Spatial and Temporal Analysis of Application Efficiencies in Irrigation Systems for the State of California

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Abstract

Analyzing who is using the water, where, but most importantly, how efficiently, is important to identify enhancements already achieved and potential areas where further improvements can be made. *Application Efficiency* (*AE*) is a performance criterion that expresses how well an irrigation system performs when is operated to deliver a specific amount of water, for instance, the water requirements of a crop. *AE* is defined as the ratio of the average water depth applied and the target water depth during an irrigation event. The *average water depth* is the average height of water applied in a field during an irrigation event. The *target water depth* is the desired water to be supplied in a field during an irrigation event. The target water depth considered in this research is the *low quarter depth*, which is the average of the depths in the sections of the field that receive less water than the rest of the field (percentile < 0.25). Five irrigation surveys have been conducted in California: 1972, 1980, 1991, 2001 and 2010. These surveys have improved our understanding of the irrigations methods used on the various crops grown in California. The two primary goals of this project are: (1) estimate the spatial *AE* for different crops and hydrologic regions by using the irrigation surveys from 2001 and 2010 combined with theoretical AE values, and (2) create a geographic information system called California Irrigation Information System (CALIIS) to store and display this analysis. The primary target audience for the *AE* estimated in this report is regional/state water planners as well as large-scale water resource modelers. An extensive literature analysis was done to understand the relationship between *AE* and Distribution Uniformity (*DU*). A set of theoretical *AE* values were adopted considering the following assumptions: (a) irrigation surveys are representative samples of the population, (b) every farmer knew their irrigation system's *DU* and water requirements for their crops, (c) all farmers supplied exclusively the low quartile depth as the target water depth, and (d) water losses from the irrigation system were not considered. These assumptions allowed the use of *AE* values for hydrologic regions. Results show that averaged over all crops *AE* improved 3.0% statewide from 2001 to 2010. *AE* improved in all hydrologic regions of California, except in North Lahontan with a slight decrease of 0.1 % region wide. Sacramento River, South Coast and San Francisco Bay, are the hydrologic regions with highest increase in *AE*, 4.8%, 4.3% and 3.9% respectively. Similarly, the *AE* improved for all crops from 2001 to 2010, with highest *AE* values occurring in vineyards, subtropical trees, pistachio and almond and tomato. At least 14 crops improved their *AE* by 2% or more from 2001 to 2010: cotton, other field crops, cucurbit, onion and garlic, tomato (fresh and process, other truck crops, almond and pistachio, other deciduous, subtropical trees, turf grass and landscape, and vineyards. Further refinement in *AE* values is needed to reduce and address the uncertainty in the results presented