What Makes Recharge Effective for Streamflow Support? Lessons from Basin Scale Hydrologic Modeling

Shubham Tiwari[1], Claire Kouba[1], Leland Scantlebury[1], Bisrat A Yifru[1], Laura Foglia[1], and Thomas Harter[1]*

[1]University of California, Davis, Davis, CA, USA

***Keywords*:** Managed Aquifer Recharge, Climate Resilient Streamflow, Sustainable Groundwater Management

***Abstract*:**

Understanding what makes managed aquifer recharge effective for streamflow support is essential for sustaining groundwater fed rivers and associated groundwater dependent ecosystems (GDEs) during seasonal low flow periods in alluvial basins. Although winter recharge is widely promoted as a strategy to enhance summer streamflow, clear guidance on when and where it is effective remains limited.

This study evaluates the seasonal hydrologic response to winter managed aquifer recharge using an integrated basin scale modeling framework representative of irrigated alluvial valleys under Mediterranean climate conditions. A fully coupled soil water, groundwater, and surface water model was applied over more than 30 water years to capture interannual hydrologic variability. A winter recharge scenario was implemented during a representative high flow year, with approximately 3,600 acre feet of diverted surface water applied between January and March.

Results show that winter recharge enhanced streamflow for several weeks beyond the recharge period by strengthening stream aquifer connectivity, with benefits extending into late spring. However, sustained summer streamflow enhancement was limited, as recharge primarily contributed to groundwater storage rather than prolonged baseflow support. Recharge effectiveness was strongly controlled by spatial proximity to stream corridors and by timing relative to seasonal flow recession. These findings highlight key hydrologic controls that should guide recharge design to maximize ecological and water management benefits.

***Funding Acknowledgements**: This project is funded by California State Water Board Agreement # 21-066-300.*

***Contact Information for Presenting Author**: shtiwari@ucdavis.edu*