

Introducing *iwaqr*: an open-source integrated framework for irrigation water quality assessments and visualizations in R

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This abstract describes the structure, functionality, utility, and validation of the *iwaqr* package (version 1.8.4), developed at NCE in Geology. The *iwaqr* package provides an integrated framework for researchers, agronomists, and environmental scientists. This package streamlines the estimation of key irrigation water quality indices, including Sodium Adsorption Ratio (SAR), Sodium Calcium Adsorption Ratio (SCAR), Magnesium Hazard (MAR), Permeability Index (PI), Kelly's Ratio (KR), Potential Salinity (PS), Residual Sodium Carbonate (RSC), and Residual Sodium Bicarbonate (RSBC). These indices serve as crucial metrics for evaluating water suitability in agricultural contexts, aiding in sustainable irrigation management and soil conservation. Beyond numerical assessments, *iwaqr* also offers visualization capabilities, generating widely recognized irrigation water quality classification diagrams such as the US Soil Salinity Diagram (USSL), Wilcox Diagram, Riverside Diagram, and Doneen's Diagrams for varying permeability levels (Low, Medium, High). Built upon the *ggplot2*, *ggthemes*, and *ggrepel* libraries, the package enables the creation of high-quality, publication-ready visualizations with minimal user intervention. Functions such as *plot_USSL*, *plot_Wilcox*, *plot_Riverside*, and *plot_Doneen* allow users to generate these diagrams seamlessly by specifying essential parameters. Designed for flexibility and ease of use, *iwaqr* includes features such as automatic unit conversion from mg/L to meq/L, simplifying data pre-processing. Its *irrigationALL* function facilitates the simultaneous computation of multiple indices, storing results in a structured data frame for further analysis. This abstract presents the functionality and validation of the package and compares its utility with other well-known open-source and commercial software. The open-source package is available on CRAN and Github repositories. Future developments would include additional irrigation water quality metrics, visualizations, bug fixing, and the estimation of a composite index.

Keywords: Environmental informatics; R; *iwaqr*; irrigation waters; visualization; software