

Scaling the Value of Water Regulation Services Beyond the Watershed: An Integrated InVEST–MRIO Framework

Topic: Hydrologically Integrated Input–Output Models (HIIO): An Emerging Interdisciplinary Approach

Author: Gino Sturla

Co-Authors: Eugenio Figueroa, Tommaso Pacetti

The economic valuation of seasonal surface water regulation (SSWR) is commonly conducted at the watershed scale using replacement or opportunity cost methods, capturing only local economic value (LEV). This approach overlooks how ecosystem service impacts propagate through intersectoral and interregional production networks, leading to systematic undervaluation by omitting regional (REV) and national economic value (NEV).

This paper develops an integrated framework that scales SSWR valuation from the watershed to the national economy by combining biophysical modeling with an interregional economic approach. Specifically, estimates from the Seasonal Water Yield module of the InVEST model are linked to a multiregional input–output model for Chile, covering 16 regions and 12 sectors, allowing us to trace how water regulation affects production and trade across regions.

Methodologically, the paper builds on the Hydro-Economic Equilibrium Cost (CHEE) approach—which captures the national opportunity cost of water-related ecosystem services in terms of avoided production losses—and extends it through a value-added formulation (CHEE-A). Unlike previous CHEE applications, which typically assume fixed production structures, CHEE-A incorporates substitution possibilities and sector-specific efficiency differences, enabling the model to represent how economic systems adjust to changes in water availability. This provides a more flexible and realistic valuation framework while remaining consistent with ecosystem accounting principles.

Applied to the Choapa River basin in Chile—a semi-arid region where water regulation is critical for sustaining agricultural and mining activities—results show that NEV represents 0.017% of GDP under historical hydrological conditions and 0.022% under climate change. National economic value exceeds local economic value by a factor of 2.5–3, highlighting the importance of interregional production linkages and trade multipliers.

Overall, the results demonstrate that water regulation services generate economic effects well beyond the watershed, functioning as macroeconomically relevant infrastructure embedded in interregional value chains.