07, 08, 09 e 10 de novembro de 2023
ISSN 2177-3866

Drivers of non-revenue water in developing countries: a multilevel approach for the Brazilian case

CLÁUDIA ORSINI MACHADO DE SOUSA
UNIVERSIDADE DE SÃO PAULO (USP)

NUNO MANOEL MARTINS DIAS FOUTO
FACULDADE DE ECONOMIA, ADMINISTRAÇÃO E CONTABILIDADE DA UNIVERSIDADE DE SÃO PAULO - FEA

Drivers of non-revenue water in developing countries: a multilevel approach for the Brazilian case

Introdução

The growing pressure on water resource, which is accelerating due to climate change and increase in the occurrence of extreme weather events, has led to a urgent need in increasing efficiency in water systems, which includes minimizing water loss (González-Gómez et al., 2012; Pillot et al., 2016). Nevertheless, despite the uncertainties related to water availability in the future, water utilities still struggle with non-revenue water ("NRW"; Pillot et al., 2016; Amaral et al., 2023; Beker & Kansal, 2023).

Problema de Pesquisa e Objetivo

Brazil has been facing water scarcity in the last years, in different regions of the country (Sousa & Fouto, 2019; Sousa et al., 2021; Getirana et al., 2021). Yet, in the country, water loss in the last years has been growing, reaching the level of 40% of total produced water in 2021 (SNIS, 2022). That is why there is an urgency in implementing effective plans and actions focused on reducing this problem (Oliveira et al., 2022). Considering this scenario, this study seeks to identify the main drivers of non-revenue water in Brazil.

Fundamentação Teórica

There is no water distribution system with zero water loss, nevertheless, the more efficient the system, the lower NRW levels are (SNIS, 2022). Utilities' operations must be guided by measures seeking to reduce NRW as little as possible. This is because NRW represents a burden, both financial and environmental (Amaral et al., 2023), indicating a great source of inefficiency for water utilities (Alsharif et al., 2008).

Metodologia

We proposed a hierarchical linear model with two levels (HLM2), in which, for the first level, we consider the year, and for the second level, the municipality. The main advantage of multilevel models over traditional regression models is the consideration of the natural nesting of data, allowing the analysis of individual heterogeneities between groups in which these individuals belong to and enabling the specification of random effects in each level of analysis (Santos et al., 2016; Hair & Fávero, 2019).

Análise dos Resultados

The results reveal that a small portion of the explanatory variables introduced in the model have a significant effect on water loss, measured by the linear NRW index. Such fact goes against some findings in the literature that indicates a higher number of factors to be significative on determining water loss rates (Adams & LutzLey, 2012; Gonzalez-Giomez, 2012; Van den Berg; 2015). Nevertheless, our model presents a level 2 intraclass correlation (ICC) of 0.96907, meaning nearly 97% of the NRW indexes variance in our database it is explained by the variables included in the final model.

Conclusão

The kind of relation with water loss levels (positive or negative) differed in some cases from findings in available studies, reinforcing the need to consider regional particularities when studying ways to reduce NRW and implementing public policies. This work presents several factors that managers must prioritize and study when planning the strategy to reduce NRW, seeking on preserve water

ISSN 2177-3866

resources as well as achieving better financial returns on the operations.

Referências Bibliográficas

AMARAL et al. (2023) Drivers of water utilities' operational performance – An analysis from the Portuguese case. Journal of Cleaner Production, 389. BEKER, B.A. & KANSAL, M.L. (2023) Complexities of the urban drinking water systems in Ethiopia and possible interventions for sustainability. Environment, Development and Sustainability. PILLOT et al. (2016) Up to what point is loss reduction environmentally friendly?: The LCA of loss reduction scenarios in drinking water networks. Water Research 104: 231 – 241.