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# Predicting runoff and phosphorus loads from variable source areas: A terrain-based spatial modeling approach

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## Abstract

Research has been conducted at Flaxley Agricultural Centre in South Australia to predict phosphorus loss in surface runoff from dairy pastures. Part of the research investigated if the topography based, spatially distributed hydrological model - TOPMODEL could be adapted to successfully predict phosphorus loads off dryland and irrigated catchments, where variable source area hydrology is considered a dominant

process. This was carried out by integrating one season of field measured runoff and P load data with rainfall and evapotranspiration data. The methodology uses TOPMODEL to simulate runoff volume and spatial extent of saturated areas, using a topographic index - ln(As/tanB) to distribute variable source areas across catchments, within a loose coupled GIS framework. Using the simulations of runoff from the dryland and irrigated catchments, phosphorus loads in surface runoff were then simulated, using an empirically established, terrain-based phosphorus load index relatable to variable source runoff (TOPMODEL-PLI). TOPMODEL was found to model runoff for dryland and irrigated catchments with some success, based upon one season of monitoring data. The dynamics of runoff events were reasonably accurately predicted. There was a tendency for TOPMODEL to over predict runoff volumes from catchments with a high average topographic index and under predict runoff volumes from catchments with a low average index. Results of modelling P loads using TOPMODEL-PLI for dryland and irrigated catchments were encouraging but the model tended to over estimate total P loads volumes off all catchments. A case assessment of the predicted P loads for one dryland and one irrigated catchment showed they were well within acceptable error limits. The modelled P load results may, in part be due to the accuracy of the load index that was used in TOPMODEL. Two issues are identified - the interpolation of soil P surfaces and robustness of the soil P-runoff P relationship used to establish the load index. TOPMODEL-PLI performance for catchments at FAC is encouraging. Although the prediction of P load was within acceptable error it may be improved by further research into the soil P:runoff P relationship which underpins the phosphorus load index.

# Keywords

TOPMODEL; Hydrological modelling; terrain analysis; surface water; phosphorus

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