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Cost Optimization of Water Resources in Pernambuco, Brazil: Valuing Future Infrastructure and Climate Forecasts

Ipsita Kumar (1), Laureline Josset (1), Upmanu Lall (1), Erik Cavalcanti e Silva (2), José Marcelo Cordeiro Possas (2), and Marcelo Cauás Asfora (2)

(1) Columbia Water Center, Columbia University, New York, United States (ik2350@columbia.edu), (2) Agência Pernambucana de Águas e Clima (APAC), Recife, Brazil

Optimal management of water resources is paramount in semi-arid regions to limit strains on the society and economy due to limited water availability. This problem is likely to become even more recurrent as droughts are projected to intensify in the coming years, causing increasing stresses to the water supply in the concerned areas.

The state of Pernambuco, in the Northeast Brazil is one such case, where one of the largest reservoir, Jucazinho, has been at approximately 1% capacity throughout 2016, making infrastructural challenges in the region very real. To ease some of the infrastructural stresses and reduce vulnerabilities of the water system, a new source of water from Rio São Francisco is currently under development. Till its development, water trucks have been regularly mandated to cover water deficits, but at a much higher cost, thus endangering the financial sustainability of the region.

In this paper, we propose to evaluate the sustainability of the considered water system by formulating an optimization problem and determine the optimal operations to be conducted. We start with a comparative study of the current and future infrastructures capabilities to face various climate. We show that while the Rio Sao Francisco project mitigates the problems, both implementations do not prevent failure and require the reliance on water trucks during prolonged droughts.

We also study the cost associated with the provision of water to the municipalities for several streamflow forecasts. In particular, we investigate the value of climate predictions to adapt operational decisions by comparing the results with a fixed policy derived from historical data. We show that the use of climate information permits the reduction of the water deficit and reduces overall operational costs. We conclude with a discussion on the potential of the approach to evaluate future infrastructure developments.

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