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## Whole-System Efficiency of Small- and Medium-Scale Reservoir-Based Irrigation Schemes in Northern Ghana

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### Abstract

The design of relevant adaptation strategies for water users in irrigation schemes in water-scarce regions of sub-Saharan Africa requires up-to-date information about the current performance of these schemes in view of rapid changes in climate and land use, population growth, and competing water demands. Many previous assessments concentrated on field-level crop irrigation but information on the schemes as the whole considering their multiple water users remains scarce. We evaluated the entire system of a small- and a medium-scale irrigation scheme shared by multiple users and included a water reservoir, water conveyance and distribution network, cropping fields, and the management entity in the Upper East region of Ghana. Multiple indicators relevant to water delivery and utilisation as well as to agricultural production during two consecutive dry seasons and the intervening rainy season were analyzed. The assessment has shown that technical factors such as underutilised reservoir storage capacity and deteriorated water delivery infrastructure strongly undermined the performance of the schemes. In particular, the medium-scale irrigation scheme utilised less than 40 % of the total storage, showing a huge need for improvement. The observations of the field-level irrigation practices suggest that an application efficiency of about 58–68 % is achievable in both irrigation schemes. The overall system efficiency can be increased from 50 % to about 68 % by reducing the large water conveyance network losses and by improving the irrigation scheduling at field level. The holistic approach considering all competing water demands is an appropriate method for performance evaluation of reservoir-based irrigation schemes in water-scarce regions.

**Keywords:** Field application efficiency, holistic performance assessment, multiple water users, overall system efficiency, small-scale irrigation schemes