Phosphorus runoff risk from different fertilizer strategies using rainfall simulation and Bayesian modeling

Lucy Burkitt[1], Warwick Dougherty[2], Ross Corkrey[1], Shane Broad[3]

[1] *Tasmanian Institute of Agricultural Research, University of Tasmania, TAS, Australia;* [2] *Science, Innovation and Performance, Industry and Investment New South Wales, Richmond, NSW, Australia;* [3] *Tasmanian Institute of Agricultural Research, University of Tasmania and CSIRO Sustainable Ecosystems, TAS, Australia.*

Lucy.Burkitt@utas.edu.au

The general increase in soil phosphorus (P) fertility concentrations to optimum or above optimum concentrations under intensively managed pastures in Australia has contributed to greater adoption of a strategy of split P maintenance applications, (i.e. multiple small applications within a year), which in total are equivalent to the annual maintenance P requirements. Although lower rates of P fertiliser generally result in disproportionately lower surface runoff P concentration, there has been very limited research comparing total P losses generated from several smaller applications of P to the same total P rate applied in a single application. This information is essential as lower runoff concentrations associated with multiple smaller applications may be countered by the greater likelihood of runoff occurring soon after one of these applications. In this study we applied a novel approach which combined runoff P concentration data from rainfall simulation trays and long term runoff data from two contrasting catchments using Bayesian statistics to compare the long term risk of P loss in runoff from single and split P fertiliser application strategies.

The single application of 40 kg P/ha resulted in disproportionately high runoff P concentrations should runoff occur at short times since fertilizer application. However, when runoff concentration and temporal understanding of runoff were combined in the Bayesian model, we found that the 3 applications of 13.3 kg P/ha resulted in a greater risk of P runoff compared to a single application of 40 kg P/ha as splitting P fertilizer applications increased the likelihood of a coincidence of fertilizer applications and runoff occurring. We found that the overall risk of P runoff is also increased in catchments where the rainfall/runoff pattern is less predictable, compared to catchments where rainfall/runoff is winter dominant. This suggests that land managers should apply P fertilizer less frequently and only during periods of the year when surface P runoff risk is low.