In this paper, Kahil et al. present the development of ECHO-Global version 1.0, a global hydro-economic model designed to assess the economic and environmental performance of water management options at the subbasin (BCU) scale. By integrating a detailed representation of water flows from multiple sources—including surface water, groundwater, and non-conventional supplies—with advanced economic benefit functions calibrated via positive mathematical programming, the model simulates future water management scenarios under climate and socio-economic changes (SSP2-RCP6.0). The study offers valuable insights into changes in water withdrawals, irrigated crop areas, and associated economic impacts, and its outputs are broadly consistent with previous global assessments. Although the work represents an important advancement in global water resource modeling, I have several comments (see below).

Section 2 – Modeling framework

1. The authors make extensive use of multiple indices (e.g., i, a, u, j, k, w) and a variety of binary or proportional coefficients (b_i, b_a, etc.) to capture the system's complexity. While this is understandable, clarity would be improved by providing a comprehensive table that summarizes all indices, variables, and coefficients—including their definitions and units.

2. Equation 1 (Headwater Inflow): For BCUs, a critical omission in the headwater inflow representation is the lack of consideration for direct evaporation from natural surface water bodies. While Equation 1 accounts for local runoff and upstream inflows, it doesn't factor in evaporative losses from rivers, lakes, and wetlands prior to reaching the headwater gauge. This can represent substantial water losses, especially in arid regions, leading to significant overestimation of available surface water. While this might be negligible in some BCUs, it becomes critically important in others, for instance, in the Sudd swamp (potentially located in a BCU between Sudan and the Nile polygon), where studies suggest up to 50% of surface water can be lost annually through evaporation. I suggest that the authors either add an evaporation term in Equation 1 or provide a clear justification for why its omission does not affect the overall accuracy of water availability estimates.

3. Equation 4 (Reservoir Storage): The current formulation expresses reservoir dynamics as a net release (outflow minus inflow), which obscures the separate contributions of inflows and outflows and makes tracking mass conservation problematic. A formulation that explicitly distinguishes between inflows, outflows, and evaporation would offer a more transparent representation of reservoir operations.

4. When discussing water stocks, the explicit focus on reservoirs raises the question: what about the natural lakes, aren't they sources of water for irrigation and other purposes in many parts of the globe? which can be substantial water stocks in many regions.

2.2.3 Groundwater pumping

5. Although the model distinguishes renewable from non-renewable groundwater pumping, it currently assumes no interaction between groundwater and surface water. Given that groundwater recycling, induced recharge, and lateral exchanges often play pivotal roles in water resource sustainability, especially under climate change scenarios, a more nuanced representation of groundwater-surface water interactions would be highly beneficial. Even if such dynamics are slated for future improvements, acknowledging current limitations and discussing potential impacts on long-term resource sustainability would enhance the study.

Section 2.2.7 Economics

6. The coupling of water supply dynamics with economic benefit functions (calibrated via the positive mathematical programming procedure) is strength of the methodology. However, the calibration of these economic functions and the underlying demand and cost parameters inherently introduces uncertainty. The paper would be strengthened by a clearer discussion or sensitivity analysis regarding the impact of parameter uncertainty, especially given that water pricing, elasticity, and sectoral cost estimates play a critical role in determining net benefits. A discussion on how these uncertainties propagate through the model would help evaluate the robustness of the policy simulations

Section 2.3 – Spatial delineation and node-link network

7. The pragmatic choice of using BCUs, defined as intersections of river basins with country administrative boundaries, effectively balances computational demands with spatial detail. However, this approach leads to heterogeneous spatial resolution, with some countries (e.g., the USA) represented in much finer detail than others. Such differences may influence the accuracy and policy relevance of country-specific outputs. While I am not suggesting a change to the model's fundamental structure, I recommend that the authors discuss how this heterogeneity might affect results and if there are any plans to explore alternative BCU delineations that could mitigate resolution bias, particularly in regions where aggregated representation may obscure important subnational variability.

2.4 Model database

8. Regarding Table 1, the reservoir area-capacity function slope is based on Yigzaw et al. (2018). Notably, there has been some critical review of this dataset—especially regarding the 'area-depth' relationship (see Shrestha et al., 2024, Figure 8). Although area-volume comparisons with other methods appear reasonable, it is unclear how sensitive the model is to potential flaws in this dataset. I recommend that the authors double-check this dataset

and verify whether any uncertainties in the area-depth relationship might have implications for their work.

Section 3: Water management scenarios

9. Scenario rationale and uncertainty: The paper presents an extensive set of 2050 water management scenarios under SSP2-RCP6.0. However, the exclusive focus on SSP2-RCP6.0 warrants further justification. Given the uncertainties in water supply prediction alongside those in water demand projections influenced by economic assumptions, the authors should discuss how these uncertainties might affect model outcomes. It would be useful to know whether alternative SSP-RCP combinations were considered or if sensitivity analyses were performed, with these insights ideally integrated into the discussion section.
10. Interdependencies in policy constraints and management strategies: Table 2 outlines detailed policy constraints for the scenarios (BAU, ENV, DM, NC, RES), yet the interplay between supply management and demand management strategies is not fully explained. I recommend that the authors provide a brief clarification on how these various constraints and the associated optimal allocation methods interact. This addition would enhance transparency in how water is allocated among sectors without altering the model's fundamental structure.