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Linking on-farm change to catchment response using dynamic simulation modelling: assessing the impacts of farm-scale land management change on catchment-scale phosphorus transport processes and water-quality.

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Australian Natural Resource Management and Agri-industry Development agencies have recently invested considerable resources into a number of research and development projects that have investigated the actual and potential economic, social and, particularly, environmental impacts of varying farming activities (with a strong focus on dairies) in a "catchment context". These activities have resulted in the development of a much-improved understanding of the likely impacts of changed farm management practices within the farms and regions in which they were investigated, as well as the development of a number of conceptual models which place dairy farming within this broader catchment context.

The project discussed in this paper was charged with the objective of transforming these conceptual models of dairy farm nutrient management and transport processes into a more temporally and spatially dynamic model. This could then be loaded with catchment-specific data and used as a "policy support tool" to allow the Australian dairy industry to examine the potential farm and catchment-scale impacts of varying dairy farm management practices within some key dairy farming regions. This paper describes the series of dynamic models and farm management – land use scenarios which were executed to examine these issues.

Models were developed, validated and calibrated for the Peel-Harvey catchment in Western Australia and the Gippsland and Latrobe (a sub-catchment of Gippsland) catchments in Victoria.

Scenarios which range from simple, on-farm riparian management, through changes in fertiliser application rates, to gross changes in the land use mosaic were examined and described in terms which included changes to phosphorus (P) loss rates at the farm scale, the relative contributions to catchment P loads from dairying and, ultimately, changes to downstream water quality.

A comprehensive suite of scenarios and policy options was examined but, in summary, the results indicate that whilst broadscale implementation of dairy farm environmental best practices can go some way towards reaching farm and catchment-scale water quality and sustainability targets, the effectiveness of most of these practices is limited. Changes to actual nutrient input rates are shown to have the most impact on nutrient loss rates at both the farm and catchment scales, but these improvements in environmental quality come at a considerable cost to dairy productivity. Furthermore, because dairying as a land use occupies only a small percentage of the areal extent of the catchments investigated, changes to other land uses within the catchment, or changes to the regional landuse mosaic are shown to change downstream water quality response much more than can be achieved by changes to dairy farm management practices alone.

The major implications from this research are that the broad-scale effectiveness of the implementation of environmental "best practice" is limited by the extent to which these practices are actually adopted within their industries, and where they are implemented in the nutrient management "treatment train" (from fertiliser input to ultimate nutrient loss to waterways). The importance of "contextualizing" the roles of the variety of catchment neighbours and their ultimate potential to influence water quality at the catchment scale is also clarified.