Special section - Water, Sanitation and SDGs in Brazil: challenges, contradictions and governance
Vol. 62, p. 941-959, jul./dez. 2023. DOI: 10.5380/dma.v62i0.89502 e-ISSN 2176-9109

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DeMA DESENVOLVIMENTO E MEIO AMBIENTE
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SDG 6 indicators: importance and methodological differences in first measurements

Indicadores do ODS 6: importância e divergências metodológicas nas primeiras medições

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Article received on January 23, 2023, final version accepted on May 18, 2023, published on November 10, 2023.

ABSTRACT: This article addresses the methodology adopted by the United Nations to calculate the indicators for the sixth Sustainable Development Goal (SDG 6: Drinking water and sanitation) and the results for Brazil. The focus is on target 6.1 and indicator 6.1.1, which address the provision of safe water for all. The main databases available in Brazil and a descriptive and interdisciplinary approach to the subject are used. We present weaknesses in the calculation parameters and available data and emphasize his importance in translating local and regional realities in line with national laws and regulatory acts. Differences were observed between the results presented by different entities responsible for indicator 6.1.1, leaving doubts about its contribution to guide policies aimed at universalizing services. Regarding other indicators, such as participatory governance and integrated management, they are based heavily on processes and not on practical results, being insufficient in the case of developing countries like Brazil. New indicators are suggested for SDG 6, in addition to the 11 currently measured, to cover all directives present in its eight goals.

Keywords: water; management; monitoring; Sustainable Development Goals.

RESUMO: O artigo aborda a metodologia para cálculo dos indicadores adotada pela Organização das Nações Unidas para o sexto Objetivo de Desenvolvimento Sustentável (ODS 6: Água potável e saneamento) e resultados para

o Brasil. O foco é a meta 6.1 e o indicador 6.1.1, que tratam do abastecimento de água segura para todos. São utilizadas as principais bases de dados disponíveis no Brasil e uma abordagem descritiva e interdisciplinar do tema. Ao apresentar fragilidades nos parâmetros de cálculo e nos dados disponíveis, o texto ressalta a importância de que eles traduzam realidades locais e regionais em sintonia com as leis e os atos regulatórios nacionais. Foram observadas divergências entre os resultados apresentados por entidades responsáveis distintas para o indicador 6.1.1, restando dúvidas sobre sua contribuição para orientar políticas tendo em vista a universalização dos serviços. Sobre outros indicadores, como os de governança participativa e gestão integrada, são baseados fortemente em processos e não em resultados práticos, sendo insuficientes no caso de países em desenvolvimento como o Brasil. São sugeridos novos indicadores para o ODS 6, além dos 11 atualmente medidos, de modo a cobrir todas as diretivas presentes nas suas oito metas.

Palavras-chave: água; gestão; monitoramento; Objetivos de Desenvolvimento Sustentável.

1. Introduction

The joint monitoring of goals and indicators is an inseparable issue in the context of the Sustainable Development Goals (SDGs). The option adopted in the UN 2030 Agenda, which is anchored in goals in the form of guidelines, makes it essential that the indicators complement them and, in the case of SDG 6 (water and sanitation), that they provide answers as to whether or not each of its eight goals has been achieved. Among the challenges are the difficulties in producing reliable data and information (Santos & Kuwajima, 2020; ANA, 2019 and 2022) on water supply and quality, sewage, pollution, participatory management and governance, investments, research, among other sub-themes.

The importance of producing good SDG indicators also lies in supporting the monitoring of goals and related public policies, such as the universalization of basic sanitation services and integrated water management. Indicators that express comparisons with national laws and strengthen them are relevant. In addition, the indicators encourage debates in management bodies, strengthen social actors in participatory spaces, promote changes in behavior, and reveal bottlenecks and conflicts. In certain situations, they feed into other agreements, as well as actions by control bodies (comptroller's offices, courts of auditors) and those promoting justice (Public Ministry).

There is, however, a naturally generalist and even ambiguous content to the SDG goals and indicators (Dye 2018; Swain, 2018; Scherer *et al.,* 2018). This is understandable given that the 2030 Agenda is the result of an agreement between 193 countries, which have enormous differences, difficulties, challenges, and interests. Therefore, the creation and improvement of SDG indicators is a requirement, as indicated by the UN itself (United Nations, 2015), with a focus on increasing the capacity to express different local realities within countries.

In Brazil, the goals and indicators of SDG 6 can foster a series of actions by entities involved in water governance, strengthening non-market civil organizations. Santos *et al*. (2018) and Santos & Kuwajima (2019) emphasize that the indicators must be faithful to the goals, in line with the provisions of national laws. The law that deals with water and basic sanitation in the country reflects this need, including providing for production systems, platforms

for organizing and disseminating data, monitoring and evaluation, highlighting:

i) Law 9.433/1997, which creates the National Water Resources Information System - SNIRH;

ii) Laws 11.445/2007 and 14.026/2020, which structure the National Sanitation Information System (SNIS) of the Ministry of Cities, which propose interfaces between SNIRH and SNIS.

In this context, the aim of this article is to address key concepts and definitions about SDG 6 indicators, with a focus on goal 6.1, which deals with water supply with a view to universalization of services. The question that motivates the text is the assumption that the SDG indicators should portray the realities to which the goals refer.

The text is divided into 4 sections, in addition to this introduction. Section 2 presents the proposed methodology, followed by a discussion of the literature on the subject in section 3. Section 4 presents the results of the research on SDG 6 indicators, with a focus on data on water supply in Brazil. Finally, section 5 points out other considerations on improving indicators in the context of the SDGs and national laws.

2. Methodology

The article presents a bibliographical survey followed by a descriptive analysis of water supply indicators in the context of SDG 6 in the Brazilian reality. Data is used from the SNIS, the Brazilian Institute of Geography and Statistics (IBGE) and the National Sanitation Plan (Plansab) in its 2017-2019 revision (Brazil, 2019a). It is also based on recent studies on rural sanitation (Brasil, 2019b) and coverage data, prioritizing the goals of SDG 6 (Santos & Kuwajima, 2019; Kuwajima *et al*., 2020).

The content researched involves:

i) the structure and process of monitoring by UN entities;

ii) comparisons of Brazilian and global data for the SDGs;

iii) comparison of data to verify the evolution of target 6.1 and indicator 6.1.1 on the level of water supply based on UN, ANA and IBGE data.

As this is secondary and short-term data, aggregated for the country scale, it is limited to exploratory and descriptive analysis of concepts and data. The data for indicator 6.1 from these three institutions (UN, ANA and IBGE) is therefore analyzed at the national level. At the UF scale, only ANA and IBGE information is used, as there is no UN data for this section.

The text also provides a description of the data and the situation of indicator 6.1.1 at the Federation Unit (FU) level. Finally, a discussion was held on the indicators for water supply, sewage disposal and water resource management, in order to highlight the need for new indicators, according to an interdisciplinary approach on the subject. Data is used from 2015, when the 2030 Agenda begins, with the option of not using extrapolations for previous years, due to a lack of data that may not reflect changes in water and sanitation systems.

3. Sustainability indicators and SDG 6: a brief discussion

Following the understanding of Tunstall (1994), Hammond *et al.* (1995) and Gallopin (1997), sustainability indicators must have attributes that are necessary and representative of measures of events and situations. They are also planning, management and control tools and their dissemination is fundamental for the balance of information between social actors, especially in complex governance issues such as the environment, water, and sanitation. In the context of the SDGs, which dialogue with national laws and various public policies, it can be added that indicators are essential elements that help create, execute, and coordinate projects, actions and programs.

The functions of indicators, their attributes, limits, and definitions, according to Tunstall (1992, 1994) and Gallopín (1997) encompass, as Van Bellen (2004) summarizes, the attributions of: "assessing conditions and trends; comparing places and situations; assessing conditions and trends of goals and objectives; providing warning information; anticipating future scenarios and trends." (Van Bellen, 2004, p.5). Other functions in the context of public sustainability policies, according to Hammond *et al*. (1995), Gallopín (1997) and Van Bellen (2004) are: analytical, by allowing groupings and the creation of synthetic indices; communication to scholars and decision-makers; assistance in setting and evaluating goals; and alert and mobilization to assist managers.

The production of indicators that comply with these and other legal provisions will also allow control and promotion of justice bodies to act with greater precision in mitigating conflicts and monitoring the obligations of public and private sector's agents in the area, especially service regulatory agencies, basin committees and other collegiate bodies. In turn, the planning bodies, financing agents and society will have better structured information and analysis, allowing for allocations that promote universalization and quality of services.

3.1. Structure for calculating SDG indicators according to UN methodology

The methodologies for calculating the UN indicators for SDG 6 were released by UN-Water and the *United Nations Statistics Division* (UNSD). The definitions and metadata are collected and made available by the UN-recognized agencies in the *Inter-agency and Expert Group on SDG Indicators* (Iaegi)[1], of which, in South America, only the IBGE has been a member since 2016. AUN-Water coordinates the efforts of UN entities - the *World Health Organization* (WHO) and the *United Nations Children's Fund* (UNICEF) - and international organizations in matters related to water and sanitation. In Brazil, the indicators are calculated based on the definitions and protocols established within this UN framework, according to ANA (2019; 2022) and the IBGE's SDG Brazil Platform.

To define the initial set of indicators, the UN adopted a series of revisions between 2015 and 2017, a classification that reflects the difficulties

[1] The full methodological definitions, metadata and data already calculated for the UN indicators can be found at: https://unstats.un.org/sdgs. The data for Brazil can be seen at: https://odsbrasil.gov.br/.

of establishing consensus on the choice of agreed indicators. The difficulty all countries have in generating data is at the heart of the existing gaps. In the case of countries like Brazil, which have a reasonable data collection and dissemination structure, it is important to use indicators in addition to those of the UN as a factor in inducing and supporting public policies.

According to the UN agencies, when there is a consensus on the indicator to achieve each goal, with its methodology defined and data[2] available, calculations are made for all countries. As the 2030 Agenda is an agreement between 193 countries (which negotiate concepts and definitions), many of which have difficulties producing data, one possible consequence is that the results of the global indicators are not very significant locally. Therefore, it is essential to define subnational indicators.

In Brazil, the calculation of the indicators is coordinated by the IBGE, which, in the case of SDG 6, has the support of the National Water and Basic Sanitation Agency (ANA), as well as data and information from the Ministries (especially the Ministry of Health, Cities and the Ministry of the Environment). However, the creation/adaptation of indicators still depends on consensus and deliberations between a variety of users and social actors involved (Santos & Kuwajima, 2019). In the case of the indicators that measure goals 6.1 and 6.2, on human water supply and sanitation, respectively, the data is produced by service providers (public and private) and municipalities, reported to SNIS, as well as by the National Household Sample Survey (PNAD and PNAD Continuous).

Despite the difficulties mentioned, both the UN and Brazil have made indicator results available for the SDGs as a whole, prompting authorities to produce or organize data and reflect on the results. In the case of SDG 6, however, there are only 11 indicators with methodology, consensus, and data available. Santos & Kuwajima (2019) argue that a total of 29 indicators are needed to cover the set of definitions, concepts and parameters set out in the eight goals of SDG 6. There are also challenges regarding the lack of data, its quality and inconsistencies between the 5,570 Brazilian municipalities. The following subsection provides definitions and details of this understanding.

3.2. SDG 6 indicator for safe water supply: definitions and limitations

The UN bodies' original conception of indicators for the SDGs brings the idea of measuring processes more strongly than impacts - especially in the cases of management and governance. This option of measuring processes can be more effective in countries where there is greater consolidation of environmental, water management and sanitation legislation and which have solid institutions and strengthened collegiate bodies. However, this solidity has not been the case in countries like Brazil or in Latin America; for example, in Brazil both the SDGs and the entire system of management and

[2] Na metodologia da ONU os indicadores são classificados em três Tier ou níveis. Tier I (Nível I) é a situação em que o indicador é conceitualmente claro, tem metodologia e padrões internacionalmente estabelecidos e os dados são produzidos regularmente para pelo menos 50% dos países e população em todas as regiões onde o indicador é relevante; Tier II (Nível II) segue o nível I, porém os dados não são produzidos regularmente; e Tier III (Nível III) não há metodologia ou padrões estabelecidos internacionalmente (não medido).

governance in the environment and water resources were disfigured in 2019 by simple acts (decrees) of the executive branch.

The Brazilian government began implementing the SDGs in 2018, by adjusting the goals of the 17 Goals (IPEA, 2018; ANA 2019; Santos & Kuwajima, 2020). Then, it carried out calculations of global indicators, creating the ODS Brazil platform, by the Brazilian Institute of Geography and Statistics (IBGE). However, it did not advance in the creation of new indicators that better express realities with greater demand for public policies. Specifically on SDG 6, the National Water Agency (ANA, 2019) presented a first contribution to the topic, pointing out limitations of the UN methodology, resumed in 2022. Santos & Kuwajima (2019) point out the need to build new indicators, in order to more comprehensively cover the content of the eight goals of the SDG.

In the case of SDG 6 "Ensure the availability and sustainable management of water and sanitation for all" (United Nations, 2015), this text analyzes the data for the first goal, originally expressed in the international agreement as "6.1 By 2030, achieve universal and equitable access to safe and potable water for all". In adapting the goals to the Brazilian reality (IPEA, 2018), this goal 6.1 was "By 2030, achieve universal and equitable access to water for human consumption, safe and accessible for all", making the text closer to the norm in force in Brazil, which is more complete and more precise than the UN definition. The replacement of the term "potable" by "safe" complies with national legislation and the placement of the term "all", which asks for an indicator (to be built), is due to the important relationship between water and gender in the 2030 Agenda, which also awaits the definition of specific indicator. Currently, the indicator used for this goal is the same as that of the UN, as Brazil has not adopted internal indicators for the SDGs, adopting indicator 6.1.1 "Proportion of population using safely managed drinking water services" (IPEA, 2018).

In the texts of the goals, some terms whose definitions are essential for the choice of indicators (Santos & Kuwajima, 2019) are highlighted, so that they are able to describe and allow the monitoring of the achievement of what is proposed. The following key concepts obtained from the consolidation of the goals of SDG 6 (Working Group - WG), in Ipea (2018) and in the Glossary of SDG 6 (UN-BR, 2018) are highlighted:

i) Safe water "It's the water that has microbiological, physical, chemical and radioactive parameters and respective limits that ensure that its consumption does not pose health risks" (UN Committee on Economic, Social and Cultural Rights - CESCR). (ONU-BR, 2018, p. 20).

ii) Water for personal or domestic consumption "[...] must be free of micro-organisms, chemical substances and radiological risks that constitute a threat to the person's health. In addition, it must be of acceptable color, odor, and taste." (ONU-BR, 2018, p. 19).

iii) Affordable water for all "Implies that payment for services does not prevent people from having their basic needs met and promoting their quality of life". (ONU-BR, 2018; Ipea, 2018, p. 161). It relates to the average income of families, according to their country and political-territorial subdivisions (ONU-BR, 2018).

iv) Universal and equitable access to water "It's about ensuring that access to water is provided for everyone, regardless of their social, economic or

cultural status, gender or ethnicity. This concept is in line with the notion of access to water as a human right" (ONU-BR, 2018, p. 15).

In addition to these concepts, other terms, routinely used as synonyms for them, are important for understanding the indicators. The terms allow the framing of solutions and services such as: drinking water, water potability standard, sanitation and hygiene (ONU-BR, 2018).

Comparing the definitions and indicators adopted by Brazil, the adjustments in goal 6.1 actually made the term more specific and challenging. This is due to the fact that Brazilian legislation provides for a more demanding standard of water for human consumption than that set out in the original version of the UN. However, the indicators did not follow the same path, since the UN standards are still adopted in the country. For example, although the term "safe water", adopted in the adequacy of the goals for Brazil instead of "safely managed" (United Nations, 2015), in goal 6.1, is more precise than the latter, from the UN, the indicator continues to be the one dealing with "drinking water", which is less demanding in terms of quality. The accessibility component (availability and affordable price) does not yet have a clear and consensual indicator in the debate.

Thus, in view of the definitions presented, the challenge remains to analyze the data already produced on SDG 6 and point out gaps and solutions. It starts with the definitions and concepts contained in the goals, observing the coherence or otherwise of their respective indicators. Another challenge is to identify the extent to which the SDG indicators help move towards universal access to services, in terms of water quality, regularity and safety, according to the definition adopted in Brazil (Ordinance 594/2020 – Ministry of Health).

4. Current situation and the need for new SDG 6 indicators

The UN agencies and the countries that adhered to the 2030 Agenda have published results of the SDG 6 indicators for which there is already an internationally defined methodology and data available (Tier *I* , in the definition of the entity). According to the parameters of the United Nations, Brazil is positioned comfortably in relation to the group of countries, both in terms of access to water (potable, safe or improved) and the degree of implementation of integrated management of water resources and cross-border management (Sachs *et al.*, 2019; 2022). With 97.9% of water safely managed, in 2021, the country is close to universalization, in the urban environment, as also evidenced by Plansab (Brasil, 2019a; Santos *et al*., 2020).

However, sanitary sewage, the *deficit* in rural sanitation, quality problems and intermittence put the country in an international lag (Brasil, 2019a and 2019b; Kuwajima *et al.*, 2020). The following subsections present data from the exploratory analysis carried out, highlighting the uncertainties about the effectiveness of the indicators to reveal the real, local, and regional difficulties of the countries.

4.1. Partial results of indicators according to UN parameters

The monitoring of SDG 6 at the international level has reinforced the lack of access to safe water and sewage facilities, which, added to shortages,

floods, and precarious management, hinders social and economic development. Based on information with data from 2015 and 2020, compiled in the Secretary General's report to the United Nations Economic and Social Council (United Nations, 2022), it appears that the global population with safely managed sanitation increased from 47% to 54% and the population with access to facilities for washing hands with soap and water at home increased from 67% to 71%.

The United Nations report (United Nations, 2022) pointed out that about 2 billion people did not use safe drinking water services (i.e., 26% of the global population). In 2021 there were 2.8 billion people lacking a basic level of sanitary sewage and 494 million people continued to practice open defecation, even with an improvement in this indicator between 2015 and 2020. The report shows that, if the goals are not achieved by 2030, 829,000 people will die each year from diseases related to improper water, inadequate sanitation, and bad hygiene practices.

When observing the global indicators brought by the Panel of Indicators of the SDGs (Sachs *et al*., 2022; United Nations, 2022), Brazil appeared in 53rd place, among 163 countries in the index. The fifth highest score in the composition of the country's indicator is SDG 6, which in 2021 reached 87.1%, in the measure disseminated by the UN (Figure 1).

The panel also points out that 99.3% of the population has access to water in urban areas (indicator 6.1.1), without going into aspects of quality and regularity. Along with this cut, the process indicators (which measure or estimate institutional, norms and infrastructure convergences) determined a high score for Brazil, in the whole of SDG 6 (87.1%), while the result indicators, mainly of sanitary sewage, present lower values. In previous years, this panel presented even more favorable results for SDG 6 (Sachs *et al.* 2019; 2022), indicating weaknesses in its design or measurement.

Regarding management, an issue that is inseparable from water and sewage services, in the case of Brazil, data from the IAEG-SDG (United Nations, 2022; Sachs *et al*., 2022) point out that water stress – defined as the relationship between abstraction of fresh water and the total of renewable resources – was above 70% at the global level, in 2019, which indicates a strong probability of future water scarcity at levels higher than the current ones. In the 153 countries that share cross-border waters, several conflicts show the urgency of shared and integrated management, which can only be achieved through interaction between local actors and States. In 15 of these countries, withdrawals amount to more than 100% of the renewable volumes of fresh water, a situation that does not yet occur in Latin America.

Data from the IAEG-SDG platform indicate that the average percentage of cross-border basins, across the Planet, with an operational agreement was 59% according to the 2017-2018 data and only 17 countries reported that all their border basins were covered by such operating arrangements. Thus, when observing the realities of each indicator, it must be considered that the UN methodology is still insufficient to reflect the status of the goals, as they are quite comprehensive and daring.

Furthermore, the methodology developed by the UN agencies, although it indicates the importance of capturing regional and local data, still does not consider, for example, more demanding standards of water quality and the degree of sewage

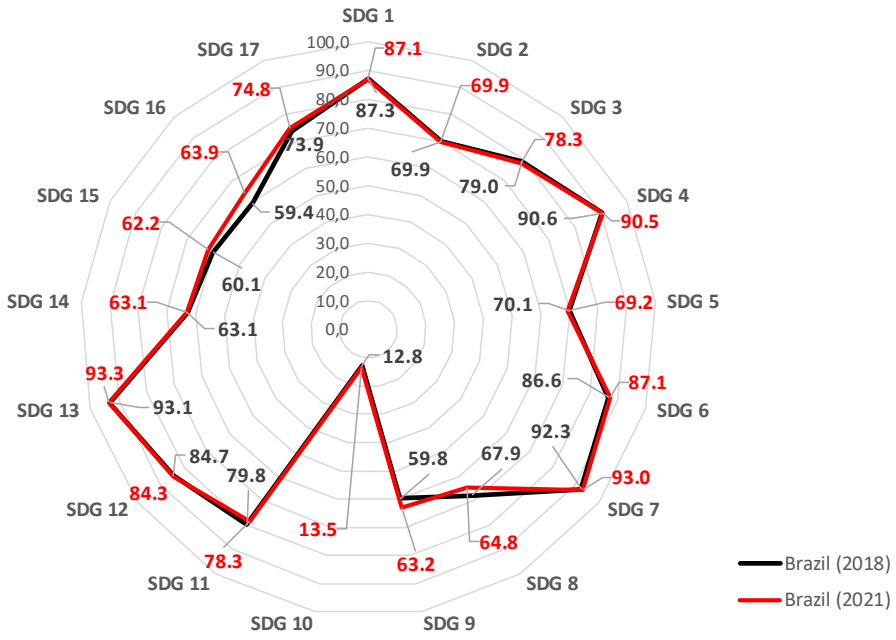

FIGURE 1 – Average performance of Brazil in the SDG Panel (Sustainable Development Goals).
SOURCE: Sachs *et al*. (2022), adapted by the authors.

treatment. Therefore, national legislation is more indicated as a guideline in the preparation of national and regional indicators, as it is more advanced than the text of the agreement around the SDGs.

4.2. Partial results of SDG 6 indicators in Brazil

In Brazil, monitoring systems for sanitation and water management services have important tools and bases, albeit with inconsistencies (Santos *et al* . 2018; Santos & Kuwajima, 2019)[3] . As already mentioned, the instruments for monitoring and disseminating information provided for in Law no. 11,445/2007 (amended by Law no. 14,026/2020), which establishes the National Sanitation Information System (SNIS), Plansab and Municipal Sanitation Plans, as well as Law no. 9,433/1997, which establishes the National System of Information on Water Resources (SNIRH), the granting, classification of water resources and other instruments, are the main references for monitoring the evolution of the goals of SDG 6.

Important steps have been taken in this context, for example: from the ANA monitoring reports on water resources; improvements to the SNIS and

[3] The entirety of expert contributions heard in the seminars dealt with by Santos *et al.* (2018) is available at: https://www.youtube.com/watch?-v=Sliyhr_T4g0&feature=youtu.be.

SNIRH platforms; initiatives such as the "Acertar" program (training and support for the production and registration of municipal sanitation information) of the National Sanitation Secretariat (SNS)/ Ministry of Cities. Also relevant, within the scope of academia and partnerships with civil society actors, is the expansion of initiatives of governance observatories and monitoring of sanitation and water resources.

The production of indicators from the point of view of these actors, mainly at the local level, can encourage debate and lead to advances in public policies. Therefore, such movements, their articulations and institutions are part of the positive results of the 2030 Agenda, being observed within the scope of SDG 6. The effects of this movement can be studied in the future, with a view to characterizing a possible strengthening of governance based on the Agenda.

In the specific case of monitoring SDG 6 and national laws on the subject, a complex challenge remains to be overcome: the lack of methodological standardization in the calculation of indicators, which leads to a plurality of metrics for the indicators. Along these lines, we highlight the difficulties of measuring just one of the 11 indicators already calculated for this SDG. This is indicator 6.1.1 "Proportion of population with safely managed drinking water services", which is the main one referring to goal 6.1 (achieve universal and equitable access to safe drinking water for all). Table 1 presents the indicator values, according to the UN methodology, also with calculations from other institutions.

The values referring to the SNIS are not directly referred to as equivalent to indicator 6.1.1, however, they are total water service indices (Indicator 055 of the SNIS). In any case, the set of data presented in Table 1 shows a great difference between the values. The UN metrics are close to the values calculated in the SNIS, being lower than the values calculated by the ANA and IBGE, which more strictly follow the guidelines of the UN itself for the calculation of SDG 6. Both ANA and IBGE add up the alternative sources of water in rural areas, approaching the local reality in terms of coverage of services, but without data on interruptions and water quality.

In view of the importance of these metrics, not only for monitoring the 2030 Agenda but also for formulating public policies towards universalization, the question arises: which of these indicators is closest to Brazil's reality, that is, to what extent is the Brazilian population, in fact, safely served?

ANA (2019; 2022) presents, in addition to calculating the indicators, a critical analysis of the importance of developing SDG 6 indicators, as disseminated by the UN, but highlighting limitations and difficulties of reliable data. In fact, what draws attention in the indicators obtained by the UN parameters is the high rate of water supply service, in relation to Plansab data, due to the difference between the methodologies. The lack of data from the rural environment (Brasil, 2019b; Santos & Santana, 2020) and the absence or inaccuracy of information from guardians are factors that contribute to this.

Table 2 presents data for the years 2015 to 2019, according to ANA and IBGE measures. The divergences observed between the metrics for the national level are also evident in the data on the Federative Units for indicator 6.1.1 values, however with much closer values than those measured by the SNIS and those disseminated by the UN - which water supply systems, that is, the urban environment.

In a personal communication made with ANA specialists, during the preparation of this article, part

TABLE 1 – Indicator 6.1.1 – Safely managed water supply – Brazil.

Year	Values disclosed by entities (in %)			
	ONU	ANA	IBGE	MDR
(SNIS)	82,0	95,1		83,3
2015	82.0	95.1		83.3
2016	82.7	97.0	97.9	83.3
2017	83.5	96.9	97.9	83.5
2018	84.3	97.2	98.2	83.6
2019	85.1	97.4		83.7
2020	85.8	-		84.1

NOTE: Data from the Ministry of Regional Development (MDR) are restricted to urban areas.

SOURCE: elaborated by the authors with data from the Platform ODS Brazil/IBGE, SNIS/Ministry of Regional Development, ANA (2022) and PNAD Contínua/IBGE.

of the differences found between the IBGE and ANA data were questioned and clarified, which are due, in short, to changes and absence of data in the methodological transition of the PNAD for the Continuous PNAD, between 2015 and 2018. As the teams work together, the differences tend to disappear for this indicator, when a joint methodology is adopted. In fact, the numbers in Table 2 show convergence in the results (with a maximum of 6 percentage points, in the state of Acre in 2017); At the same time, this data sends the message that:

i) Brazil is in a comfortable situation, for the purposes of SDG 6.1, water supply;

ii) that this metric does little to encourage universalization actions.

It is important to highlight, as shown by the data in the last column of Table 2, that the greatest advances in terms of coverage of water services (indicator 6.1.1) occurred in the states with the greatest deficits, that is, in the North regions (except Rondônia) and Northeast, with emphasis on the states of Amapá, Acre and Maranhão. The difference observed between the values obtained for the indicator calculated by ANA and IBGE is in the hundredths; however, it is higher in the states of the North and Northeast, despite the advances made in recent years. In this regard, there is confirmation of data from recent studies (Brasil, 2019a; Kuwajima *et al*., 2020). The states whose SDG goal 6.1 data show the smallest discrepancy are in the South and Southeast regions, as they have a high level of water supply.

In addition to service coverage, data on water quality, intermittency and adequacy of treatment processes can point to priorities for these poorer regions (Brasil, 2019a; Brasil, 2019b; Kuwajima *et al.,* 2020). On this point, information from Sisagua greatly exceeds the measurement of the indicator on

TABLE 2 – Results available for Indicator 6.1.1 for the state profile.

	Indicator 6.1.1 per entity								
STATE	**ANA 2015**	**ANA 2016**	**IBGE 2016**	**ANA 2017**	**IBGE 2017**	**ANA 2018**	**IBGE 2018**	**ANA 2019**	**Evolution 2015-2019**
Acre	0.79	0.86	0.91	0.84	0.90	0.88	0.92	0.90	13.92%
Alagoas	0.87	0.91	0.95	0.90	0.94	0.90	0.95	0.92	5.75%
Amazonas	0.88	0.91	0.95	0.92	0.95	0.92	0.95	0.90	2.27%
Amapá	0.88	0.95	0.96	0.98	0.97	0.96	0.97	0.98	11.36%
Bahia	0.91	0.95	0.96	0.94	0.96	0.95	0.97	0.96	5.49%
Ceará	0.88	0.91	0.94	0.92	0.95	0.93	0.96	0.94	6.82%
Federal District	0.99	0.99	1.00	1.00	0.99	1.00	1.00	1.00	1.01%
Espírito Santo	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01%
Goiás	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01%
Maranhão	0.77	0.89	0.93	0.90	0.94	0.91	0.94	0.91	18.18%
Minas Gerais	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01%
Mato Grosso do Sul	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01%
Mato Grosso	0.98	0.99	0.99	1.00	0.99	0.99	0.99	1.00	2.04%
Pará	0.86	0.91	0.94	0.89	0.93	0.92	0.95	0.90	4.65%
Paraíba	0.91	0.89	0.92	0.87	0.92	0.89	0.93	0.91	0.00%
Pernambuco	0.88	0.91	0.94	0.9	0.94	0.90	0.94	0.92	4.55%
Piauí	0.88	0.91	0.95	0.92	0.95	0.94	0.97	0.95	7.95%
Paraná	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00%
Rio de Janeiro	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	2.04%
Rio Grande do Norte	0.93	0.94	0.97	0.94	0.97	0.95	0.97	0.95	2.15%
Rondônia	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.00%
Roraima	0.93	0.99	0.99	0.98	0.99	0.98	0.98	0.97	4.30%
Rio Grande do Sul	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00%
Santa Catarina	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01%
Sergipe	0.91	0.94	0.96	0.94	0.96	0.94	0.96	0.94	3.30%
São Paulo	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01%
Tocantins	0.95	0.97	0.98	0.98	0.98	0.98	0.98	0.98	3.16%

SOURCE: elaborated by the authors with data from the Platform ODS Brazil/IBGE, ANA (2022) and PNAD Contínua/IBGE.

screen, either in the number of variables monitored or in terms of analysis methodology (Oliveira Júnior *et al.* 2019). Although the national parameters are regulated by an act of the Executive branch (Ordinance 594/2020 of the Ministry of Health), leading authors to argue that it becomes law, the monitoring system of the Ministry of Health with companies has evolved continuously.

Thus, the continuity of joint work between IBGE, ANA and the Ministry of Health is essential for comprehensive and more accurate monitoring of this indicator, based on national parameters and standards. The dissemination of this data should be the basis of actions and policies in the country, with greater dissemination, in a complementary way to Plansab, with a view to universal access to quality water. Such a directive does not ignore the importance of isolated systems, of individual solutions, and yes, it points the way for necessary advances in coverage, quality, and regularity. In turn, the data for this indicator 6.1.1 of SDG 6, at the stage they are at, should only serve for the generation of reports within the UN and for comparisons of access to water in basic conditions. However, the entity has disclosed other values, as seen, making our measurements, which precisely follow the parameters established by it, become meaningless and useless.

4.3. Notes on other SDG 6 goals and indicators

In addition to indicator 6.1.1, referring to goal 6.1, analyzed in the previous sections, it is equally important that studies observe the other indicators, of the other goals, given the interconnected nature of the subtopics addressed in SDG 6. Although the space here is not enough, some notes in this regard and notes for studies and debates that follow on this theme fit.

Goal 6.2 "By 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation, with particular attention to the needs of women and girls and those in vulnerable situations" and the indicator "6.2.1 Percentage of population using safe sanitary facilities" were kept unchanged for Brazil (Ipea, 2018). The indicators "6.2a – Proportion of the population using safely managed sanitation services" and "6.2b – Proportion of the population using facilities for washing hands with soap and water" were also adopted by the IBGE and ANA. established later by the UN.

These indicators seek to show coverage of sanitary sewage and hygiene conditions. Initially, the IBGE adopted the PNAD and the Continuous PNAD as a source of data, given the limitations already pointed out for the SNIS, which also applies to urban areas in this case. The limitations of both can be seen in the texts by Brasil (2019a), Santos & Kuwajima (2019) and ANA (2019 and 2022). It remains to measure, annually, the access to hygiene equipment, mainly in the cases of children and girls, as well as to discriminate the access and quality of water and sanitation in rural schools. In specific situations, solutions for sewage collection include acceptable solutions such as septic tanks – in rural dwellings, mainly. However, this fact leads to inconsistent results, since both in urban and rural areas, the safety of alternative systems/solutions is not known.

Indicators already produced for goals 6.3 (improve water quality, reduce pollution and hazardous chemicals, and increase reuse) and 6.4 (promote water use efficiency in all sectors, with sustainable

withdrawals and address the scarcity) are incomplete. Even with important results for starting monitoring (ANA, 2019; 2022), with calculations by river basins and by productive sectors, the indicators already available do not cover the entire content of these goals. Indicators (at the international and national levels) still do not provide consistent criteria for measuring impacts on most water bodies that receive sewage; they also do not cover aspects of service quality, interruptions and dangerous products released into the water, such as pesticides. The continuous production and dissemination of data on industrial, mining and farming activities, in addition to domestic sewage, are therefore a necessity and a challenge to respond to goals 6.3 and 6.4.

To monitor goal 6.5 (integrated management of water resources, including cross-border ones) two indicators are calculated. The methodology used (ANA, 2019) starts from a score based on favorable ambience, institutional base, financing, and management instruments, based on a questionnaire with the responsible bodies. The results, for a scale from zero to 100, point to indicator 6.5.1 (Degree of implementation of integrated water resources management): 44.2 in 2010; 47.3 in 2013; and 53.8 in 2016. Therefore, the evolution of the indicator is important, despite its limitations in terms of significance and scope. In the other indicator of goal 6.5 (indicator 6.5.2 - Proportion of cross-border river basin areas covered by an operational agreement for water cooperation), data identified by ANA (2019) indicated that 72.7% of the basins have treaties, since 2010, a trajectory that started in 1969 (with 17.4%), but with concrete actions, although with little impact, starting in the 1990s (Brasil, 2013), when agreements were reached in 63.6% of the bordering basins with neighboring countries.

To measure goal 6.6, the indicator 6.6.1 is calculated, which deals with "change in the extent of water-related ecosystems over time". The calculation uses three sub-components: changes in the extent of aquatic ecosystems (in %); changes in water quality (in %); and changes in the amount of water (in %). The results, obtained for the years 2010, 2011, 2013, 2014 and 2015, show significant variation (both positive and negative signs), mainly for the Amazon, São Francisco, East Atlantic and South Atlantic hydrographic regions.

It is important to emphasize the difficulty of monitoring the indicator of goal 6a. Defined as "6.a.1 – Amount of official development assistance in the area of water and sanitation, included in a government expenditure plan", there is no systematized data or even a conceptual interpretation. The effort carried out in ANA (2019) identified allocations from the water and sewage, hydroelectric, agriculture, water management, flood control and prevention and administrative sectors, at amounts close to 235 million dollars, in the ANA annual average (2022).

Finally, goal indicator 6b (6.b.1. "Local administrative units with established and operational policies and procedures for the participation of local communities in water and sanitation management") brings only the quantitative aspect related to the participation of local communities for water and sanitation. The UN indicator refers to processes and would be interesting if there were guarantees that, once created and operational, the actions of the responsible units converged with their purposes and guidelines. The need for progress in this regard remains clear, in the Brazilian case, since only the South and Southeast regions reached 50% of units

with policies and instruments to promote local participation (ANA, 2019).

4.4. Next steps for improving SDG 6 indicators

Improving the production and availability of data for monitoring systems continues to be essential to increase reliability and help decision-making. The case of goal 6.1 and its indicator for water supply is illustrative of existing gaps, which extends to the other goals and indicators, as seen above. In addition, many municipalities in Brazil suffer from water shortages during droughts and severe droughts, especially in the semi-arid region of the Northeast, with rationing situations and frequent interruptions that deserve specific monitoring.

In terms of sanitary sewage, data from the Continuous PNAD of 2019 allow an estimate of around four million people without regular access to a toilet in Brazil, including open defecation, which is an indicator provided for in SDG 6 that must be adopted in the country in each UF.

Furthermore, the fact that the goals of SDG 6 are quite comprehensive and have several propositions considered ambitious (Santos & Kuwajima, 2019) requires an increase in the number of indicators in relation to what has already been obtained within the scope of UN institutions. The 11 SDG indicators that have already been measured do not cover the nearly 30 propositions or concepts that make up the set of its eight goals. In this sense, Santos & Kuwajima (2019) present suggestions for new indicators, on the occasion of the SDG baseline Brazil report. In addition to the conceptions present in the literature about indicators and sustainability, the authors used the contributions obtained from specialists and managers between 2018 and 2019 (Santos *et al.*, 2018). Table 3 exposes the proposal initially presented in Santos & Kuwajima (2019), with modifications and limited to indicators referring to goals 6.1 and 6.2, which are intrinsically related. The concept that guides the suggestions is to have an indicator for each sentence or concept contained in the goals, allowing the monitoring of the whole.

It should be noted that several of the indicators proposed or to be improved depend on information for which Brazil already has collection and organization mechanisms; for others, still without reliable data, the country has technical capacity for production and dissemination. It should be noted that part of the indicators (current and new) are indices, following what the UN does, while others are dismemberments of the current ones, already measured. The new indicators also seek to meet the forecast of the rules in force in Brazil.

As with goals 6.1 and 6.2, there is a need for new indicators, as well as the improvement and detailing of the current ones for the Brazilian reality in goals 6.3, 6.4, 6.5, 6.6. 6a and 6b, as raised in Santos & Kuwajima (2019). Although this topic is not discussed in depth in this article, it is worth pointing out issues to be observed in subsequent works, here restricting themselves to the goals that refer to water resources within SDG 6:

i) improve the definition and calculation of the proportion of freshwater withdrawals in relation to the total ecologically available volume or flow (modeling estimates of future demand with ecologically sustainable withdrawals), in indicator 6.4.1;

ii) improve indicator 6.4.2, on water stress or risk of shortages by municipality, water body and hydrographic basin;

iii) measure the volume of water captured and sewage discharged, as well as the level of efficiency in the use of water in production (considering sectorial parameters, diversities and guiding aspects of trajectories, including reuse);

iv) record the number of people who suffer from occasional and chronic shortages of water used for supply.

Likewise, issues of governance and community and social participation deserve equal or greater attention, both in decision-making structures and in indicators referring to the goals that deal with the subject, as provided for in SDG 6 and in national laws on the environment, water, sanitation, urban policies, city, infrastructure, and production systems. On all these fronts, the calculation of indicators, on an ongoing basis, depends on the consistent production of data, as previously discussed.

It is important to highlight the need to obtain reliable and periodically updated data, mainly regarding depletion and the stage of degradation/classification of water bodies. According to Brasil (2019a), there appears in the records (PNAD and SNIS) a large set of self-declared information or information obtained through sampling (also with self-declaration in the field), whether provided by sanitation companies or by interviewees. In the same vein, it is essential to measure or improve:

i) measurement of flows extracted by individuals and legal entities in large quantities;

ii) information on water quality, on the types of treatment systems that must be improved;

iii) data on grants (capturing and releasing) of water by productive units, including in rural areas, and the respective productive sectors.

TABLE 3 – Need for indicators for the Brazilian reality – goals 6.1 and 6.2.

Goal	Current indicator	Proposal	Indicator needed for SDG 6
6.1	6.1.1	New	Percentage of the population using safe water for human consumption (quality defined in a standard by the Ministry of Health). Indicator 6.1.1a. Breakdown by vulnerable population
6.1	6.1.2	New	Equity index of access to safe drinking water (percentage of access according to price and by income group)
6.1	6.1.3	New	Percentage of monthly time with uninterrupted supply and in accordance with national quality and availability standards
6.2	6.2.1	Breakdown of the current one	Percentage of population using safe toilets and handwashing facilities with water and soap - breakdown by urban and rural areas (Indicators 6.2.1a and 6.2.1b)
6.2	6.2.2	New	Percentage of women and girls using safe sanitary facilities – follow the text of goal 6.2, detailing the indicator

FONTE: Santos & Kuwajima (2019), com acréscimos e adaptações.

The movement towards improving such information and indicators must be coordinated nationally, for example, by the ANA in partnerships with state governments, city halls and the productive sector. The generation of periodical reports on the achievement of goals should include these issues, to overcome the inconsistencies observed in the UN methodology. In the set of SDGs, and not just SDG 6, such reports can even guide the possibility of generating bonuses for access to policies in general, reduction of liabilities, tax exemptions, induction of pro-sustainability behavior, attracting private investment and asset valuation. The measurement of agreed indicators can be promoted, for example, as occurs within the scope of the Consolidation Program of the National Pact for Water Management (Progestion - MMA/ANA), including interfederative transfers of resources and support to states and municipalities less structured to comply sustainability agendas.

5. Final considerations

This text discussed the SDG indicators, based on UN methodologies, highlighting the importance and potential of producing and disseminating information on the subject, based on consistent data. These data and indicators were treated as essential to support implementation, monitoring and evaluation systems of public policies related to SDG 6, focusing in greater depth on goal 6.2, which deals with water supply. Initial data already produced in Brazil and in other countries and their limitations were presented.

It was highlighted that the monitoring of goals and indicators, as well as national and local policies and laws related to the theme are the key factor in achieving the SDGs. The achievement of good results for the SDG 6 indicators is due to the standardization carried out by the UN, which differs from other data presented in Brazil, both with gaps. Differences in local realities in aspects such as the material conditions of access to water in rural areas, the availability of services by number of hours of the day and weeks, the quality of the water, the prices of services in view of social vulnerability are also not considered.

It is important to develop new indicators for the other dimensions of basic sanitation, whether they are rainwater drainage, collection, and treatment of solid waste, in addition to complementing existing ones, as pointed out in the text. With this, institutions will be able to disseminate meaningful and consistent information about all water uses, sewage releases, pollution by hazardous chemical substances, conflicts, participatory governance, integrated management, and outreach to minorities and people in vulnerable situations. Indicators of integrated management and participatory water governance, for example, are largely based on processes and not on practical results, which tends to be more reliable in rich countries, whose information and compliance with rules are at a more advanced stage. In countries like Brazil, where power and access imbalances are a reality, it is necessary that the indicators are aligned with the entire content of the legal provisions. As seen, in Brazil, the legislation on water resources management and on basic sanitation converge with the goals of SDG 6, so it is necessary to improve the indicators.

The central challenge in this regard, which presupposes the efforts of public and private agents, is the requirement for institutions to work together,

sharing data, information and responsibilities that can be translated into indicators. The parallel step, of equal importance, is the monitoring of public policies and the actions of the sector, in each of the eight goals of the SDG. There is a need to go beyond the replication of aggregated indicators, whether of processes or results, paying attention to the regional, state and municipal scope, in order to make SDG 6 an opportunity for city halls, states and the Union, in addition to the concessionaires, including when seeking resources for the universalization of sanitation.

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