

# Agricultural Water Management

## Soil water balance models for determining crop water and irrigation requirements and irrigation scheduling focusing on the FAO56 method and the dual Kc approach

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### Abstract

This study reviews soil water balance (SWB) model approaches to determine crop irrigation requirements and scheduling irrigation adopting the FAO56 method. The Kc-ETo approach is discussed with consideration of baseline concepts namely standard vs. actual Kc concepts, as well as single and dual Kc approaches. Requirements for accurate SWB and appropriate parameterization and calibration are introduced. The one-step vs. the two-step computational approaches is discussed before the review of the FAO56 method to compute and partition crop evapotranspiration and related soil water balance. A brief review on transient state models is also included. Baseline information is concluded with a discussion on yields prediction and performance indicators related to water productivity. The study is continued with an overview on models development and use after publication of FAO24, essentially single Kc models, followed by a review on models following FAO56, particularly adopting the dual Kc approach. Features of dual Kc modeling approaches are analyzed through a few applications of the SWB model SIMDualKc, mainly for derivation of basal and single Kc, extending the basal Kc approach to relay intercrop cultivation, assessing alternative planting dates, determining beneficial and non-beneficial uses of water by an irrigated crop, and assessing the groundwater contribution to crop ET in the presence of a shallow water table. The review finally discusses the challenges placed to SWB modeling for real time irrigation scheduling, particularly the new modeling approaches for large scale multi-users application, use of cloud computing and adopting the internet of things (IoT), as well as an improved wireless association of modeling with soil and plant sensors. Further challenges refer to the use of remote sensing energy balance and vegetation indices to map Kc, ET and crop water and irrigation requirements. Trends are expected to change research issues relative to SWB modeling, with traditional models mainly used for research while new, fast-responding and multi-users models based on cloud and IoT technologies will develop into applications to the farm practice. Likely, the Kc-ETo will continue to be used, with ETo from gridded networks, re-analysis and other sources, and Kc data available in real time from large databases and remote sensing.