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Application of fuzzy decision trees in predicting phosphorus retention and delivery in headwater catchments in the UK

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The UK governments R & D programme of phosphate (P) research has recently led to considerable advances in our understanding of how P moves through the landscape.

The potential diffuse and point sources of agricultural P and the transport routes it may follow within the landscape have received considerable attention. Diagnostic models such as the P Indicators Tool (Heathwaite et al. 2003) have been used to predict the risk of P losses from different areas of agricultural land to watercourses. These models embody the source-mobilisation-delivery-impact framework as a simple logical summary of process understanding, however, the assessment of P delivery has been neglected in the past (Beven et al., 2005). Models such as PIT, PSYCHIC (see www.psychic-project.org.uk) and INCA-P (Wade et al., 2002)) models requires further refinement and development of their P delivery coefficients and as a result an alternative approach to the estimation of P delivery coefficients has been developed.

Here we present a fuzzy decision-tree approach to predict the delivery of P to water bodies. The approach makes use of national coverage data held within a GIS at the

$1km^2$ scale, in combination with a 'field toolkit' of measurements and qualitative observations to both constrain the uncertainty associated with model predictions and to be explicit as to the quality of predictions that are possible given the limitations of existing data and understanding. The field-based measurements allow the incorporation of a standardised soil P test (DESPRAL, Quinton et al., 2003) to characterise soil P status with other qualitative variables such as the degree of retardation or acceleration of P delivery afforded by topographic features including hedgerows, ditches and field drains.

Results are presented for a number of 'data rich' first-order, agricultural catchments where monitoring of P has occurred over recent years enabling evaluation of the modelling and field toolkit approach.