**Mitigating salinity for improved watershed management and crop production**

Emmanuel Kwabena Opoku1, Ryan T. Bailey1, Miguel F. Acevedo2, Breana Smithers2

1 Department of Civil and Environmental Engineering, Colorado State University, 1372 Campus Delivery, Fort Collins, CO 80524, USA

2 Department of Electrical Engineering, University of North Texas, 1155 Union Circle #305340, Denton, TX 76203, USA

**Abstract.** This study explores the impacts of on-farm irrigation water desalination on the environment and agricultural sustainability in a semi-arid watershed. The purpose is to assess how varying desalination intensities affect hydrology, soil and water quality, and crop yield. We apply a comprehensive modeling approach using the SWAT-MODFLOW-Salt coupled surface-subsurface flow and salt reactive transport model to the Lower Arkansas River Basin. We found that increased desalination intensity reduces surface runoff and increases evapotranspiration rates. Notably, desalination significantly reduces salt ion concentrations in soil (up to 56%), which could positively impact soil health and plant productivity. In-stream salt ion concentrations also decrease, with up to 16% reductions seen for some salt ions. More intensive desalination efforts yielded greater reductions in Total Dissolved Solids (TDS) concentrations in groundwater highlighting improvements in groundwater quality. Crop yield analyses show increases in crop yield with increasing desalination intensity. Alfalfa is seen as the most responsive crop, showing a remarkable 18% increase in yield with 100% salt ion removal from irrigation water. These findings have implications for food security and agricultural sustainability, particularly in semi-arid and arid regions facing water scarcity and salinity issues. For future research, socio-economic analysis is needed to evaluate the economic viability and societal implications of desalination in agriculture, providing a holistic understanding of its potential benefits. This study contributes valuable insights into the impacts of desalination on agriculture and the environment, underscoring its potential as a sustainable water resource management strategy.