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Assessment of Data Availability and Quality in SINISA Based on a Sanitation Deficit Index in Minas Gerais, Brazil

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Abstract: This study analyses the availability and quality of information in the National Basic Sanitation Information System (SINISA), using the state of Minas Gerais as a case study. The analysis is based on the Basic Sanitation Deficit Index (IDESB), developed by the João Pinheiro Foundation (FJP), using data from 2017 to 2021. The IDESB serves as a management tool for monitoring deficiencies in sanitation services, focusing on water supply, sewage collection and treatment, solid waste disposal, and stormwater management. The study reveals that 58.3% of municipalities in Minas Gerais present either insufficient or inconsistent data, compromising public policy planning. The results indicate significant information gaps particularly in smaller municipalities, and highlight the need for improved data collection, verification, and capacity building at the local level. Recommendations include restructuring the State Sanitation Information System (SEIS) with updated technologies, respondent training, and cross-validation mechanisms. Reliable data is critical to achieve the universalization goals outlined in the National Basic Sanitation Plan.

Key words: sanitation deficit index, data quality, National Basic Sanitation Information System (SINISA), basic sanitation services, Minas Gerais

1. Introduction

The proper planning of policies and services related to the basic needs of the population directly depends on urban planning and management that perceive the city as a habitat encompassing multiple realities in the same space. The existence of an unequal income distribution, which favours those with greater social mobility at the expense of the majority, is just one variable in the complex urban fabric.

It is essential to understand urban problems and the specific needs of each area to design interventions and actions that will universalize access to essential services and ensure minimally dignified living conditions for all.

But how does the public administrator understand the city? How can one identify where the greatest pressures and needs lie? And finally, how can one assess whether they are on the right track toward improving the population's quality of life?

In the field of public policies and services, there has been investment in developing planning tools at municipal, regional, and national levels. These tools aim to foster a more inclusive planning and management process across all levels. Examples include the Master Plan, the Municipal Basic Sanitation Plan, the Municipal Integrated Solid Waste Management Plan, and the Watershed Management Plan, among others. It is important to emphasize that such planning must include public participation throughout all its phases — from conception and implementation to ongoing monitoring — through the creation of forums or councils that give voice to community demands.

The planning and management of these instruments must be conducted continuously, aiming to assess the effectiveness of programs and proposed actions. To do

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this, monitoring must be able to indicate whether the path taken is correct and whether population demands are being met. One of the main supports for this monitoring process is the use of data associated with the implementation of public policies and actions.

Thus, the use of data, indicators, and indices serves as the foundation for planning and operational improvements of various policies and related public services, such as basic sanitation services in municipalities. According to Pereira et al. (2018) [1, 2], these services play a critical role in improving public health and contributing to local and regional socioeconomic and environmental development. Moreover, when used in diagnostics, these data can help identify scientific and technological development needs in the sector and inform planning, pointing to goals and objectives for future projects while considering socioeconomic concerns and environmental protection.

Therefore, intensive use of information is essential to understand the impact of public policies. In the case of basic sanitation services, it is necessary to understand the real conditions of access and service quality to assess their effects on health and quality of life. Without high-quality data, it becomes an arduous and imprecise task to promote socio-environmental development and universal access to these services.

Accordingly, this study aims first to review the history of sanitation-related data and information in Minas Gerais and assess the status of the main existing information system in the field — namely, the National Basic Sanitation Information System (SINISA)[4-8], which succeeded the former National Sanitation Information System (SNIS), discontinued in 2023. The paper will examine the advantages and challenges of SINISA and then focus on data from Minas Gerais to assess the current state, quality, and inconsistencies in sanitation data for the state.

The discussion of these topics was based on documentary research using online and published materials related to SINISA, as well as an analysis of the underlying database, particularly for the state of Minas Gerais. This analysis involved building a dataset with SINISA information [8] and calculating the index proposed by the João Pinheiro Foundation (FJP), the Basic Sanitation Deficit Index (IDESB) [9-14], for the years 2017 through 2021. Descriptive statistics were used to assess the availability of information — its existence and consistency across the studied years — and the possibility of inconsistencies in the time series. The choice of this period corresponds to the availability of data on urban stormwater drainage and management, whose historical series begins in 2017.

It is important to highlight that although SINISA is an invaluable database for the basic sanitation sector, like any information and knowledge tool, it must be continually analyzed, improved, and updated.

2. Material and Methods

To assess the availability of data regarding municipal realities across the four dimensions of sanitation — public water supply, sanitary sewage, solid waste management, and urban stormwater drainage and management — data were retrieved from the SINISA database for calculating the deficit in each IDESB dimension for the years 2017 to 2021 [8].

Once collected, the municipalities were classified in terms of information availability, based on the existence and consistency of data over time. The following categories were applied:

- Desirable: Information on the deficit for each dimension was available, and the IDESB was calculated for all years in the study (2017 to 2021).
- Unsatisfactory: Information on the deficit for each dimension was available for three or four years, and the IDESB was calculated for the available years.
- Unfeasible: Information on the deficit for each dimension was available for two years or fewer.

To analyse data inconsistencies in SINISA, this study utilized the data from 2017 to 2021 and the corresponding IDESB calculations for the following indicators: deficit in water supply, deficit in sewage collection, deficit in sewage treatment, deficit in proper disposal of urban solid waste, and deficit in stormwater drainage and management.

In this inconsistency analysis, potential discrepancies and errors in the IDESB data and its components were examined across the 853 municipalities of Minas Gerais. Municipalities with at least three available data points between 2017 and 2021 were selected for analysis. Fig. 1 illustrates the classification used:

- No information: No IDESB calculation available.
- No inconsistency: No identifiable contradiction, error, or discrepancy given the available data (2 to 5 data points).
- Potential inconsistency detected.

Municipal code	Municipality	Sanitation Territories	IDESB Values					Normalized IDESB values					Classification
			2017	2018	2019	2020	2021	2017	2018	2019	2020	2021	
310010	Abadia dos Dourados	Rio Paranaíba	-	41,95	-	-	-	-	0,000				No Information
310020	Abaeté	São Francisco Alto Médio	-	-	-	50,24	50,02	-	-	-	0,707	-0,707	No inconsistency
310030	Abre Campo	Rio Doce	28,41	-	28,04	28,39	34,69	-0,459	-	-0,575	-0,464	1,498	Potential inconsistency detected
310040	Acaiaca	Rio Doce	44,24	43,39	43,78	43,78	29,29	0,515	0,384	0,444	0,444	-1,787	Potential inconsistency detected
310050	Açucena	Rio Doce	-	-	-	53,80	27,74	-	-	-	0,707	-0,707	Potencial inconsistency detected
310060	Água Boa	Rio Doce	25,51	26,74	19,42	31,92	-	-0,076	0,164	-1,261	1,173		Potential inconsistency detected
310070	Água Comprida	Rio Grande	13,61	0,00	0,00	0,00	0,00	1,789	-0,447	-0,447	-0,447	-0,447	Potencial inconsistency detected
310080	Aguanil	Rio Grande	45,58	42,07	16,30	15,79	21,72	1,199	0,955	-0,832	-0,867	-0,456	Potential inconsistency detected
310090	Águas Formosas	Jequitinhonha	-	50,69	52,26	50,48	51,40	-	-0,645	1,306	-0,906	0,245	No inconsistency
310100	Águas Vermelhas	São Francisco Médio Baixo	32,25	-	-	32,13	32,22	0,793	-	-	-1,123	0,330	No inconsistency
310110	Almorés	Rio Doce	8,78	11,65	11,35	11,28	10,58	-1,684	0,797	0,538	0,473	-0,125	Potential inconsistency detected
310120	Aluruoca	Rio Grande	26,51	27,54	16,12	15,67	17,23	1,001	1,176	-0,762	-0,839	-0,575	Potential inconsistency detected
310780	Bom Jesus do Galho	Rio Doce			40,68	15,33				0,707	-0,707		Potencial inconsistency detected

Fig. 1 Example of analysis criteria used to detect potential inconsistencies in Basic Sanitation Deficit Index data (2017-2021) [8].

In addition, some municipalities with only two data points showing strong signs of inconsistency were also included.

To understand the relationship between the service providers and the inconsistencies in the data, municipalities showing potential inconsistencies were analysed based on the SINISA database (2024) [8] and supplemental data gathered from online sources, including the website of the Regulatory Agency for Water Supply and Sanitary Sewage Services of the State of Minas Gerais – Arsae/MG [15]. Additionally, data from municipal websites, local councils, and river

basin committees were reviewed due to the frequent discrepancies observed regarding the designated service providers in the SNIS/SINISA database.

To improve the accuracy of the analysis, information was also gathered from Arsae-MG reports [15], news sources, and available municipal sanitation plans to verify the actual service provider in each municipality.

3. Basic Sanitation Deficit Index (IDESB)

Basic sanitation services are critically important for ensuring quality of life. These services are considered essential because they aim to preserve environmental conditions, prevent diseases, and improve public health, while also enhancing labour productivity, which supports everyday economic activity. According to Law No. 10,257/2001 (City Statute) [16], Article 2, ensuring a dignified and equitable life for all in urban areas is directly linked to the provision of adequate basic sanitation for current and future generations.

Furthermore, Goal 6 of the United Nations Sustainable Development Goals (SDGs) [17] sets the target to "ensure availability and sustainable management of water and sanitation for all," thereby affirming sanitation as a fundamental human right.

With this in mind, a synthetic index was developed using deficit data for each service, measured against the goals defined in the National Basic Sanitation Plan (Plansab) [18]. The creation of this index has two main objectives:

1) To assess the consequences of deficiencies in water supply, wastewater treatment, solid waste management services, and stormwater drainage and management. across sanitation territories.
2) To visualize the challenges in achieving universal access to these services.

This index is intended to provide a simple and direct tool to assist in decision-making and in the formulation of public policies that respond to the population's needs in basic sanitation [9-14].

The formula used to calculate the index is as follows:

$$IDESB_{municipality} = [(DA * pe_1) + (DCE * pe_2) + (DTE * pe_3) + (DRSU * pe_4) + (DDR * pe_5)]$$

Where:

- IDESB municipality: Basic Sanitation Deficit Index
- DA: Deficit in public water supply
- DCE: Deficit in sewage collection
- DTE: Deficit in sewage treatment
- DRSU: Deficit in proper urban solid waste disposal
- DDR: Deficit in urban stormwater drainage
- pi: Specific weight of each sub-index (i = 1,...,5)

The overall index, called the Basic Sanitation Deficit Index (IDESB), is the sum of the products of each sub-index and its corresponding weight.

The variables used in the IDESB calculation are defined as follows:

- Deficit in Public Water Supply (DA): Based on National Basic Sanitation Information System (SINISA) indicator IN-023 [8], which measures the proportion of the urban population served by water supply relative to the total urban population, and how far this proportion is from the Plansab target for 2033.
- Sewage Collection Deficit (DCE): Based on SINISA indicator IN-015 [8], which reflects the ratio between the volume of sewage collected in the urban network and the difference between the volume of water consumed and the volume treated outside the system, and how far this ratio is from the 2033 Plansab target.
- Sewage Treatment Deficit (DTE): Based on SINISA indicator IN-046 [8], representing the proportion of sewage treated (both locally and externally) compared to the volume of water consumed, and the gap between this ratio and the 2033 Plansab target.
- Urban Solid Waste Disposal Deficit (DRSU):n Based on SINISA indicators UP007 (annual

volume of household and public waste received at processing facilities) and UP003 (type of processing facility used) [8], this deficit measures the share of waste that is improperly disposed (e.g., open dumps, rivers, streams, lakes) relative to total urban waste production, compared to Plansab targets.

- Stormwater Drainage Deficit (DDR): Based on SINISA indicator IN-040 [8], which measures the number of urban households at risk of flooding relative to the total number of urban households, and how far this figure is from the 2033 Plansab target.

To improve balance in the final index, specific weights were assigned to each sub-index. Recognizing the importance of sanitation services — and the fact that wastewater management is already represented by two subcomponents (collection and treatment) — the following weights were adopted [9-11]:

- Public water supply – weight: 0.25
- Wastewater management:
  - Sewage collection – weight: 0.10
  - Sewage treatment – weight: 0.15
- Solid waste management – weight: 0.25
- Urban stormwater drainage – weight: 0.25

As implied by the formula, the closer the IDESB value is to zero, the closer the municipality is to universalizing sanitation services. Conversely, values approaching 100 indicate a worse situation in terms of service provision.

It is important to note that the IDESB was calculated only for municipalities with data available for all five sub-indices. Municipalities lacking one or more sub-indices were classified as "No Information".

4. Results and Discussion

Regarding the availability of data on municipal conditions, the analysis of the 2017-2021 dataset (Table 1) revealed that in 41.5% of all municipalities in Minas Gerais, it was not possible to calculate the IDESB due to the absence of data in one or more of its components. These municipalities were therefore classified as unfeasible.

Table 1 Degree of municipal data availability on basic sanitation – Minas Gerais (2017-2021) [8].

IDESB Index and Indicators	Degree of municipal data availability on basic sanitation						
	Desirable (All years)	Percentage (%)	Unsatisfactory (Up to two years without data)	Percentage (%)	Unfeasible (3 to 5 years without data)	Percentage (%)	Total
IDESB In de x	231	27.1%	268	31.4%	354	41.5%	853
Water supply deficit indicator		89.4%	56	6.6%	34	4.0%	853
Sewage collection deficit indicator		55.1%	184	21.6	199	23.3%	853
Sewage treatment deficit	470	55.1%	183	21.5%	200	23.4%	853
Urban solid waste final disposal deficit indicator	500	58.6%	212	24.9%	141	16.5%	853
Deficit of households not at flood risk indicator	397	46.0%	285	33.4%	176	20.6%	853

When examining the specific indicators that make up the IDESB — public water supply, sewage collection, sewage treatment, solid waste disposal, and stormwater drainage — it became evident that sewage collection and treatment indicators were most impacted by data unavailability. During the analysed period, 23.3% of municipalities lacked information on sewage collection, and 23.4% failed to report on sewage treatment. These municipalities were thus deemed unfeasible for IDESB calculation. Only 27.1% of municipalities had complete data for all years, enabling the calculation of all IDESB components and were accordingly classified as desirable.

In terms of data availability:

- 89.4% of municipalities had information on the water supply deficit,
- 58.6% had data on the solid waste disposal deficit, and
- 55.1% had data on both sewage collection and treatment deficits.

Within the unsatisfactory category, excluding water supply (6.6%), the other deficit indicators ranged from 21% to 34% in terms of incomplete data across years.

When data was stratified by municipal population size (up to 10,000 inhabitants and above 10,000), Tables 2 and 3 showed that most municipalities in Minas Gerais (482 or 56.5%) have populations under 10,000.

Table 2 Degree of municipal data availability on basic sanitation – Minas Gerais (2017-2021) [8].

Number of municipalities/Percentage [%]	Municipalities with populations up to 10,000 inhabitants			
	Degree of availability of information about the municipal situation — IDESB			
	Desirable	Unsatisfactory	Unfeasible	Total
Number of municipalities	108	119	255	482
Percentage [%]	22.4%	24.7%	52.9%	100.0%
Percentage in relation to the state of Minas Gerais (%)	12.7%	14.0%	29.9%	56.5%

Table 3 Degree of municipal data availability on basic sanitation – Minas Gerais (2017-2021) [8].

Number of municipalities/Percentage (%)	Municipalities with populations up to 10,000 inhabitants			
	Degree of availability of information about the municipal situation — IDESB			
	Desirable	Unsatisfactory	Unfeasible	Total
Number of municipalities	123	149	99	371
Percentage (%)	33.2%	40.2%	26.7%	100.0%
Percentage in relation to the state of Minas Gerais (%)	14.4%	17.5%	11.6%	43.5%

Notably, the unfeasible data availability class was more prevalent among smaller municipalities (255 municipalities or 29.9% of the state's total), representing 41.5% of all municipalities. This suggests a correlation between smaller population size and lower data availability. Conversely, within the unsatisfactory category, a higher number of municipalities had populations above 10,000 (149 municipalities, 55.6%).

In terms of service providers, SINISA data showed that public companies (Minas Gerais Sanitation Company — COPASA and/or COPASA Integrated Sanitation Services of North and Northeast Minas Gerais — COPANOR) were the primary providers for water supply, followed by municipal governments and autonomous water and sewage services (SAAEs). Private companies were few. Municipalities without provider information were found only among those with fewer than 10,000 inhabitants.

Regarding sewage services, in smaller municipalities, municipal governments played the leading role, although public companies had increased presence (101 municipalities with public companies, 250 with municipal governments, 17 with SAAEs). In larger municipalities, public companies led (166 municipalities), followed by municipal governments (126) and SAAEs (48).

For water supply, the unfeasible class was most prevalent among public company providers (282 municipalities, 33.1% of the total), which is concerning given their dominant presence. For sewage, municipal governments had the highest share in the unfeasible category (146 municipalities, 17.1%).

In the solid waste and stormwater drainage categories, municipal governments were also the main service providers in the unfeasible class:

- Solid waste: 302 municipalities (35.6%).

- Stormwater drainage: 279 municipalities (32.7%).

Despite these services being primarily managed by municipalities, the lack of data is alarming — especially given growing demand, recent natural disasters, and increased public awareness and pressure.

One likely explanation for this lack of information, whether in small or large municipalities, is the shortage of qualified human resources and physical infrastructure for planning and managing sanitation services — especially those under municipal responsibility such as sewage, solid waste, and stormwater drainage. These services often show the highest rates of missing or unfeasible data.

When using sanitation territories, as defined in the Minas Gerais State Basic Sanitation Plan (PESB-MG) [19-21], and the IDESB calculations from 2017-2021 (Table 4), it was observed that:

- The São Francisco Médio Baixo territory had the highest percentage of unfeasible municipalities (68.0%), followed by Paraíba do Sul (48.5%) and Jequitinhonha (46.3%).

Conversely, the Rio Grande territory had the highest proportion of municipalities in the desirable class (33.5%), followed by Rio Paranaíba (30.4%).

Table 4 Degree of municipal data availability on basic sanitation – Minas Gerais (2017–2021) [8].

Sanitation territory	Number of municipalities	Degree of availability of information about the municipal situation: IDESB					
		Desirable	Percentage of municipalities in relation to the territory (%)	Unsatisfactory	Percentage of municipalities in relation to the territory (%)	Unfeasible	Percentage of municipalities in relation to the territory (%)
Jequitinhonha	67	16	23.9%	20	29.9%	31	46.3%
São Francisco Médio Baing	97	18	18.6%	13	13.4%	66	68.0%
Paraiba do Sul	101	223	22.8%	29	28.7%	49	48.5%
Rio Doce	221	57	25.8%	77	34.8%	87	39.4%
Rio Grande	182	61	33.5%	59	32.4%	62	34.1%
Rio Paranaiba	46	14	30.4%	14	30.4%	18	39.1%
Sie Francisco Alto Medio	139	4242	30.2%	56	40.3%	41	29.5%
Total	853	231		268		354	

(1) There may be more than one indicator generating inconsistency per municipality.

Another key question is: Are the data in the SINISA database reliable? For effective decision-making and analysis, the data must be both consistent and trustworthy.

After a preliminary data review, municipalities were classified by the number of available IDESB data points (Fig. 3):

- 127 municipalities (14.9%) had no IDESB data.
- 111 had data for only one year.
- 116 for two years.
- 107 for three years.
- 161 for four years.
- 231 (27.1%) for all five years (classified as desirable).

Overall, 42.9% of municipalities had extremely limited data (two years or fewer), 30.4% had incomplete information, and only 27.1% were in the desirable range.

However, the reliability and quality of the available data must also be considered.

In a deeper analysis, 259 out of 372 municipalities showed signs of inconsistency. The IDESB component indicators likely responsible for these inconsistencies were analysed (Fig. 4), noting that more than one component could contribute per municipality.

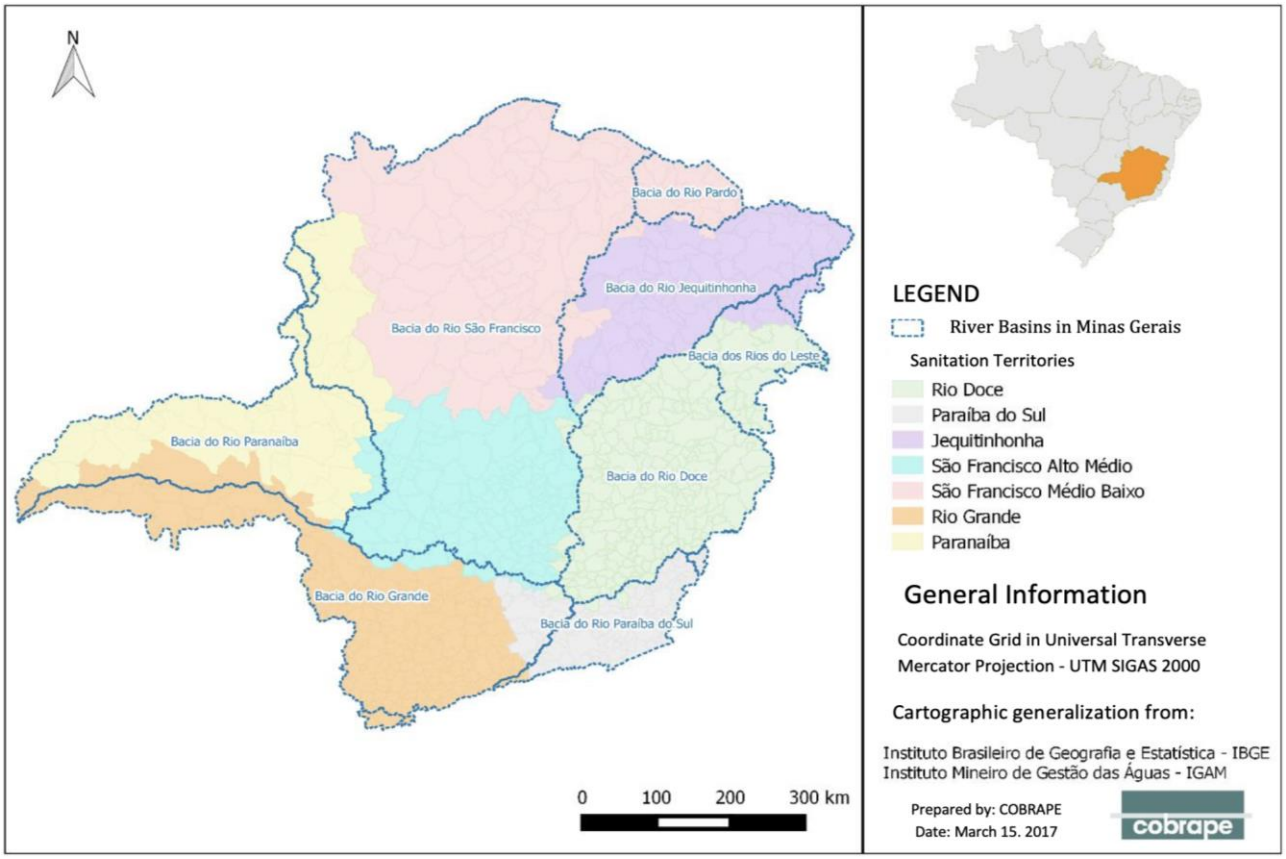

Fig. 2 Sanitation territories and boundaries of the state's watersheds [19].

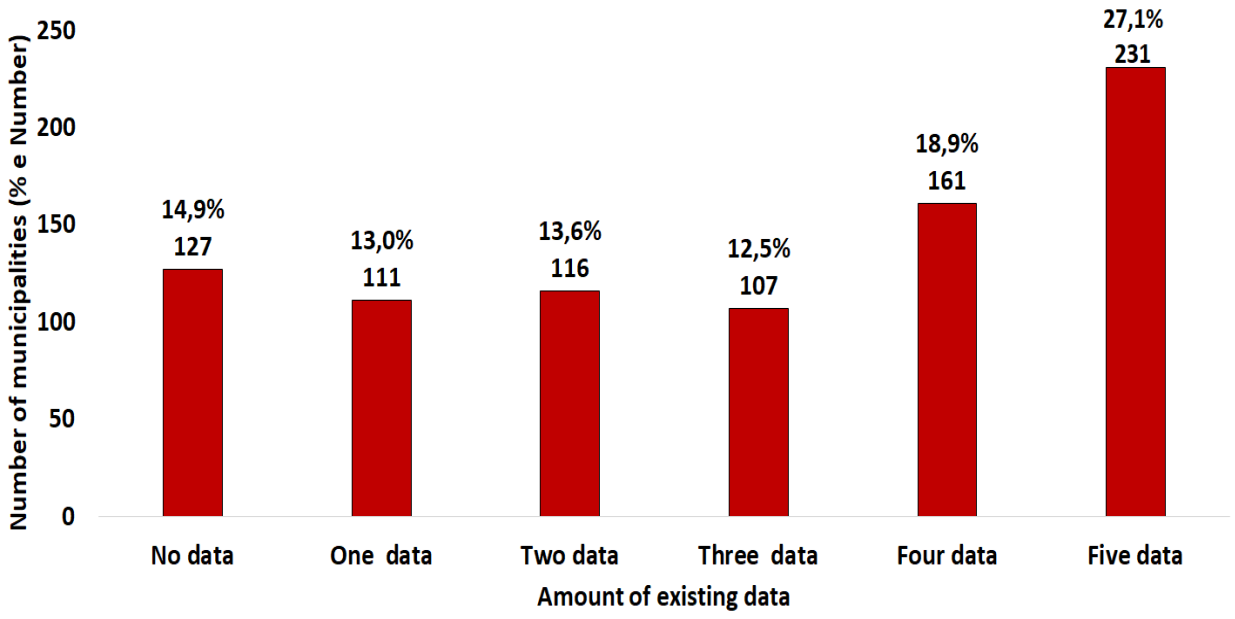

Fig. 3 Number of IDESB data points per municipality (2017–2021) [8].

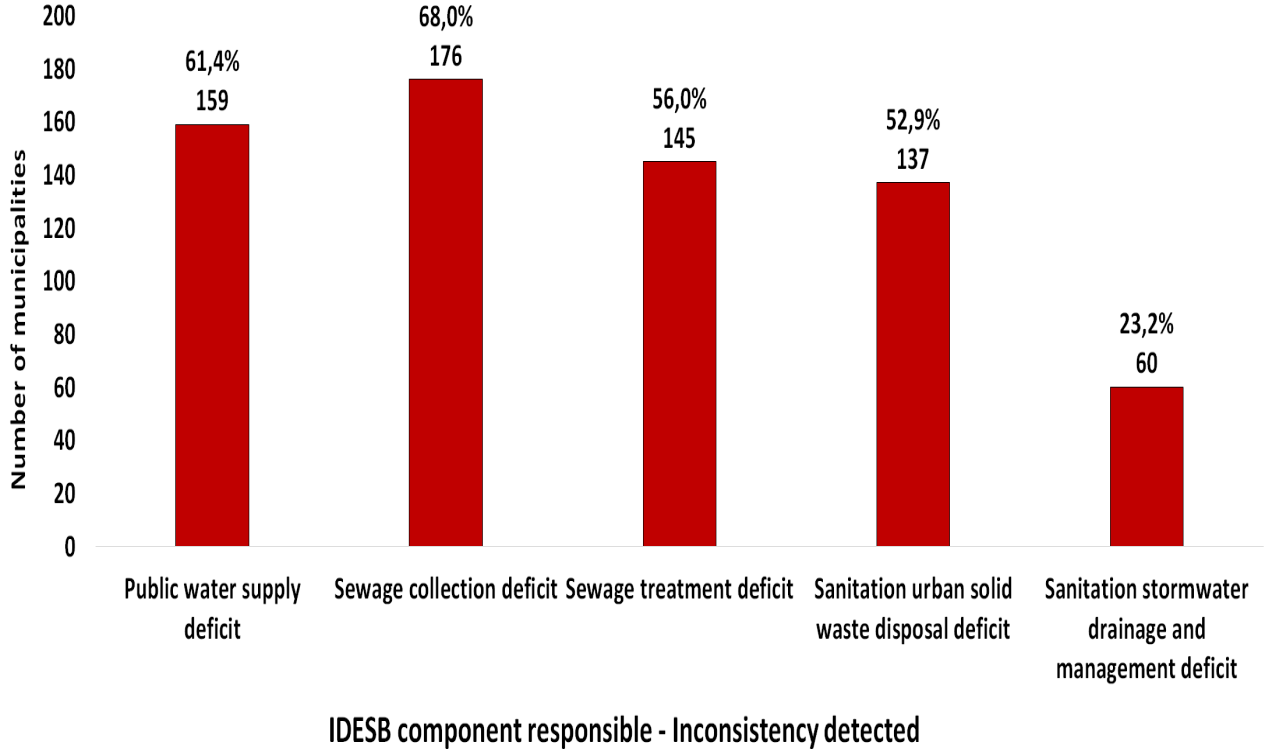

Fig. 4 IDESB indicator(s) likely responsible for inconsistencies per municipality (2017-2021) [8].

Results showed that nearly all indicators contributed to inconsistencies in over 50% of municipalities, except for stormwater drainage, which affected only 23.2% (60 of 259 municipalities).

Key contributors to inconsistencies:

- Sewage collection: 176 municipalities (68.0%).
- Water supply: 159 municipalities (61.4%).
- Sewage treatment: 145 municipalities (56.0%).

Looking at inconsistencies by territory (Table 5):

- The Rio Paranaíba territory had the highest share (43.5%), followed by Jequitinhonha (35.8%), São Francisco Alto Médio (35.3%), and Rio Grande (35.2%).

Table 5 Degree of municipal data availability on basic sanitation – Minas Gerais (2017-2021) [8].

Território de saneamento	Inconsistência detectada (Número de municipios)	Percentual em relação ao total de municípios de cada território de saneamento (%)	Sem Informação (nenhum ou um dado) - Número de municipios	Percentual em relação ao total de municipios de cada território de saneamento (%)
Jequitinhonha (67 municipios)	24	35.8%	20	29.9%
Paraiba do Sul (101 municipios)	17	16.8%	37	36.6%
Rio Doce (221 municípios)	72	32.6%	64	29.0%
Rio Grande (182 municípios)	64	35.2%	30	16.5%
Rio Paranalba (46 municípios)	20	43.5%	11	23.9%
São Francisco Alto Médio (139 municipios)	49	35.3%	28	20.1%
São Francisco Médio Baixo (97 municipios)	13	13.4%	48	49.5%

Table 6 Number of municipalities with inconsistency by indicator (1) that makes up each component of the Basic Sanitation Deficit Index by sanitation territory – Minas Gerais (2017-2021) [8].

Sanitation territory	Indicator responsible for the inconsistency									
	Public water supply deficit	Percentage (%)	Sewage collection deficit	Percentage (%)	Sewage treatment deficit	Percentage (%)	Sanitation urban solid waste disposal defici	Percentage	Sanitation stormwater drainage and management deficit	Percentage (%)
Jequitinhonha	17	10.7%	17	9.7%	16	11.0%	10	7.3%	9	15.0%
Paraíba do Sul	10	6.3%	12	6.8%	7	4.8%	7	5.1%	4	6.7%
Rio Doce	47	29.6%	49	27.8%	35	24.1%	39	28.5%	24	40.0%
Rio Grande	41	25.8%	47	26.7%	32	22.1%	41	29.9%	12	20.0%
Rio Paranaíba	10	6.3%	10	5.7%	13	9.0%	11	8.0%	3	5.0%
São Francisco Alto Médio	23	14.5%	30	17.0%	34	23.4%	27	19.7%	6	10.0%
São Francisco Médio Baixo	11	6.9%	11	6.3%	8	5.5%	2	1.5%	2	3.3%
Total	159	100.0%	176	100.0%	145	100.0%	137	100.0%	60	100.0%

(1) There may be more than one indicator generating inconsistency per municipality.

- For municipalities with no or one data point, the most affected territories were São Francisco Médio Baixo (49.5%), Paraíba do Sul (36.6%), and Jequitinhonha (29.9%).

The combined percentage of municipalities with inconsistencies or no information (497 in total) exceeded 60% in several territories:

- Rio Paranaíba: 67.4%.
- Jequitinhonha: 65.7%.
- São Francisco Médio Baixo: 62.9%.
- Rio Doce: 61.5%.

Regarding the contribution of the public water supply component (public water supply deficit indicator) to municipal inconsistency, in percentage terms relative to the number of municipalities in each territory, the Rio Doce sanitation territory has the highest percentage of municipalities (29.6%), followed by the Rio Grande (25.8%) and the São Francisco Médio Alto (14.5%) territories. Furthermore, the Paraíba do Sul sanitation territory has the lowest percentage contribution of the public water supply deficit indicator to municipal inconsistency (6.3%).

Regarding the sewage component, specifically the sewage collection deficit indicator, an increase in the contribution to municipal inconsistency is observed in almost all territories, with the Rio Doce (27.8%), Grande (26.7%), and São Francisco Médio Alto (17.0%) sanitation territories standing out. The sanitation territory with the lowest percentage contribution to inconsistency related to the sewage collection deficit was the São Francisco Médio Baixo region (6.3%).

Analysing the sewage treatment indicator, from the sewage component, in relation to its contribution to inconsistency in municipalities, the sanitation territories of Rio Doce (24.1%), São Francisco Alto Médio (23.4%), and Rio Grande (22.1%) contribute most to inconsistency. On the other hand, the Paraíba do Sul region has the lowest percentage contribution from the sewage treatment deficit to inconsistency in municipalities (4.8%).

In the case of the urban solid waste component (indicator for final disposal of urban solid waste), the municipalities of Rio Grande (29.9%), Rio Doce (28.5%), and São Francisco Alto Médio (19.7%) contribute most to inconsistency. The São Francisco Médio Baixo region had the lowest percentage contribution from the urban solid waste component (indicator of urban solid waste final disposal deficit) to municipal inconsistency (1.5%).

Finally, regarding the contribution of the drainage and stormwater management component indicator to municipal inconsistency, the largest contributions came from the Rio Doce (40.0%), Rio Grande (20.0%),

and Jequitinhonha (15.0%) regions. However, the São Francisco Médio Baixo region had the lowest percentage contribution from the drainage and stormwater management component to municipal inconsistency (3.3%).

Analysing Fig. 5, it is generally observed that the municipalities with the highest number of inconsistent IDESB indicators are found in municipalities with populations up to 10,000 inhabitants. It can also be seen that in municipalities with a population over 10,000, the sewage treatment indicator has the highest percentage (52.4%), followed by the public water supply indicator (50.3%). From a quantitative point of view, the IDESB sewage collection deficit indicator has the highest number of occurrences in municipalities with inconsistencies (176 of 259 municipalities), followed by the public water supply indicator (159 of 259 municipalities), the sewage treatment indicator (145 of 259 municipalities), the urban solid waste final disposal deficit indicator (137 of 259 municipalities), and the drainage and stormwater management deficit indicator (60 of 259 municipalities).

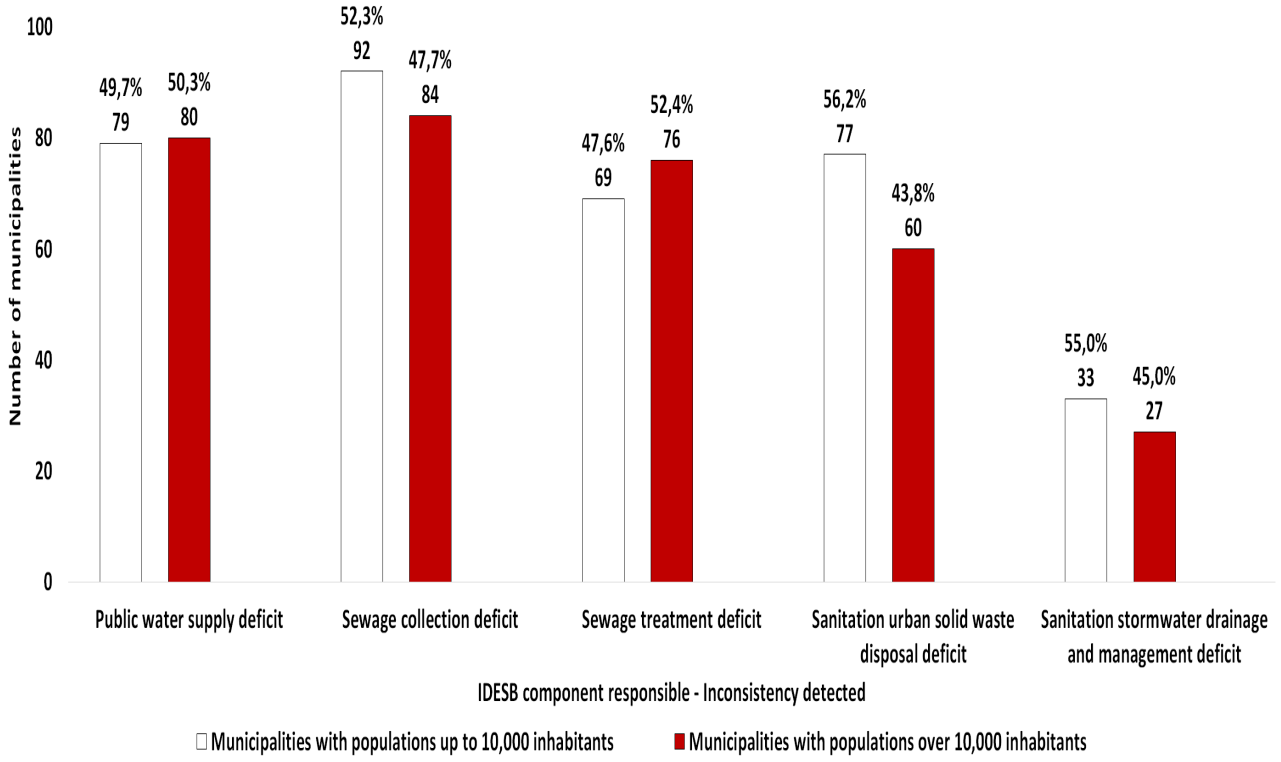

Fig. 5 IDESB component responsible for inconsistencies by municipality population size (2017-2021) [8].

5. Conclusions and Recommendations

The objective of this study was to discuss the availability, quality, and reliability of data from the National Basic Sanitation Information System (SINISA) [8], which is used in calculating the IDESB. The aim was not to point out right or wrong practices, but to demonstrate the challenges researchers face when using these data to understand the reality of basic sanitation services in Brazil, particularly in the state of Minas Gerais.

The reality is that, among the 853 municipalities in Minas Gerais, 497 municipalities — those with no or only one available data point (238) and those with inconsistencies (259) — represent 58.3% of the total and exhibit either partial or complete data absence or probable inconsistencies. This significantly impairs

short-, medium-, and long-term planning and management of sanitation services, considering the current state of the SINISA database.

When examining sanitation territories, combining the number of municipalities with missing data and those with inconsistent data reveals highly concerning proportions, ranging from 51.7% (Rio Grande) to 67.4% (Rio Paranaíba) of municipalities within each territory.

Among the 259 municipalities with inconsistencies, the main indicators contributing to unreliable data are:

- Sewage collection deficit (present in 68% of cases),
- Water supply deficit (61.4%), and
- Sewage treatment deficit (56%).

When analysed by territory, the most critical areas regarding inconsistencies related to:

Water supply, sewage collection, sewage treatment, and solid waste disposal were the Rio Doce, Rio Grande, and São Francisco Alto Médio territories.

For stormwater drainage, the Rio Doce, Rio Grande, and Jequitinhonha territories were the most affected.

Considering these findings, the current state of information reported by service providers or contracted companies seriously hampers effective planning and management of sanitation services. The key stakeholders — municipal governments and the general population — often lack access to reliable data, either due to its absence or poor quality and trustworthiness (contradictions, errors, or discrepancies), all of which hinder realistic planning and implementation of services.

Furthermore, the collection of primary data in Brazil is of paramount importance, as public policy relies on such information. In recent years, however, the process of collecting primary data has been dismantled due to various reasons, such as lack of funding, shortage of qualified personnel, logistical challenges, and underuse of modern technologies.

In the case of sanitation data:

- Many SINISA respondents lack technical knowledge of the services they report on.
- Existing data is difficult to use for planning purposes.
- There is a need to integrate other data sources to improve quality and reliability.
- There is an urgent need to improve data quality.

Brazil faces ambitious goals for achieving universal access to sanitation services, which will require:

- Substantial investments in planning and management, and
- Large-scale infrastructure projects, all demanding significant resources.

To ensure that these resources are allocated effectively and efficiently, accurate and reliable data are essential. Unfortunately, in the current reality, the quality of available data is far below what is needed.

Therefore, based on the discussions and analyses in this study, it is recommended to restructure the State Sanitation Information System (SEIS), as proposed by Cobrape (2022) [19-21]. This reorganization should consider:

- Modern digital technologies,
- The need for data availability and accuracy,
- Proper training of respondents, and
- The auditing of information using alternative sources to ensure consistent and reliable data.

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