Targeting perennials to balance profit, water yields and salt loads

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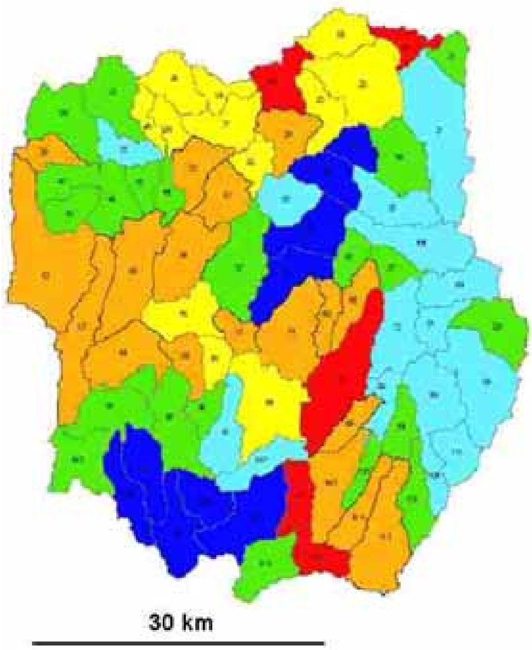
In the slopes region of New South Wales, the planting of perennial vegetation is promoted as part of the strategy for salinity management. Recent modelling has highlighted the need for care about where in the landscape these are established. Poorly sited perennials can result in major economic costs to landholders, major losses of freshwater additions to rivers, and can even make salinity concentrations in the rivers worse. On the other hand, well located perennials can substantially reduce salt concentrations without excessive costs in terms of farm production or river flows.

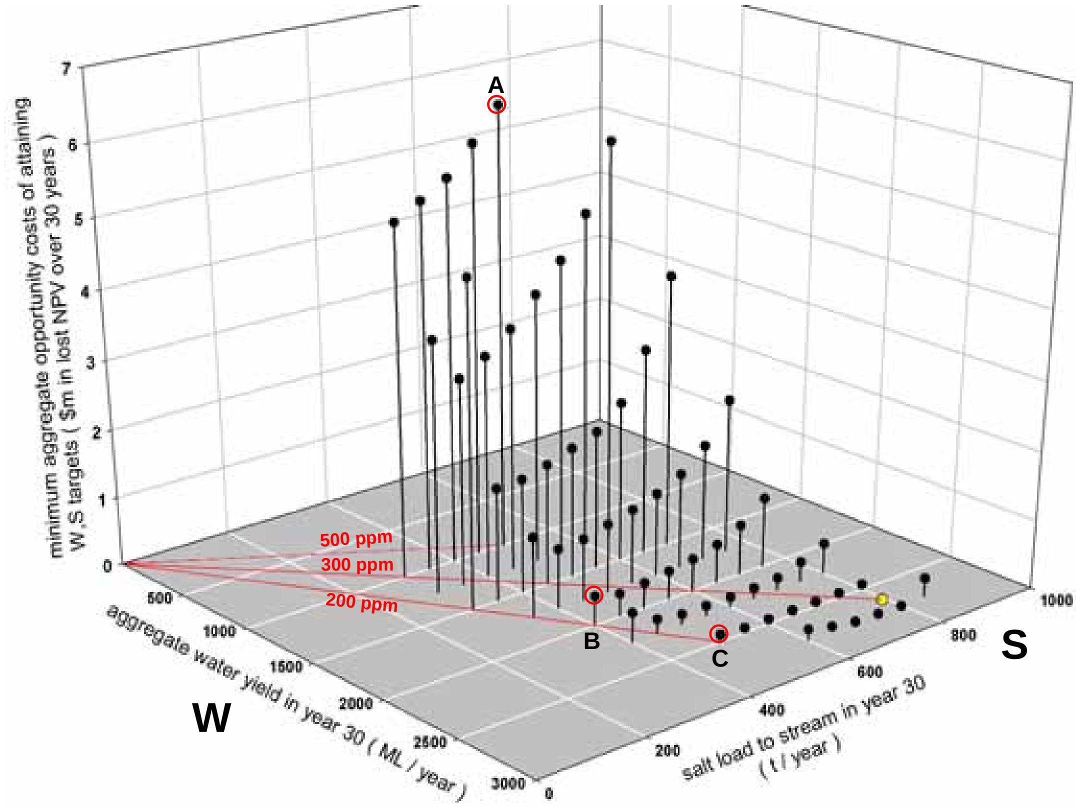
Our modelling allows us to estimate the trade-offs among profitability, water yield and salt concentrations by integrating information on land use, plant water use, rainfall, soils, groundwater salinity, catchment hydrogeology, and economics.

Contributions to stream water flow and salt load differ widely among sub-catchments depending on groundwater salinity, soils and current land use. For example, the 80 sub-catchments of upper Little River were classed into six groups according to their soils and contributions of water yield and salt load to the river (see map). Red indicates sub-catchments that deliver flows of high salt concentration; bark blue sub-catchments are the freshest. There are four in-between salt levels: pale blue (relatively fresh) and progressively saltier green, yellow and orange.

A range of W,S (Water yield, Salt load) targets can be met in the future by changing land use now. The minimum cost of attaining a specific target is illustrated in the 3-D chart below for a mini-catchment of just three sub-catchments (one red, one green and one dark blue) having a total of 4700 ha. High water yields and high profits are associated with cleared land under cropping, while forests are at the lower end of the spectrum for these outputs; improved perennial pastures are in between. The average W,S levels under current land use are shown by the yellow dot.



Economic analyses, carried out for selected water and salt targets, identified the most profitable set of land use options, including perennials and annuals of all types, that could attain the W,S target was for each situation. The profit level under current land use, minus the best profit for attaining a particular W,S target, is the opportunity cost to the land owner.



Current flows from our example 3-subcatchment mini-catchment deliver a stream salt concentration of 300 ppm (500 EC). Changes in land use offer a range of 200 to 500 ppm (320 to 800 EC) in the future.

Three example targets (A, B and C) illustrate trade-offs between farm economics, downstream water volumes and salt loads. Target A is attainable but, compared to the current set of land uses, it incurs over $6m in cost (lost profits), lowers annual stream flow by 1500 ML and increases stream salinity from 300 to 500 ppm: a lose, lose, lose option. Target B halves current salt load, costs $0.4m and 500 ML stream flow, but improves stream salinity to 200 ppm. Target C offers the same improvement in water quality as B but costs only $0.1m with little loss in stream flow.

Finding the “best” target is a question of weighing up the agricultural costs against downstream demands for water and water quality. Our framework captures the complex links involved and presents to decision makers the full set of tradeoffs on the supply side. Downstream demands for water and water quality by towns, irrigators and for environmental flows comprise the other side of the question. In regions such as the Little River catchment, where flows of fresh water into rivers are significant, a capacity to use such a framework is crucial if resource managers are to avoid the risk of making river salinity worse while also causing major losses of profits and water flow.

(For details see: http://een.anu.edu.au/e05prpap/nordblom.pdf)