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Linking local soil transport processes to catchment hydrology and policy options
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A dualism between measurement-modelling is needed to link knowledge of water and nutrient losses at the local scale in order to understand hydrology at the catchment scale. New measurement technologies and networks of remote devices, aided by a suite of rapidly improving modelling techniques, are leading to the development of knowledge to link land management of the catchments inventory of natural capital stocks to the diverse ecosystem services that flow from them (Clothier et al., 2011).

Tension fluxmeters, which mimic local hydraulic conditions in the field, are reasonably priced devices that can be installed in networks across catchments and connected wirelessly to record drainage in real-time. This enables timely manual sampling of their reservoirs to determine nutrient leaching. The results from our network of over 400 fluxmeters in New Zealand, Australia, Korea, and the Pacific Islands are providing detailed information to parameterise our mechanistic transport models. As we show, these biophysical models of transport in soil can then provide detailed understanding from which we can develop meta-models of leaching at the farm scale. From this meta-modelling, nutrient leaching from the patchwork of farm enterprises can linked to the measured quality of receiving water bodies. A challenge is to understand and model the attenuation of nutrients through the diverse transport-pathways to the receiving water bodies. Our initial attempts, just based on empirical inference, are described.

Policy to improve catchment-wide outcomes can take various forms: be it by direct regulation of nutrient inputs, or by grand-parenting through benchmarking and then mandating for a reduction in nutrient losses. Alternatively, this can be done by assessing the value of the provisioning ecosystem services flowing from the landscapes natural capital stocks. We discuss the merits and disadvantages of the various approaches that have been used in different jurisdictions in New Zealand to address the critical issue of water quality in catchments.

Reference: Clothier, B.E., A.J. Hall, M. Deurer, S.R. Green and A.D. Mackay 2011. Soil Ecosystem Services: Sustaining Returns on Investment into Natural Capital. In: Sustaining Soil Productivity & Climate Change: Science, Policy and Ethics, Wiley-Blackwell, Chapter 9, pp 115-137.

Figure. Left: Installing tension fluxmeters in an apple orchard in Australia. Right: Measurements of cumulative drainage and cumulative leaching of nitrogen from two different New Zealand apple orchards.

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