Innovative coupling of Hydrological modelling for IWRM: Linking catchment functioning with socio-economic conditions in the Olifants.

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Abstract

Computerised integrated models from science contribute to better informed and holistic ex-ante integrated assessments of multifaceted policies and technologies. This view has lead to considerable effort being devoted to developing integrated models to support decision-making under Integrated Water Resources Management (IWRM). Nevertheless, an appraisal of previous and ongoing efforts to develop such decision support systems shows that attempts to address the hydro-socio-economic effects on livelihoods have been deficient and fragmented. To date, no universal standard integration method or framework is in use. Existing integrated models application failures have pointed to the lack of stakeholder participation. In an endeavour to close this gap, this thesis focuses on an integrated model development with prediction capability, ICHSEA, developed in Avenues script language in ArcView 3.3, to take advantage of the mapping capability of ArcView. This model couples existing hydrology (SWAT), agronomy (PARCHED-THIRST) and socio-economic (OLYMPE) models to link livelihoods of resource-constrained smallholder farmers to water resources availability at catchment level in the semi-arid Olifants subbasin, South Africa. These three models were calibrated and validated using observed data and local stakeholder participation, prior to coupling in the integrated model. All the models performed well in representing the study conditions, as indicated by the statistical performance. The integrated model is generally applicable to any catchment. The study methodology was inspired by the need to enhance rural livelihoods and to close the gap of stakeholder involvement in building and applying integrated models to ensure acceptability and application in decision-making. Over 20 years, the predicted impacts of untied ridges and planting basins versus conventional rainfed tillage on surface runoff reduction were 14.3 % and 19.8 %, respectively, and about 41─46 % sediment yield reduction in the catchment. At 90 % confidence interval, family savings improved from US$ 4─US$ 270 under conventional rainfed to US$ 233─US$ 1 140 under supplemental irrigation. These results underscore the economic and environmental

benefits that could be achieved by adopting the new crop management practices. A relationship between maize crop evapotranspiration and family savings under different crop management strategies was also derived for five farm typologies in the catchment.

Keyword: Food security; Farming system, Hydrological; Integrated model; Environmental benefits