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Fuzzy and process modelling of contour ridge water dynamics

Alexander Mhizha (1) and John Ndiritu (2)

(1) Department of Civil Engineering, University of Zimbabwe, Harare, Zimbabwe, (2) School of Civil and Environmental Engineering, University of Witwatersrand, Johannesburg, South Africa

Contour ridges are an in-situ rainwater harvesting technology developed initially for soil erosion control but are currently also widely promoted for rainwater harvesting. The effectiveness of contour ridges depends on geophysical, hydro-climatic and socio economic factors that are highly varied in time and space. Furthermore, field-scale data on these factors are often unavailable. This together with the complexity of hydrological processes at field scale limits the application of classical distributed process modelling to highly-instrumented experimental fields. This paper presents a framework that combines fuzzy logic and process-based approach for modelling contour ridges for rainwater harvesting where detailed field data are not available. A water balance system for a representative contour-ridged field incorporating the water flow processes across the boundaries is integrated with fuzzy logic to incorporate the uncertainties in estimating runoff. The model is tested using data collected during the 2009/10 and 2010/11 rainfall seasons from two contour-ridged fields in Zhulube located in the semi-arid parts of Zimbabwe. The model is found to replicate soil moisture in the root zone reasonably well (NSE=0.55 to 0.66 and PBIAS=-1.3% to 6.1%). The results show that combining fuzzy logic and process based approaches can adequately model soil moisture in a contour ridged-field and could help to assess the water dynamics in contour ridged fields.