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Rationalizing Systems Analysis for the Evaluation of Adaptation Strategies in Complex Human-Water Systems

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Abstract: Water resources management is a non-trivial process requiring a holistic understanding of the factors driving the dynamics of human-water systems. Policy-induced or autonomous behavioral changes in human systems may affect water and land management, which may affect water systems and feedback to human systems, further impacting water and land management. Currently, hydro-economic models lack the ability to describe such complex dynamics by either not accounting for the multi-factor/multi-output nature of these systems, and/or not designed to operate at a river basin scale. This paper presents a methodological framework for the integration of a microeconomic multi-factor/multi-output Positive Multi-Attribute Utility Programming (PMAUP) model with the eco-hydrologic Soil and Water Assessment Tool (SWAT) model. The linkage between the two models is performed under a sequential modular approach and is provided by a common spatial unit, named Hydrologic-Economic Representative Units (HERUs) and defined as entities with economic rationale (i.e. decision making) resulting from the unique combination of hydrologic responsive units and socio-economic agents. The resulting SWAT-PMAUP model aims to provide the means for exploring the dynamics between the behavior and self-organization of socio-economic agents, and its connections with the water system through water and land management (i.e. HERUs). Methods are illustrated with an irrigation restriction policy applied to the Río Mundo sub-basin in south-eastern Spain. Results suggest that the consideration of the proposed methodological framework captures changes in the dynamics of human-water systems following the implementation of adaptation strategies and can be a valuable tool to support decision-making in water resources management across a wide range of scales.

***Keywords**:* SWAT, Mathematical Programming, Spain, Socio-hydrology.