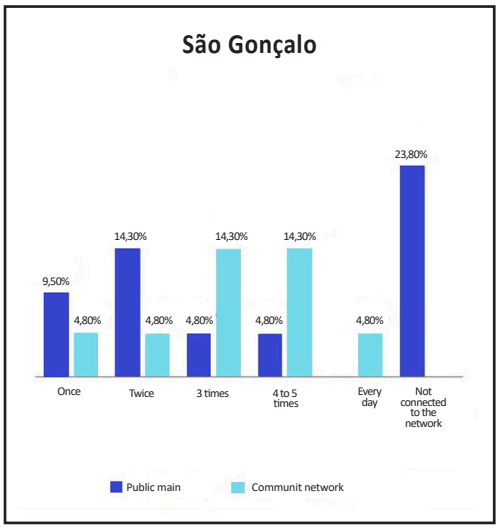
Source: the authors, 2025.

In São Gonçalo, none of the households in the surveyed tract reported using only the water from the public system. All stated that they used combined methods to access water or relied solely on wells. The types of water access identified were: 19% via the public network and cistern; 4.8% via the public network and well; 4.8% via the public network and bottled water; 4.8% via the public network, well, and bottled water; 14.3% via a community network; 14.3% via the community network and cistern; 9.5% via the community network and well; 4.8% via the community network, well, and bottled water; 9.5% via well only; 4.8% via well and cistern; 9.5% via well and bottled water (Graph 5).

The frequency of treated water supply for the 33.4% of households connected to the public network is as follows: 9.5% once a week; 14.3% twice a week; 4.8% three times a week; 14.3% four to five times a week. For the 43% of households connected to the community network, the frequency is: 4.8% once a week; 4.8% twice a week; 14.3% three times a week; 4.8% four to five times a week; 4.8% every day. The remaining 23.8% of households are not connected to any treated water network (Graph 6).

Graphs 5 and 6 – Water supply sources & Frequency of treated water supply – São Gonçalo/RJ

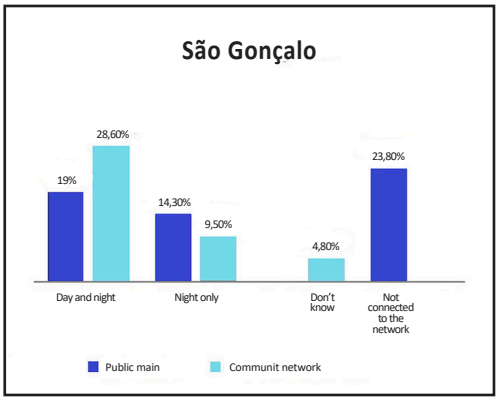


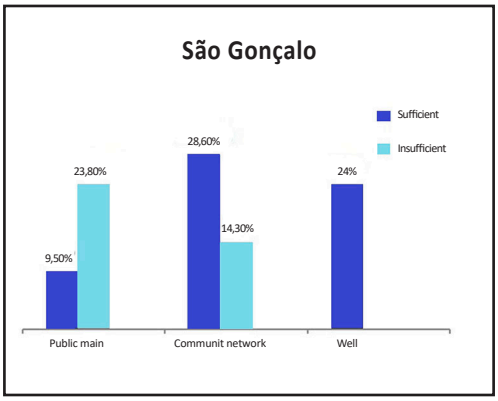


Source: the authors, 2025.

Regarding the water supply period, of the 33.3% of households that reported being connected to the public network, 19% stated that water access occurs throughout the day and night on supply days, while 14.3% reported that it occurs only at night. Among the 42.9% of households connected to the neighborhood community system, 28.6% stated that water access occurs throughout the day and night on supply days; 9.5% reported it occurs only at night; 4.8% did not know; and the remaining 23.8% are not connected to any network (Graph 7). Finally, respondents were also asked whether they considered the water available sufficient for their household needs. Of the 33.3% of households connected to the public network, 9.5% considered it sufficient, while 23.8% considered it insufficient. Among those connected to the community network, 28.6% considered it sufficient, and 14.3% considered it insufficient. Finally, all 23.8% of households supplied exclusively by wells considered the water accessed to be sufficient (Graph 8).

Graphs 7 and 8 – Water supply period & Sufficiency for household demands – São Gonçalo/RJ





Source: the authors, 2025.

Based on the results obtained, it is evident how complex the multiple arrangements for household water access in urban environments can be. Being connected to the public system does not necessarily mean having sufficient water, which undermines the DHAE principle of availability. In Maricá and São Gonçalo, households that have access to water supply via the public system considered the volume insufficient according to the users interviewed. This perception may be the consequence of intermittent weekly supply, particularly in São Gonçalo, where some households receive water only once or twice a week. This insufficiency forces most households in both municipalities to resort to combined methods of accessing water to meet their domestic water demand, such as wells or cisterns.

It is noteworthy that during interviews, most households that reported consuming bottled water related it to "prevention" in the case of well water, or as a "complementary

supply method" when there were prolonged periods without treated water from the public system. The statements of two residents from Maricá illustrate this point: "When I run out of water, I buy about two gallons to drink and cook. But when the water comes properly [according to him, three times a week], it is enough for my household"; "[...] we use well water for outside chores and drink bottled water."

Another point to note relates to the urbanization processes of the municipalities and the expansion of water infrastructure. The surveyed tract of São Gonçalo, in the Laranjal neighborhood, underwent a rapid and unplanned occupation in 1970. Located near the Laranjal Water Treatment Plant (ETA) and the start of the Imunana-Laranjal water mains, it was not initially connected to this system, being integrated only partially through alternative supply lines, mostly built by the residents themselves starting in the late 1970s (Gouveia, 2022). According to interview reports, employees of Companhia Águas do Rio (the current water provider) have been installing water networks and water meters on the alternative networks built by the residents. Thus, in the neighborhood, public networks, community networks, and "formalized" community networks coexist. In contrast, Inoã, in Maricá, maintained its strictly rural characteristics for a long time. Due to its distance from the Imunana-Laranjal system, household water supply relied almost exclusively on wells, with water supply public system installation beginning only in 2014. Therefore, these multiple scenarios for water access in the two municipalities may explain why most users in Maricá, recently connected to the network, considered the treated water sufficient for their domestic needs, while most respondents in São Gonçalo, connected for a longer period, considered it insufficient.

Another important point concerns the various meanings and functions a cistern can assume. While in IBGE Census surveys their role is associated with rainwater storage, in the field research conducted, none of the households with cisterns used them for this purpose. Instead, cisterns were used to store treated water to ensure a sufficient volume between supply interruptions. In most cases, they were responsible for creating the perception of sufficient treated water to meet daily household water needs: "Water comes two or three times a week, but I don't know exactly when because it fills my cistern." However, when the period without water extends, this alternative household storage structure becomes insufficient: "When the water was out for more than five days and the cistern was almost empty, we had to fetch it with buckets because it didn't reach the pump level. I had a lot of back and arm pain [...] it got worse [...] we had to buy water delivered by truck" – a resident of São Gonçalo recounting the worsening of general network supply at the end of 2024.

These reports show how household adaptations to inefficient network services can mask and alter individual perceptions of water sufficiency. Therefore, answering "connected to the public network" in the IBGE Census does not necessarily mean continuous access to treated water, having basic domestic needs met, or being water secure in its multiple dimensions.

Universal access to water and future censuses

From the first IBGE Census to the latest (1960 to 2022), there has been an ongoing effort to more accurately characterize Brazilian households' water supply, evolving from

three initial attributes to eight current ones. Urban public policies aimed at promoting universal access to water rely on Census data to evaluate the current situation and project future scenarios. Examples include Municipal Water and Sanitation Plans; Metropolitan Plans such as the Strategic Plan for Integrated Urban Development of the Rio de Janeiro Metropolitan Region; and regional water and sanitation plans, which have been implemented under Federal Law n. 14,026/2020. These planning instruments, in their methodologies, cannot produce access data as detailed as that provided by the Census. However, household surveys such as the one presented in this article show that in urban environments, spatial location, land use and occupation processes, technological changes, availability of urban infrastructure, socioeconomic inequalities, and governance and service provision changes can create diverse arrangements for accessing treated water and different household realities that the Census does not capture.

Field research demonstrated how inequalities in water access can exist not only between large regions of the country, states, capitals, and peripheries, or urban and rural areas, but also at the intramunicipal level, in the smallest territorial unit: the census tract. The surveyed census tracts, although in different municipalities, belong to the same Metropolitan Region and are connected to the same supply infrastructure. However, the irregularity of treated water supply in the networks, combined with historical socio-spatial factors affecting households, led to distinct individual adaptations to supply shortages. As Paviani (1998) explains, exclusion and impoverishment of portions of the population foster new modalities in the construction of urban space, the so-called urban "micro-territories." Within them, "society itself has the capacity to seek alternatives to the framework created in previous historical moments" (ibid., p. 189).

The information produced highlights how complex and challenging it is to identify inequalities in access to water when official statistical data appear similar across different geographic areas. The issue is not only water scarcity, lack of network connection, and intermittent supply, but also deeper technical and political processes that generate different forms of water access deprivation. Therefore, discussions on advances and limitations in water access in Brazil, service-management models, and planning and contractual instruments aimed at universal access must account for particularities and hidden aspects of exclusion of the Human Right to Water, especially for the most vulnerable. Due to their unique methodology and national coverage, IBGE Censuses are one of the main instruments for achieving this. In this context, the role of Demographic Censuses according to IBGE is emphasized:

> [...] to count the inhabitants of the national territory, identify their characteristics, and reveal how Brazilians live, producing essential information for the definition of public policies and the decision-making of private initiatives or any level of government. They constitute the only reference source on the living conditions of the population in municipalities and their internal divisions, such as districts, neighborhoods, and localities, rural or urban, whose realities depend on these results to be known and to have their data updated (IBGE, 2023, s/p).

Thus, censuses can play a central role in reducing inequalities that remain in the fulfillment of the right to water and citizenship

in Brazil. This study demonstrates that these inequalities not only still exist but also persist despite a legal framework aimed at social advances in current sectoral public policies. As Bichir (2020, p. 8) highlights, the "failures in public policy implementation are influenced by multiple factors, particularly the daily operation of the state and the relationships between its agents and the public served." Therefore, it is urgent to produce means to foster robust debates involving the processes of implementation, mitigation, or reinforcement of existing inequalities (ibid.). As Jannuzzi (2017) points out, as the universalization of urban infrastructure services progresses, investigations regarding the quality and regularity of services provided become a permanent necessity. Consequently, the collection and assessment of social indicators regarding access to infrastructure and safe water supply represent basic and indispensable inputs for the sector. These processes should be continuous, not exhausted as coverage by networks increases.

In this regard, an approach that could be adopted in Census surveys, already used by the PNAD Contínua and by this research, is the investigation of the frequency/availability and sufficiency of water supply. The PNAD provides not only data on the number of households with piped water connected to the distribution network, but also information indicating whether the service is available daily, one to three times per week, or four to six times per week. Additionally, it records whether it is necessary to store water in reservoirs such as water tanks or cisterns. These indicators are of utmost relevance to framing water access as a human right and are aligned with normative guidelines established by the UN. However, it should be noted that the statistical data collected by PNAD cannot replace the Census, as it is based on a sample and therefore does not cover all households. Furthermore, there is a rotation of surveyed households, so those selected for one sample will not be included in future samples of the following survey. Consequently, limitations include the non-coverage of all households, which may obscure existing inequalities in small territorial areas, as demonstrated by this research, and the lack of temporal comparability of the services provided to the same household or even within the same area.

Although it is not the objective of the present study, given the systemic intermittencies observed in the two surveyed sectors and overlooked by the official figures from the 2022 IBGE Census, it is worth questioning how efficient – or even favorable - the new governance model for water supply services established by Law n. 14,026/2020 may be in promoting universal access. The New Sanitation Framework introduces several provisions that favor private service provision, which was adopted throughout the Rio de Janeiro Metropolitan Region (RMRJ) in 2021. Service contracts used IBGE Census access data as a reference, without considering qualitative aspects, such as the frequency of supply. The targets to be met also do not take this aspect into account, focusing essentially on the expansion of household connections to the network, or the number of service units, based on operational data. It is therefore possible to meet contractual targets without fulfilling the universal access prescribed by the Human Right to Water. The findings presented here allow us to speculate that transferring the responsibility for ensuring essential life-sustaining services, dignity, and human rights to private management may be risky. Conflicting interests between "guaranteeing rights vs. generating profits" could compromise the achievement of universal access by 2033, particularly for socioeconomically vulnerable groups.

The historical survey of the attributes used to characterize water access in Brazil, conducted in this study, demonstrated an evolution in the IBGE's understanding of the complexity of such access across the various scales of a continental country like ours. However, field research revealed that there is still a need to improve the characterization of household water access. It is well known that including additional items in Census surveys entails financial costs. Seeking to reduce expenses, the Ministry of Economy under President Jair Bolsonaro requested a reduction in the basic questionnaire for the 2022 Census. The Ministry's stance regarding the Census culminated in indignation and the resignation of Institute managers as a form of protest. Therefore, how future governments produce information on social progress in access to infrastructure and treated water services in the country will reflect their real intentions regarding democratization, the reduction of inequalities, and social justice. In this regard, the sooner improvements in public data collection on household water supply are implemented, the sooner comparability of results can be ensured and the real advances toward universal access for all can be analyzed.

Concluding remarks

This study aimed to characterize the role of the IBGE Demographic Census in the formulation of public policies and the planning of sanitation services. It also sought to highlight the Census and its statistical data collection methodology as instruments to advance universal access to treated water, according to the principles of the human right to water. The results indicated that, despite advances in data production regarding forms of household water supply, the attributes used by the 2022 Census are still insufficient to capture the water (in)security of the various social groups and geographic areas that make up the country.

Field research revealed that being connected to the general network does not necessarily imply effective access to water with regularity, sufficiency, and security. Therefore, connection to the network does not prevent households from seeking alternative water sources – some considered inadequate – to supplement basic domestic water needs. Thus, the IBGE item identifying households connected to the general network, often used as the sole reference for planning, may obscure systemic intermittencies and supply failures caused by inefficient water services. In this context, it is worth highlighting the scenario experienced in Brazil following the liberalization of the sanitation sector under Law n. 14,026/2020, and the increasing shift of water and sewage services toward private management. Corporations driven by profit may not prioritize effective access to treated water, especially for poorer users, where financial returns are not always guaranteed. Situations of precarious access tend to be masked by the network connection indicator, as evidenced by the field research conducted in São Gonçalo and Maricá.

Therefore, the revision and inclusion of new attributes for characterizing household water supply – such as supply frequency and sufficiency – will allow not only for depicting the expansion of sanitation in terms of the number of serviced households but also for capturing the genuine social progress in access to treated water and the exercise of full citizenship.

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