

Modelling the effect of rainfall variability, land use change and increased reservoir abstraction on surface water resources in semi-arid southern Zimbabwe

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Abstract

The semi-arid areas of Zimbabwe receive low and erratic rainfall such that communities living and farming in these areas do not obtain adequate yields in most years forcing them to rely on surface and ground water resources during the dry season and dry years. Such water, which is a buffer during dry seasons and dry years should be managed appropriately. However, appropriate management of the limited water resources in such areas is hindered by inadequate knowledge of the changes in water resources due to rainfall, runoff, evaporation, seepage and productive water use. Mutangi (5.7 km²) and Romwe (4.7 km²) micro-catchments that are in semi-arid Southern Zimbabwe were instrumented to enable measurements of all components of hydrology including rainfall, streamflow, dam water level, soil moisture and groundwater levels in the 1999/00 and 2000/01 season. Validation of the Agricultural Research Unit (ACRU) simulation model against field data revealed that ACRU adequately simulated measured streamflow, soil moisture and dam water storage changes. The model showed that removing all the remnant woodland and leaving all the cropped land fallow did not have a significant ($P < 0.01$) effect on both catchment streamflow and dam water level over the 27 year simulation period. However, planting trees over the whole catchment resulted in a significant decrease in streamflow by 51%. Construction of tied ridges significantly ($P < 0.05$) decreased streamflow from the catchment by 19%. Water abstraction from the dam could be increased 2, 4, 6, 8 and 10-fold without the dam drying to unacceptable levels (10% of dam capacity) except for 7%, 7%, 11%, 22% and 30% of the 27 simulation years (1972–1999) respectively. This demonstrates that currently small dams are not adequately utilized and vegetable yields and income could be increased by increased surface water abstraction.