

XXVI SIMPÓSIO BRASILEIRO DE RECURSOS HIDRÍCOS

CHARACTERIZING THE FINANCIAL IMPACTS OF FLOODS AND DROUGHTS ON BRAZILIAN WATER UTILITIES

Greicelene Jesus da Silva¹; Andrea Cominola^{2,3}; Marcos Roberto Benso⁴, Eduardo Mario Menciondo¹ & Heidi Kreibich⁵;

Keywords: Damage assessment, water supply interruption, economic losses.

1. Introduction

Critical national infrastructure systems underpin a nation's economic development, human well-being, and environmental sustainability. Although infrastructure failures can lead to widespread societal disruptions, there is limited empirical research on how extreme hydroclimatic events affect these systems (Koks et al, 2022). Only a limited number of local or regional studies have examined the vulnerability of infrastructure to hazards that both impact water availability and cause physical damage to supply networks. With climate change increasing the frequency of extreme hydroclimatic events, assessing multi-hazard risks to water supply infrastructure is key to developing adaptation strategies, especially in resource-limited, high-risk developing countries (IPCC, 2022). This study aims to characterize the impact of floods and droughts on Brazilian water utilities by compiling records of past flood and drought events affecting the water supply sector in Brazil, along with their impacts on supply interruption and reductions in water-related revenue.

2. Materials and Methods

To characterize the impacts that Brazilian water utilities faced during the worst drought and flood events in the last 10 years, we developed and distributed an electronic survey for utilities all over Brazil. The survey includes questions regarding: the impact due to the worst drought, quantified as a percentage of a utility's revenues; costs of infrastructure repair during the worst flood; and financial recovery of revenue and infrastructure repair from the regulatory agency, given the possibility of recovery according to the Brazilian law framework. The survey was open to answers from May 2024 to April 2025. In total, we received 167 answers to the survey. We then excluded incomplete answers from further analysis, retaining 26 answers from different water utilities in Brazil.

3. Results and conclusion

In total, 24 out of 26 participants reported the occurrence of droughts and 12 the occurrence floods in the last 10 years. Figure 1 reports a synthesis of the survey answers.

1) São Carlos School of Engineering, University of São Paulo. São Carlos Worker Avenue, 400 - Arnold Schmidt Park. greicelene.silva@usp.br (16) 3373-6600

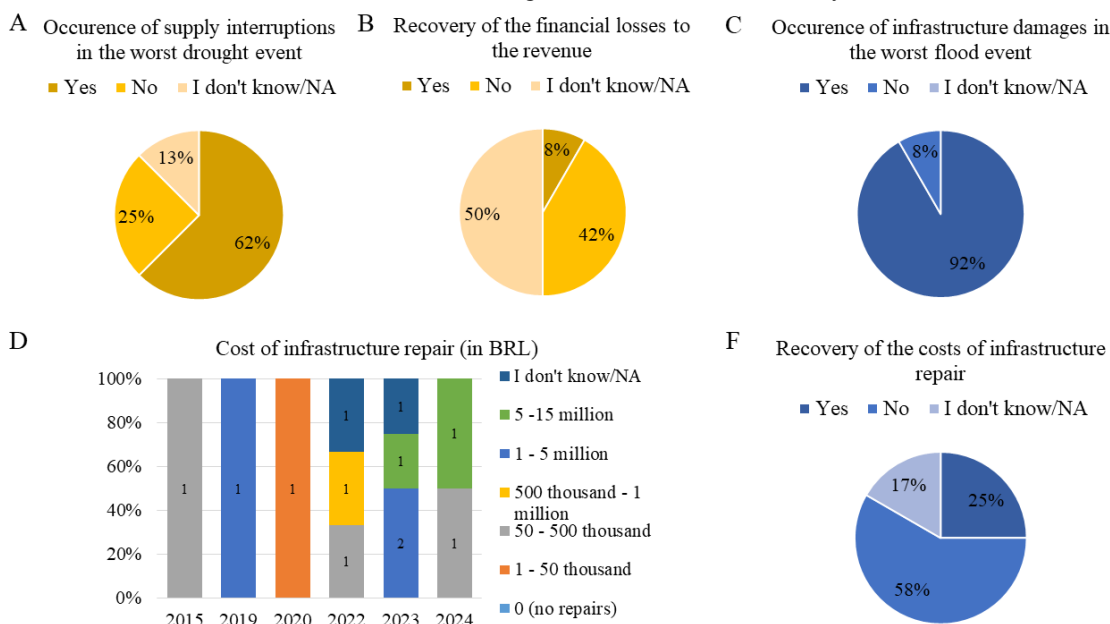
2) Technische Universität Berlin; Straße des 17. Juni 135 10623 Berlin +49 (30) 314 79707

3) Einstein Center for Digital Future; Wilhelmstraße 67, 10117 Berlin

4) Federal University of São Carlos. Washington Luis Highway, km 235, Sao Carlos (16) 3351-8111

5) GFZ Helmholtz Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany, +49 331 62640

Figure 1 – Answers for the worst events in the last 10 years regarding: (A) supply interruptions, (B) recovery of losses in revenue, (C) occurrence of infrastructure damages, (D) cost and (F) recovery of costs of infrastructure repair.



From Figure 1, during 62% of the worst drought events, the utility and users also faced supply interruption, and 42% of the total events had no recovery of revenue reduction. This lack of resource recovery can undermine the utility's ability to manage water supply crises and generate financial risks. The most severe flood events reported by the survey respondents have occurred in the past five years. In 92% and 83% of the events, utilities faced infrastructure damages and water supply interruptions, respectively. For some utilities, the cost of infrastructure repair ranges from 5 to 15 million BRL (USD 0.9-2.7) in 2023 and 2024. Further, 58% of the expenditures from infrastructure repairs were not recovered by the utility.

The findings from our survey highlight the significant operational and financial vulnerabilities that water utilities in Brazil face due to extreme hydroclimatic events. Droughts led to substantial revenue losses and frequent supply interruptions, with limited cost recovery mechanisms, posing serious financial risks. Similarly, floods in recent years have caused widespread infrastructure damage and prolonged service disruptions, with most utilities unable to recover and repair. These trends emphasize the urgent need for more robust financial resilience strategies and institutional frameworks to support utilities in managing and mitigating the impacts of climate-related events.

REFERENCES

- IPCC. **Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change IPCC**. New York: [S.n.]. Available in: <<https://www.ipcc.ch/report/ar6/wg3/>>.
- KOKS, E. E. *et al.* Brief communication: Critical infrastructure impacts of the 2021 mid-July western European flood event. **Natural Hazards and Earth System Sciences**, v. 22, n. 12, p. 3831–3838, 2022.

ACKNOWLEDGMENTS

This study was supported by the CAPES - finance Code 001, the German Academic Exchange Service (DAAD), and the Brazilian National Council for Scientific and Technological Development (CNPq).