Adaption of the LUCI framework to account for detailed farm management: a case study exploring potential for achieving locally and nationally significant greenhouse gas, flooding and nutrient mitigation without compromising livelihoods on New Zealand farms

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This talk discusses recent progress in adapting the Land Utilisation and Capability Indicator (LUCI) framework to take account of the impact of detailed farm management on greenhouse gas emissions and on water, sediment and nutrient delivery to waterways.

LUCI is a land management decision support framework which examines the impact of current and potential interventions on a variety of outcomes, including flood mitigation, water supply, greenhouse gas emissions, biodiversity, erosion, sediment and nutrient delivery to waterways, and agricultural production. The potential of the landscape to provide benefits is a function of both the biophysical properties of individual landscape elements and their configuration. Both are respected in LUCI where possible. For example, the hydrology, sediment and chemical routing algorithms are based on physical principles of hillslope flow, taking information on the storage and permeability capacity of elements within the landscape from soil and land use data and honoring physical thresholds, mass and energy balance constraints. LUCI discretizes hydrological response units within the landscape according to similarity of their hydraulic properties and preserves spatially explicit topographical routing. Implications of keeping the "status quo" or potential scenarios of land management change can then be evaluated under different meteorological or climatic events (e.g. flood return periods, rainfall events, droughts), cascading water through the hydrological response units using a "fill and spill" approach.

These and other component algorithms are designed to be fast-running while maintaining physical consistency and fine spatial detail. This allows it to operate from subfield level scale to catchment, or even national scale, simultaneously. It analyses and communicates the spatial pattern of individual provision and tradeoffs/synergies between desired outcomes at detailed resolutions and provides suggestions on where management change could be most efficiently targeted to meet water quality targets while maintaining production.

Historically, LUCI has inferred land management from nationally available land cover categorisations, so lacked the capacity to discriminate between differences in more detailed management (tillage information, type of irrigation system, stocking numbers and type, etc). However, recently a collaboration with a farmer cooperative has commenced. LUCI is being further developed to take in a range of more detailed management information, which can be entered directly to LUCI or easily integrated via existing farm management files. Example output using a variety of management scenarios and ongoing "validation" of LUCI's performance at the farm scale will be presented using New Zealand crop, beef and dairy farms as case studies.