Ratio of Real to Apparent Losses in Brazil

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1. Introduction

The struggle to control water losses in Brazil in recent years has become an extremely valuable topic in the country, especially due to fast city growth, aging of the national supply systems, and lack of control of volumes that are supplied. According to the National Sanitation Information System (SNIS), in 2016, the largest country in South America had its highest average water loss in five years: 38.1% (SNIS, 2018) of the system input volume.

Although Brazilian engineers are aware of this information, the ratio of real to apparent losses is widely unknown, particularly nationwide. This paper aims to nationally define the aforementioned ratio in order to put forward technical references to water supply system design and operation.

2. Method

Through the Water Loss Task Force, the International Water Association (IWA), which has been working on improving the operational performance of water supply systems for over two decades (AESBE, 2015), developed the "Water Balance" (Figure 2.1), best practice audit structure for drinking water utilities (AWWA, 2012).

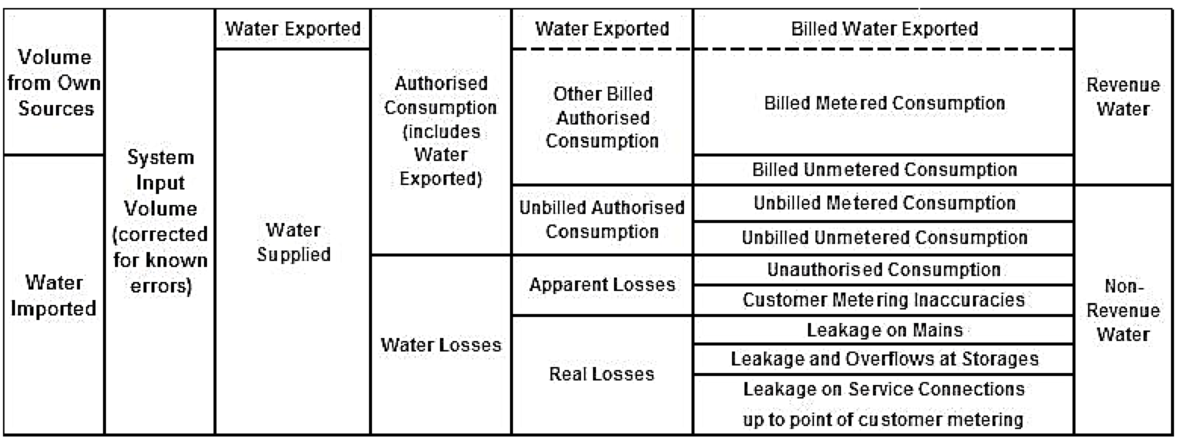

Figure 2.1 IWA Water Balance. Image source: Leaks Suite, 2018.

Based on that method to estimate volumes that are lost, and in order to contrast apparent with real losses, this work collected spreadsheet data between 2013 and 2016 provided by important companies from different municipalities in Brazil that use that performance indicator. Particularly, 29 different yearly Water Balance charts, distributed among the Northeast, the Mid-West, the Southeast, and the South were analysed concerning water supply systems that cover more than six million people (Table 2.1).

Table 2.1 Water Supply Systems under research.

SYSTEM	MUNICIPALITY	FEDERATED UNIT	PROVIDER	POPULATION DIRECTLY AFFECTED
SIA Salvador - Cabula - "Consolidação"	Salvador (Cabula)	Bahia	EMBASA	702.536
Feira de Santana	Feira de Santana	Bahia	EMBASA	612.000
Caruaru	Caruaru	Pernambuco	COMPESA	314.912
Salgueiro	Salgueiro	Pernambuco	COMPESA	54.439
Distrito Federal	DF 2015	Distrito Federal	CAESB	Not informed
Distrito Federal	DF 2016	Distrito Federal	CAESB	Not informed
Pereira	Barretos	Sao Paulo	SAAE Barretos	54.439
ETA - Batalha	Bauru	Sao Paulo	DAE Bauru	54.439
ETA - Xavantes	Guaratingueta	Sao Paulo	SAEG	118.378
Indaiatuba	Indaiatuba	Sao Paulo	SAAE Indaiatuba	228.710
East Region of Jacarei	Jacarei	Sao Paulo	SAAE Jacareí	156.387
ETA Centro	Mogi das Cruzes	Sao Paulo	SEMAE Mogi das Cruzes	247.244
Sistema ETA VI	Santa Barbara d'Oeste	Sao Paulo	DAE Santa Bárbara d"Oeste	187.352
Aguas Limpas	Sao Jose do Rio Preto	Sao Paulo	SeMAE São José do Rio Preto	103.053
Sistema Cerrado	Sorocaba	Sao Paulo	SAAE Sorocaba	568.464
Valinhos	Valinhos	Sao Paulo	DAEV	106.776
Blumenau Water Supply System	Blumenau	Santa Catarina	SAMAE Blumenau	329.082
Brusque	Brusque	Santa Catarina	SAMAE Brusque	118.728
Integrated Water Supply System of Grande Florianopolis (SIF)	Florianopolis	Santa Catarina	CASAN	292.944
ETA Central	Jaragua do Sul	Santa Catarina	SAMAE Jaraguá do Sul	153.361
Aguas de Joinville	Joinville	Santa Catarina	CAJ	118.418
Governador Valadares	Governador Valadares	Minas Gerais	SAAE Governador Valadares	266.350
Ituiutaba	Ituiutaba	Minas Gerais	SAE Ituiutaba	99.030
DMAE in Pocos de Caldas	Pocos de Caldas	Minas Gerais	DMAE	159.690
Turvo	Vicosa	Minas Gerais	SAAE	74.225
Novo Hamburgo Water Supply System	Novo Hamburgo	Rio Grande do Sul	COMUSA	235.482
Porto Alegre	Porto Alegre	Rio Grande do Sul	DMAE Porto Alegre	400.000
ETA Nova	Barra Mansa	Rio de Janeiro	SAAE Barra Mansa	54.439
Supply System of the urban area of Colatina	Colatina	Espirito Santo	SANEAR	107.952

3. Results

Besides the verification that water losses represent approximately 41% of the entire system input volume (Figure 3.1), evidence showed that apparent and real losses are quite variable among providers nationally, as seen in Figure 3.2.

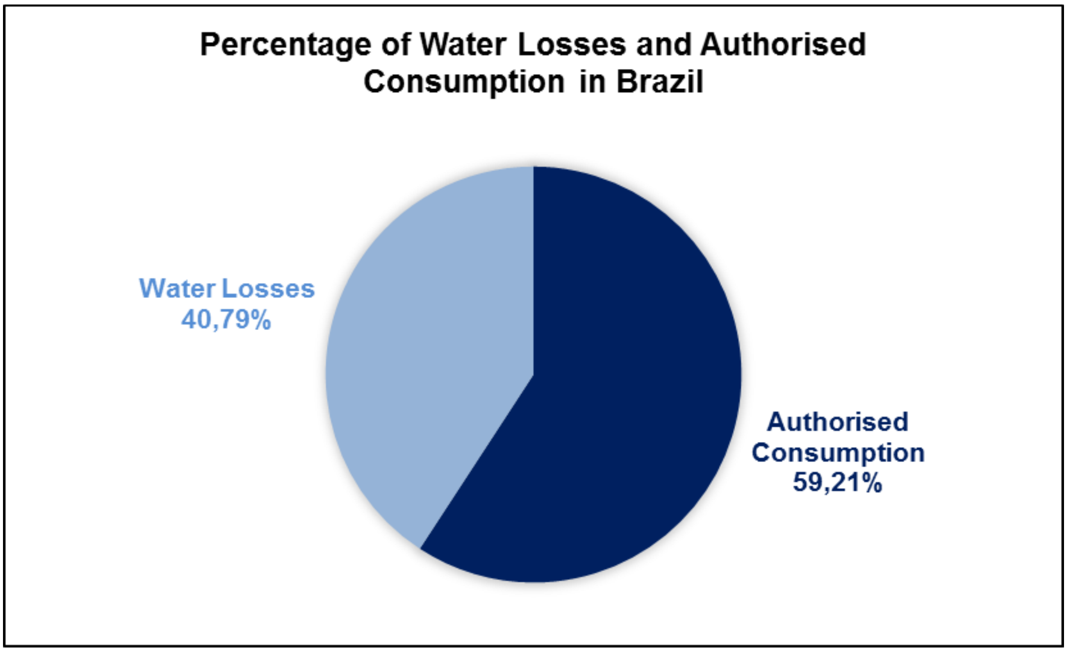

Figure 3.1 Percentage of water losses and authorised consumption in Brazil.

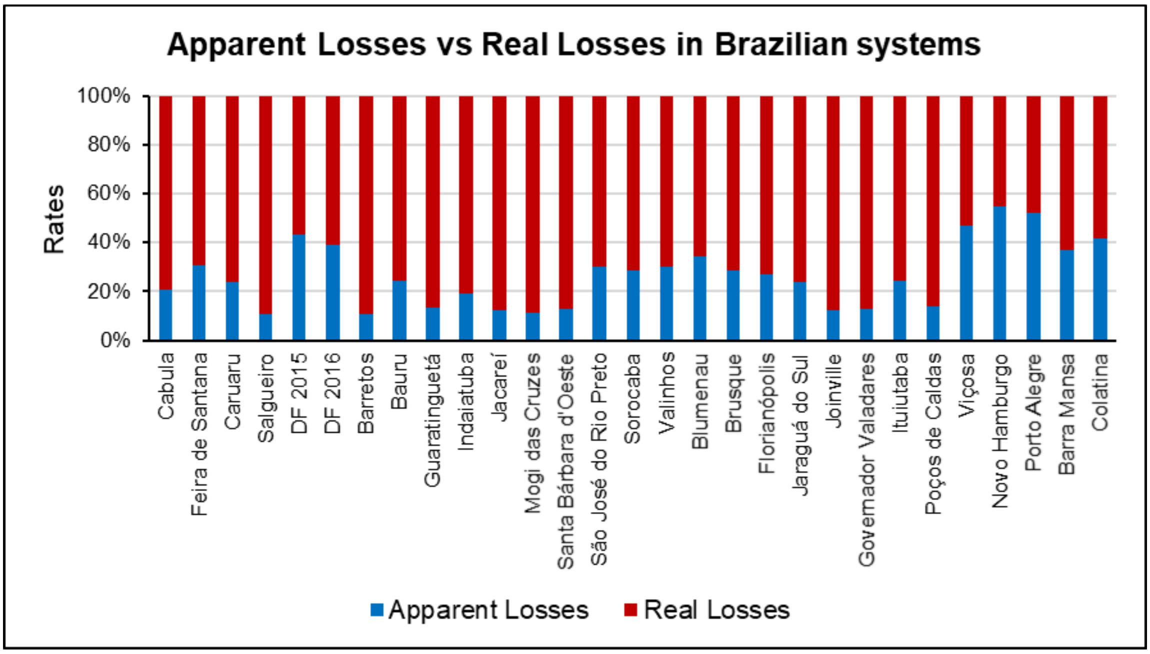

Figure 3.2 Apparent Losses v. Real Losses in Brazil.

As a whole, these numbers confirm that Brazil has a rather deficient system, especially when in comparison with countries like Japan and Germany, whose water losses are significantly low (approximately 10% on average), or Australia and New Zealand, where these percentages are even lower (AESBE, 2016). Municipalities like Salgueiro, Barretos, and Mogi das Cruzes show a very unsatisfactory infrastructure in their system, given their eminent percentage of real losses, which suggests a great number of leakages along the networks.

Consequently, it was observed that water losses are largely (73%) due to real losses in the systems, as shown in Figure 3.3.

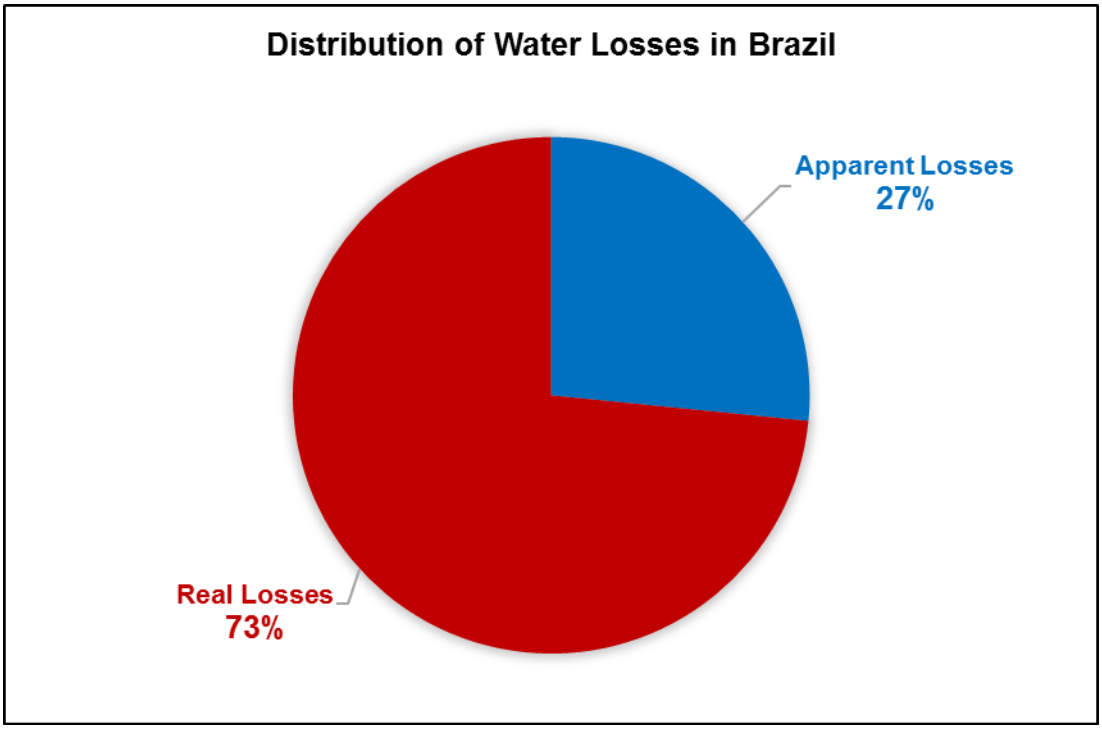

Figure 3.3 Distribution of Water Losses in Brazil.

In other words, leakages on service connections up to the point of customer metering, leakages on transmission and distribution mains, and leakages and overflows at storage tanks tend to be the predominant type of losses in Brazil. That verification must clearly shed light on the attempt to solve the issues that professionals of this field in the country face constantly. Therefore, many strategies in order to overcome these losses could be changed or readjusted by knowing where they come from in the first place.

Considering the components of real and apparent losses, it is possible to visualize each type of loss in the Brazilian system in Figure 3.4.

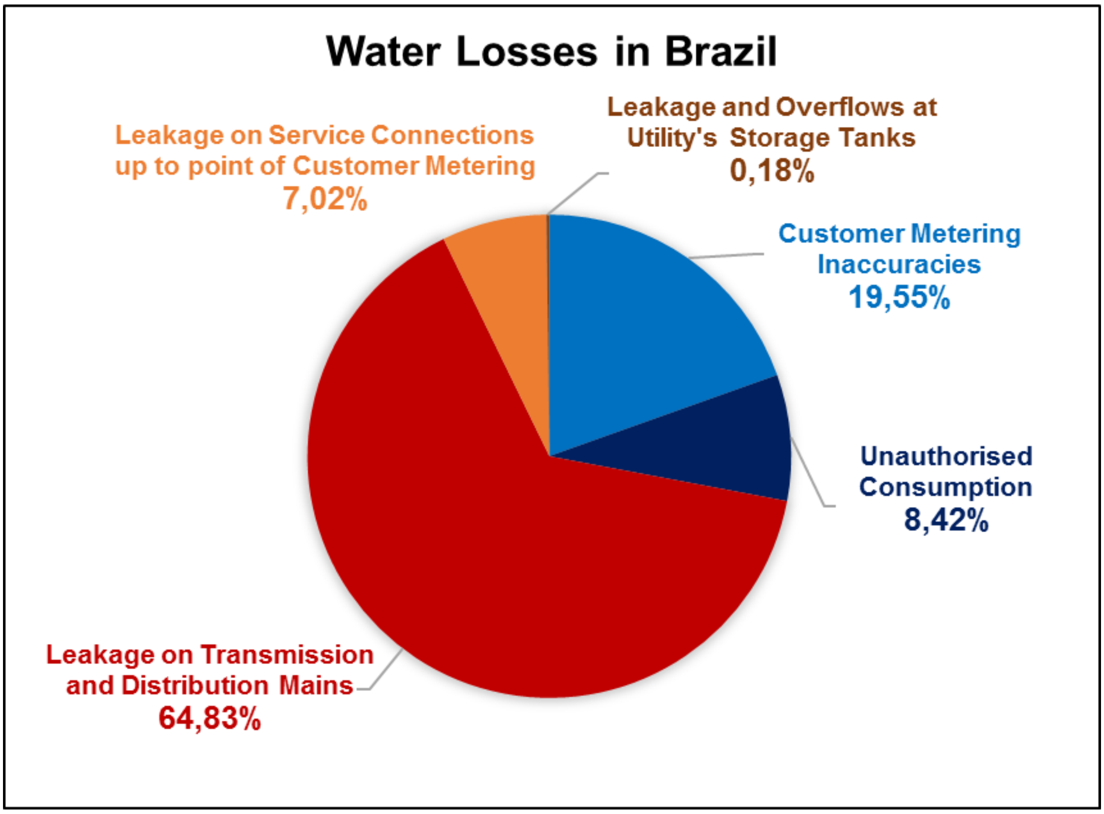

Figure 3.4 Distribution of Water Losses in Brazil.

The figure above indicates that most losses actually stem from leakages on transmission and distribution mains and that, most importantly, they encompass a substantial amount of all the water that is lost in the system (around 65%). In addition, customer metering inaccuracies are about twice as much as the unauthorised consumption. All this verification should indicate where to focus on during the effort of mitigating real and apparent losses.

4. Conclusion

These results can be used by engineers, especially in Brazil, to define technical parameters and by water suppliers to outline the best strategies to reduce non-revenue water, given that the procedures and tools to reduce real losses are extremely different from those to curb apparent losses.

The general condition in Brazilian water supply systems may be generated by: poor leakage control and detection; inefficient and ineffective repairs; lack of material enhancement as well as difficulty in improving pipeline maintenance, relocation and rehabilitation, and bad pressure control throughout the system and level control at storage tanks (Thornton, 2002 apud Tsutiya, 2014). On this account, the Brazilian situation points to precarious water supply system infrastructure, and its overall frail management.

5. References

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