

More than words: Textual analysis as urban water planning and management document assessment tool

T. M. Tsuji^{1*}, P.L. Santana¹, L. T. S. Azevedo¹, A. R. Finotti¹

¹Department of Sanitary and Environmental Engineering, Federal University of Santa Catarina, Trindade, Florianópolis, Santa Catarina, Brazil

*Corresponding author email: thaysmitsuko@hotmail.com

Highlights

- Most Brazilian planning documents do not address sustainable urban drainage issues.
- Textual analysis is a promising tool for management and planning instruments assessment.
- The sustainable stormwater management is still incipient in Brazil.

Introduction

In Brazil, wherein approximately 86% of the population lives in the urban territory (IBGE, 2010), exist legislative instruments to minimize the urbanization impacts of stormwater, such as stormwater master plans, which can be associated with the Master Plan or the Municipal Sanitation Plan (MSP). Ideally, it should be implemented an integrated municipal structure (gathering drinking water, sewage treatment, solid waste management, and stormwater management), aiming for synergy between urban water services.

Although the legislation of the country determines the incorporation of the concept of sustainable urban stormwater management, the praxis is far beyond the theory. The perception is that the majority of cities (there are 5,570 municipalities in the country) presents conventional urban drainage systems that accelerate flow and do not control adequately the runoff.

National legislation obligates the municipalities to follow the guidance proposed and to present sanitation plans, including stormwater management plans. This is a strategy to obligate the planning of sanitation, but the deadline to engagement has been postponed three times since 2014. However, the last urban Stormwater Drainage and Management Diagnosis (SDMD), published by the Brazilian Sanitation Information System (BSIS) (BRASIL, 2020), showed that from 3,653 participant municipalities, only 19.6% declared to have a stormwater management plan.

The BSIS also gathers information about the presence of sustainable urban drainage devices, e.g., linear parks, detention basins, and infiltration trenches. The SDMD reveals that a small percentage of municipalities have sustainable urban drainage infrastructure, i.e., 15.5% of municipalities stated to have infiltration trenches on urban public roads; 4.4% stated to have detention basins; only 7.7% of municipalities affirmed to have linear parks in the urban area, meaning that only 5.7% of natural water resources have a linear park in Brazil.

According to SDMD results, the purpose of this work was to deepen the understanding of the application of sustainable urban drainage management and planning in Brazilian municipal documents. Textual analysis was used to evaluate the presence and/or frequency of words referred to sustainable urban drainage in planning and management documents.

Methodology

The textual analysis was carried out using IRaMuTeQ (*Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires* - R interface for Multidimensional Analysis of texts

and questionnaires), it allows classical textual statistics; specificity of groups; descending hierarchical classification; analyses of similarity and word cloud (Camargo and Justo, 2013). Hence, IRaMuTeQ was used to evaluate the frequency of sustainable urban drainage terminologies, e.g., alternative/compensatory techniques, Best Management Practices (BMP), Green Infrastructures, Low Impact Development (LID), in the planning and management sections of Brazilian documents. For Iramuteq analysis is essential to follow the developer recommendations (Loubère and Ratinaud, 2014), in this way a python script was written to automate the process of data preparation. Three corpuses were used, i.e., Corpus a: 94 MSP from Mato Grosso state (MSP-MT); Corpus b: 33 MSP from Amazonas state (MSP-AM); Corpus c: 54 Stormwater and Sewage Management State Plan (SSMSP-BA) from Bahia state. The location of the cities is shown in Figure 1, for each corpus, it was included as many files as available in the online directories. The documents were obtained in pdf format from online directories available on state websites. All of MSP-AM documents were published in 2012; the MSP-MT were published between 2017 and 2018; and SSMSP-BA between 2010 and 2011. The analysis performed in this research followed four main steps: data collection, file format conversion, preparation of data, textual analysis using IRaMuTeQ as could be seen in Figure 1. In addition, to enrich the comparison, the Roque Saenz Peña Stormwater Master Plan (RSPSMP) published in 2018 was randomly chosen to represent Argentina as the neighbor country and, representing an advanced country into the sustainable urban drainage, was chosen the 2016-2021 Seine-Normandie Watershed Development And Management Master Plan (SNWDMMP), in France.

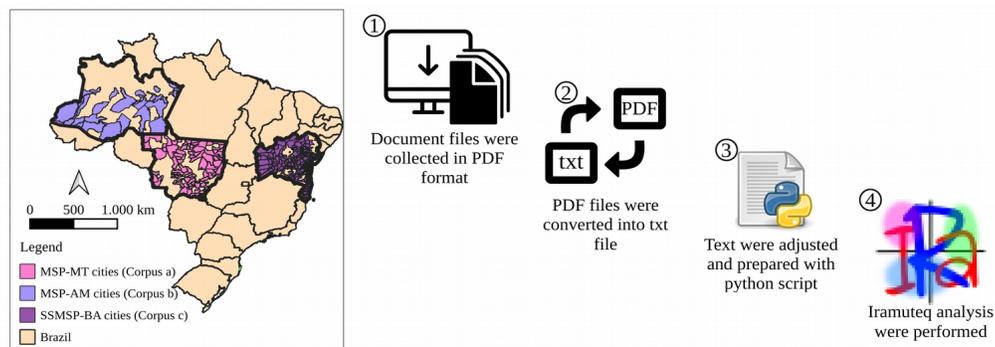


Figure 1. Location of the cities referring to analyzed plans, and the workflow used for the methodology.

Results and discussion

There is a small number of words that could be associated with a sustainable conception of urban drainage, such as certain devices or even terminologies such as BMP, SUDS, LID, WSUF, and SbN, and among those present, there is a relatively small frequency (Table 1).

The cities that most cited “urban drainage” in each corpus were: Ponte Branca (Corpus a), a city with 1,525 inhabitants and 701,138 km²; Benjamin Constant (Corpus b) with 44,873 inhabitants, 8695,391 km² where suffer to frequent floods caused by the Solimões river floods; Ten municipalities with less than 10,000 inhabitants (Corpus c), the document assesses the critical flood areas and proposes solutions for the cities. In general, was observed that the Brazilian cities that most cited the urban drainage are the cities that most have to deal with floodings.

Comparing Corpus a, b and c to RSPSMP (Argentina) and SNWDMMP (France) allowed us to perceive the management and planning main differences, however, it is important to deepen the analysis to comprehend the principles that guide the construction of those document plans in each country.

The grouping of the texts by corpus, representing the states, avoids difficulties associated with the linguistic diversity of Brazil since SDMD pointed out that the heterogeneity of the terminologies and concepts used for stormwater management in Brazil. This particularity, associated with a weak technical

staff (often composed of people with no training in the area), is one of the main limitations for data systematization (BRASIL, 2020). It is very common to notice a wide number of scientific research and productions about compensatory techniques, LID'S, sustainable urban development and the evaluation of their efficiency in different scales and cities, modeling, and planning and management strategies as well. However, this knowledge is not necessarily transferred to the technical staff, who develops the urban drainage action and strategy plans.

Table 1. Relative frequency of terms that suggest a sustainable approach to urban drainage.

Forms	Relative frequency of occurrences [%]				
	Corpus a	Corpus b	Corpus c	RSPSMP	SNWDMMP
Compensatory	0.0032	-	0.0096	0.0007	0.0228
Detention	0.0102	-	0.0017	0.0030	0.0008
Infiltration	0.0426	0.0013	0.0444	0.0096	0.0118
Management	0.1578	0.1297	0.2260	0.2456	0.5373
Planning	0.0945	0.0797	0.0574	0.2709	0.0439
Retention	0.0106	0.0023	0.0058	0.0067	0.0784
Reuse	0.0067	>0.0001	0.0295	-	0.0042
Solution	0.0436	0.0405	0.0892	0.0980	0.0388
Sustainable	0.0156	0.0097	0.0898	0.0082	0.0582
Zoning	0.0075	0.0005	0.0025	0.0045	0.6174

Finally, the data obtained in this work, associated with the low percentages of sustainable urban drainage infrastructure published by SDMD, suggest that sustainable stormwater management is still incipient in Brazil. The use of a textual analyzing program was determinant to arrive a evaluate a large number of documents. This is a very promising tool to evaluate political and management documents.

Conclusions and future work

The corpus quantitative textual analysis showed the central themes of documents, pointing out the very low relative frequency of words associated with sustainable urban drainage issues, showing that Brazil needs to learn from scientific and academic experiences to create and implement knowledge about sustainable urban drainage planning and management, following examples as SNWDMMP. It is necessary to include and encourage more LIDs, BMPs, SUDs and compensatory techniques devices to improve not only the stormwater quality but also the environmental quality. The use of textual analysis software was determinant in allowing the evaluation of the immense number of planning document pages.

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