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Mapping Irrigation Potential from Renewable Groundwater pan-Africa – an integrated approach

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Groundwater provides an important buffer to climate variability in Africa. Yet groundwater irrigation contributes only approximately 1% of the cultivated land as compared to 14 % in Asia. As opposed to previous country-based estimates, this study derives a continent-wide, distributed (0.5 degree resolution) map of groundwater irrigation potential, indicated in terms of fractions of cropland potentially irrigable with renewable groundwater. The method builds on an annual groundwater balance approach using 41 years of model data, allocating to groundwater irrigation the groundwater recharge in excess after satisfying other current human needs and environmental requirements, while disregarding any socio-economic and physical constraints in access to the resource. Due to high uncertainty of groundwater environmental needs, three scenarios, leaving 30, 50 and 70% of recharge for the environment, were implemented in a conservative estimate of the potential. In addition, current dominating crops and cropping rotations and associated irrigation requirements in a zonal approach were applied. Results show an inhomogeneously distributed gross groundwater irrigation potential across the continent, even within individual countries, reflecting recharge patterns and extent of cropland. Results further show that average annual groundwater available for irrigation ranges from 708 to 1669 km³ depending on scenario. The total area of cropland irrigable with groundwater ranges from 44.6 to 105.3 million hectares, corresponding to 20.5% to 48.5% of the cropland over the continent. The results are overlaid with socio-economic and physical parameters in order to identify the areas where agriculture development with groundwater irrigation is relevant. It appears that only 70% of the area identified with the groundwater irrigation potential approach are in socio-economic favorable areas for groundwater development for agriculture. Accounting for existing groundwater irrigation, residual irrigation potential remains high and relevant for poverty alleviation in the Sahel and Eastern Africa region.

Keywords: Groundwater irrigation potential, Africa, renewable groundwater, crop water needs, socio-economic factors, spatial analysis

