"Modelling gross margins and potential N exports from cropland in south-eastern Australia"
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Nitrogen (N) fertiliser can represent >30% of the variable costs associated with crop production in south-eastern Australia. When exported offsite, that N can impair downstream water quality and represents a wasted resource. Most tools used by consultants and farmers to help them determine the fertiliser strategy for different areas of their farm do not specifically consider the environmental consequences of their decisions. There is a common perception that improved economic performance comes at the expense of impaired environmental performance.

This study simulated the economic and environmental performance of three types of wheat sown into soils with three initial N concentrations and using ten different fertiliser management strategies. The Agricultural Productions Systems Simulator (APSIM) was used to model crop yields for which gross margins were estimated and a Bayesian Network was used to estimate environmental risk. The study area was Dunkeld (142^{o}34'E, 37^{o}65'S) in south-eastern Australia which usually has *c.* 620 mm of predominantly late winter and early spring rainfall. Temperatures are highest in summer (i.e. mean monthly maximum *c.* 26^{o}C in February) and lowest in winter and soil profiles are characterised by a fine sandy/silty clay loam to 250 mm overlying heavy clay.

The crop modelling suggests that: (a) irrespective of fertiliser application rates, for this area crops grown on soils with higher initial N concentrations are generally higher yielding; and (b) gross margins generally increased with fertiliser application rate but with decreasing marginal returns to fertiliser. The Bayesian Network suggested that transport factors (i.e. volume of drainage) have more impact than source factors on N exports. That result implies that the reductions in drainage volumes from improved crop growth, which are linearly related to N exports at constant N concentrations, potentially have a greater impact on N exports than the increased N concentrations resulting from the additional fertiliser N applications used to achieve that extra growth.

Based on economic and environmental considerations fertiliser recommendations for the Dunkeld regions were developed. It would appear that for low N concentration soils more than 10 kg N/ha is needed at sowing. For soils with medium to high N, short and medium season wheat varieties need only 10 kg N/ha, while long season varieties require more than 10 kg N/ha, at sowing. Additional N fertiliser can be applied after sowing to maximize gross margins, taking into account potential crop yield and seasonal conditions.

Interestingly, plots of projected N exports against projected yields and associated gross margins,

suggest that, compared to the current situation where farmers increase their gross margins, they are simultaneously improving their environmental performance. This is counter intuitive as it implies N fertiliser applications can lessen N exports but is consistent with the transport and source relationships encapsulated in the Bayesian Network. The finding that economic and environmental objectives are not necessarily antagonistic reinforces the importance of considering within farm processes (i.e. the complexity of agricultural systems) when assessing potential environmental impacts. It would appear that for the Dunkeld region flexible cropping systems that maximise crop potential with minimum sowing N, maximise both economic and environmental performance.

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