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Combined impacts of climate and socio-economic scenarios on irrigation water availability for a dry Mediterranean reservoir

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The impacts of climate and associated socio-economic changes on water availability, including supply and demand, quality, and storage volume, were evaluated for the Vale do Gaio reservoir in southern Portugal, located in a dry Mediterranean climate and already under drought stress. The SWAT model was applied with 6 scenarios for 2071-2100, involving two storylines (A1B and B1) with individual changes in climate (-9% annual rainfall, increasing in winter by +28 to +30%), socio-economic conditions (an increase in irrigation demand by 11%, and a replacement of cereals and pastures by sunflower), and a combination of both. Most future scenarios resulted in lower water availability, due to lower supply by streamflow (-19 to -27%) combined with higher irrigation demand (+3 to +21%). This resulted in more years with constraints on irrigation supply (presently: 28%; scenarios: 37 to 43%), although they were partially mitigated by lower losses due to storage excess discharge. However, land-use changes also decreased water quality by increasing sediment loads (+86 to +109%) and associated Phosphorus loads (+28 to +48%). This was mostly due to a projected replacement of existing pastures by sunflower cultivation for biodiesel, which was the major source of increased erosion. The combination of lower volumes and higher sediment and P flows also increased P concentrations in the reservoir (+29 to +93%), increasing conditions for eutrophication. Impacts were more severe in scenario A1B than in B1, and in combined changes than in climate or socio-economic changes alone. Water availability was resilient to climate change, as impacts led only to a moderate aggravation of present-day conditions. Lower future water availability could be addressed by improved supply and demand management strategies and, in the most extreme scenario, by water transfers from regional water reserves; future water quality issues, however, could be addressed through land-use policies aiming at soil protection.