STAG Modelling of Rotorua Catchment: Initial results

The STAG model

The STAG model uses 43 different drystock and dairy farm systems (plus a forestry model) to represent the commercial farming proportion of the Rotorua catchment. To ensure the geophysical diversity of the catchment is represented, these systems are split across:

- Allophanic, podzol, pumice, recent and organic soils
- Rainfall bands from less than 1400mm to more than 2500mm
- Slopes of 0-8d, 8-16d, 16-26d and more than 26d

These different farms systems have at least 208 management options that enable them to mitigate. These management options are constrained by a range of factors such as pasture production curves, mowable area and the need to retain a realistic stocking rate that maintains pasture quality. The management scenarios do not allow changes that would require increases in farmer skill, animal genetics, or pasture genetics (or other limitations) such as increased productivity.

The model allows each farm to mitigate as far as is logical, then to trade nutrient loss allowances. If it is more profitable for a farm to operate above its initial allocation, it will buy allowances. This cost is incorporated into effects on profit via an annualised cost of capital. If selling allowances below their initial allocation is more profitable, a farm will mitigate or change land use and sell the surplus. The incentives fund operates as a buyer on the open market, seeking to buy the same proportion of allowances from the commercial sector as from the non-commercial sector.

Changing land use is not costless, so transition costs are built in (for example, the cost of adding wires to fences or building milking sheds). These costs have a significant impact on behaviour (for example, we do not see conversion to dairy even under equal allocation, due to the cost of buying allowances, building infrastructure and then running a relatively low-intensity system.

Trading efficiency

Impacts are very different with efficient and inefficient trading. In general, the further an option is away from the status quo, the more trading is required in order for farms to optimise their profit. The least amount of trading is required from the range scenarios and the most trading is required from equal allocation.

We have modelled inefficient trading for these high and low-impact scenarios. Rather than just generally restricting the allowances that are traded, we have assumed that inefficiency would arise from a farmer choosing to not change land use, even if there is a more profitable option. The impacts of very inefficient trading are very severe for scenarios like equal allocation.

Initial runs

So far, six allocation options have been modelled. This is an initial run. It is relatively straightforward, quick and costless to try out different scenarios and options, depending on what questions STAG wants to answer. For example, there are a number of different ways of translating the sector averages and ranges into Overseer V6, and it is not clear that the same outcomes sought from the original numbers will be met in the new version of Overseer. Alternative ranges could be tested.

There is also a large amount of additional detail that can be generated describing the impacts across different geophysical zones and farm systems within sectors (e.g. impact on pumice dairy farms vs. impact on podzol dairy farms).

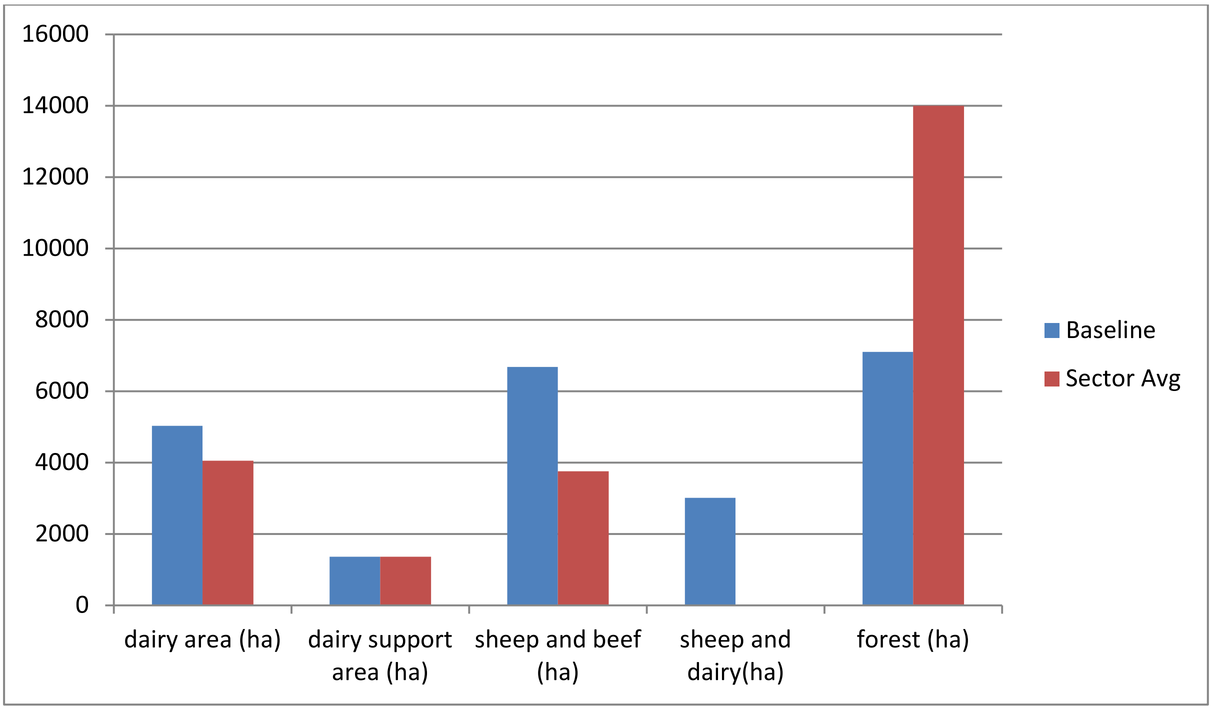
Allocation options

Option	Description
Sector averages	Flat rate averages for dairy and drystock (46 and 21kg/ha/yr)
Sector geophysical averages	Averages adjusted for geophysical impacts on leaching
Clawback with sector ranges	% clawback from initial benchmarks with drystock in 16-32kg range and dairy in 39-52kg range
Clawback with single range	% clawback from initial benchmarks with all land uses in 16-52kg range
Natural Capital	Allocation based on productivity of the land (based on
Equal allocation	Allowances averaged over land <26d

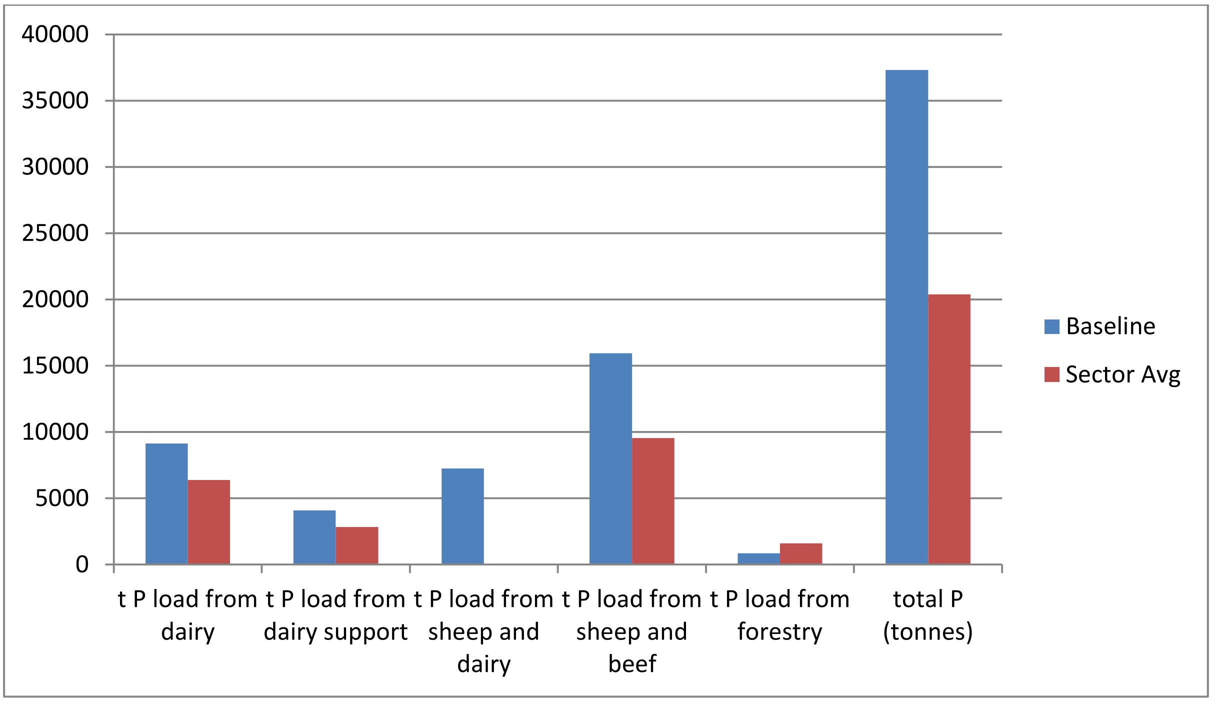
High-level impacts

Some impacts are relatively consistent across the whole catchment, regardless of allocation option. This is particularly so with efficient trading.

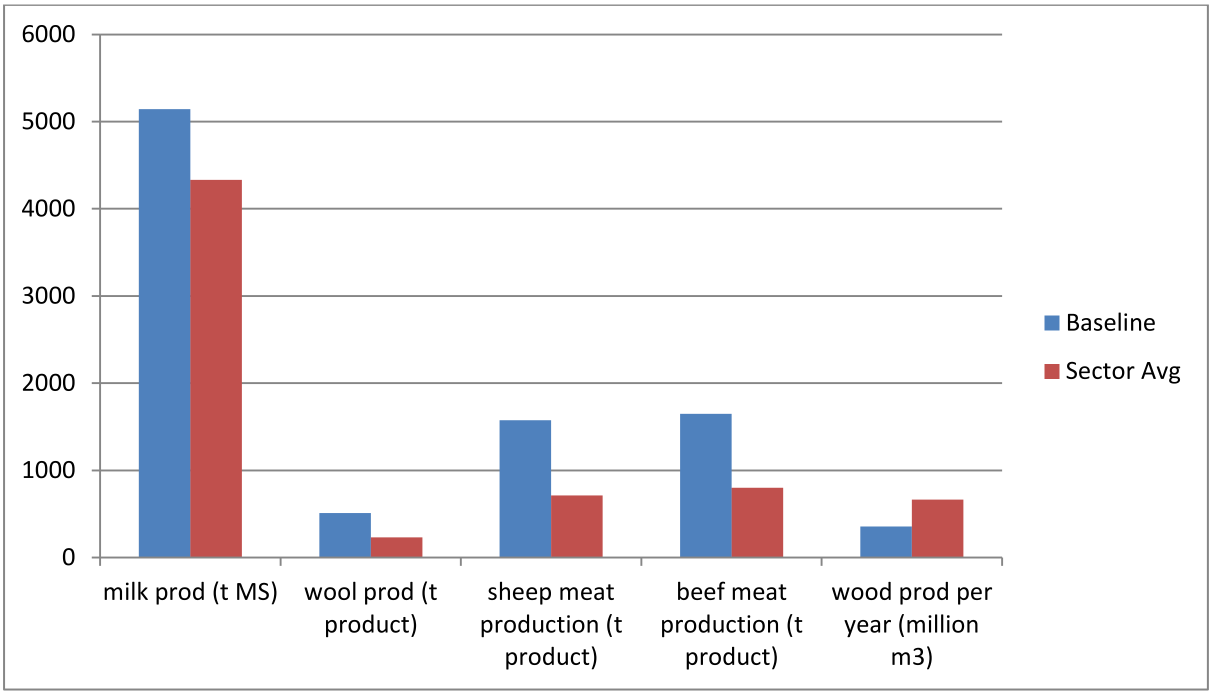
Land use change



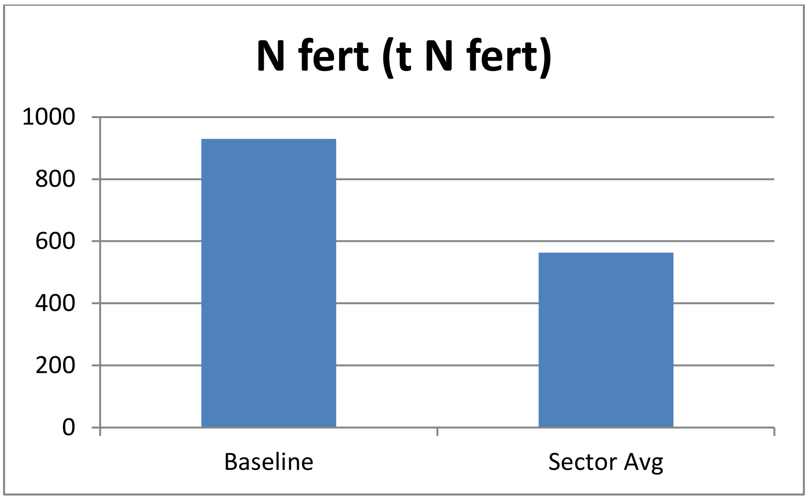
Phosphorus load

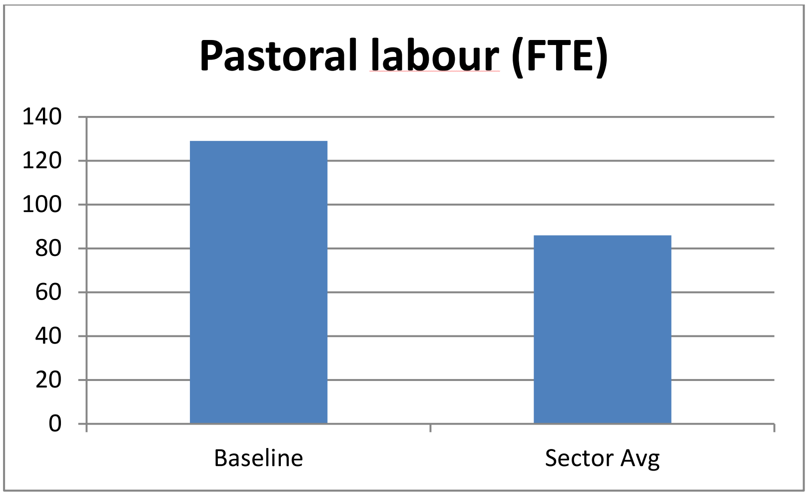


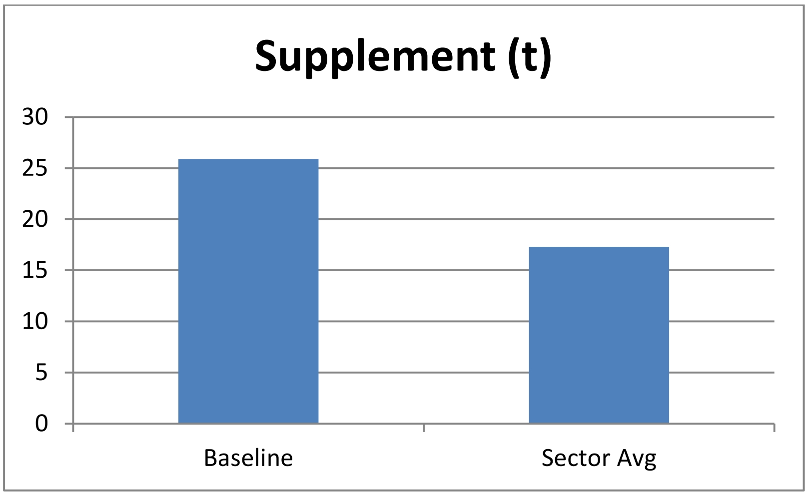
Changes in production



Changes in management

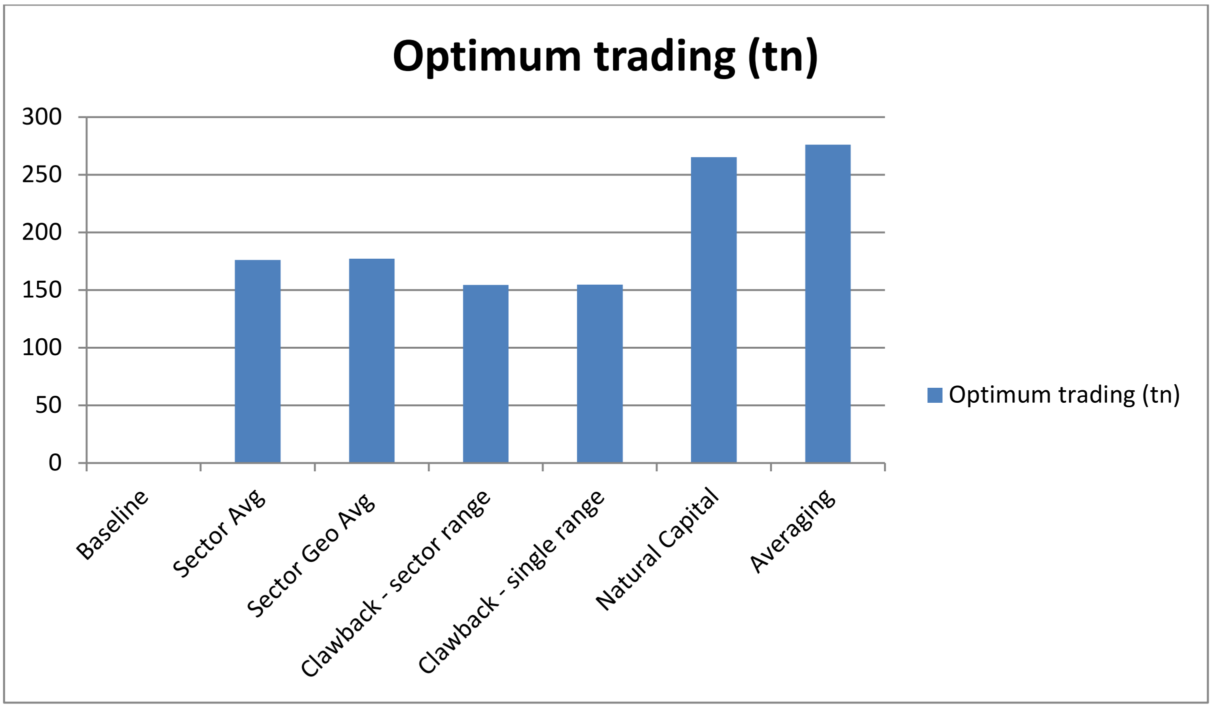




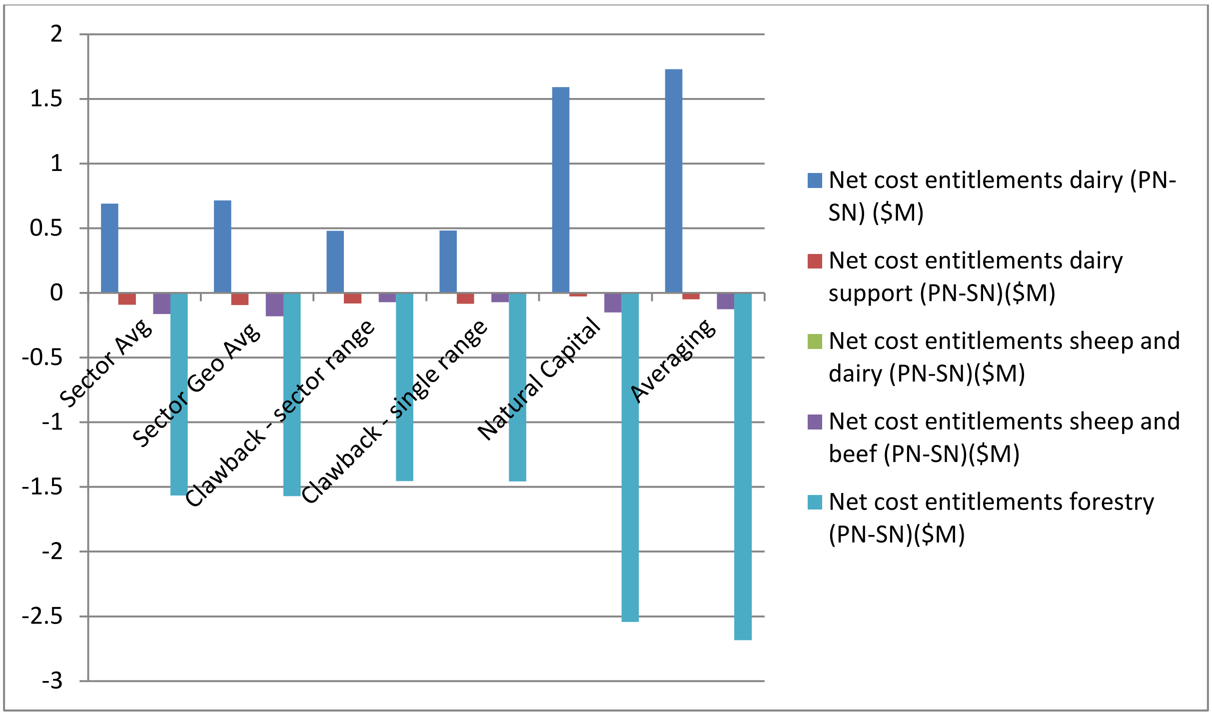


Variations across allocation options

Trading needed to reach efficient management

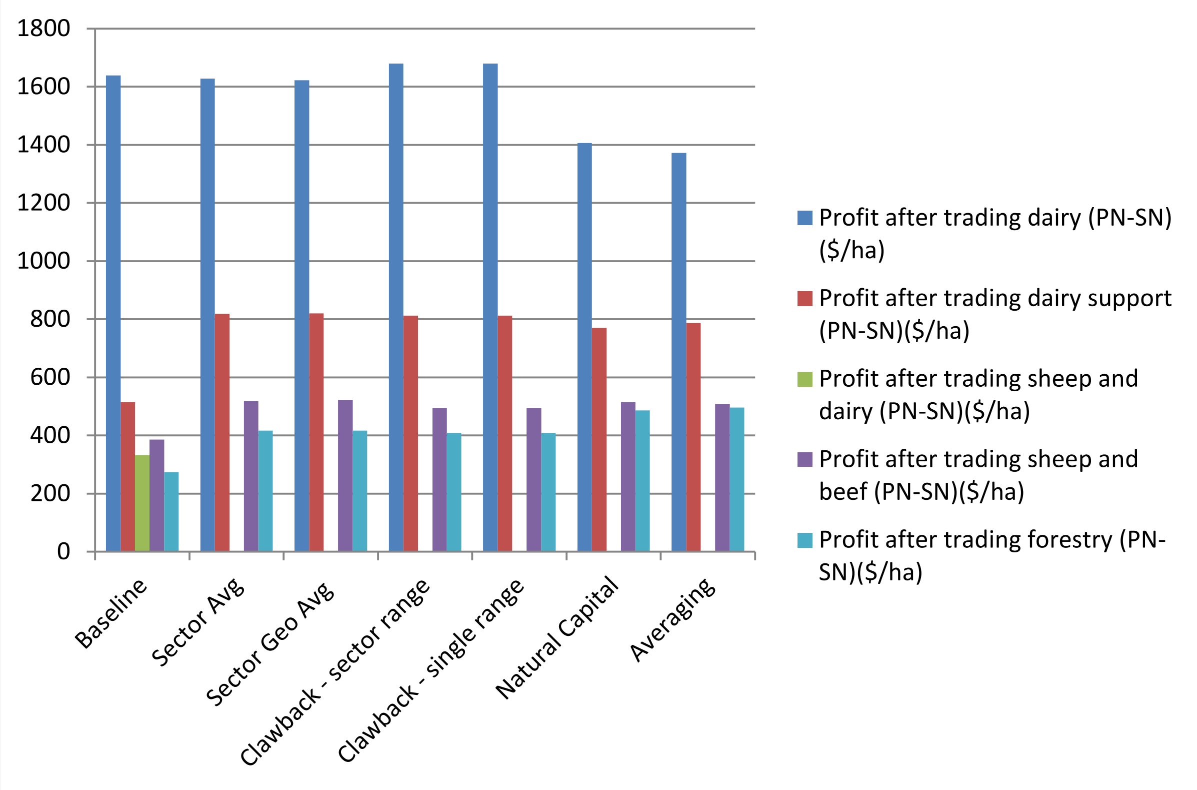


Distribution of money spent on N allowances



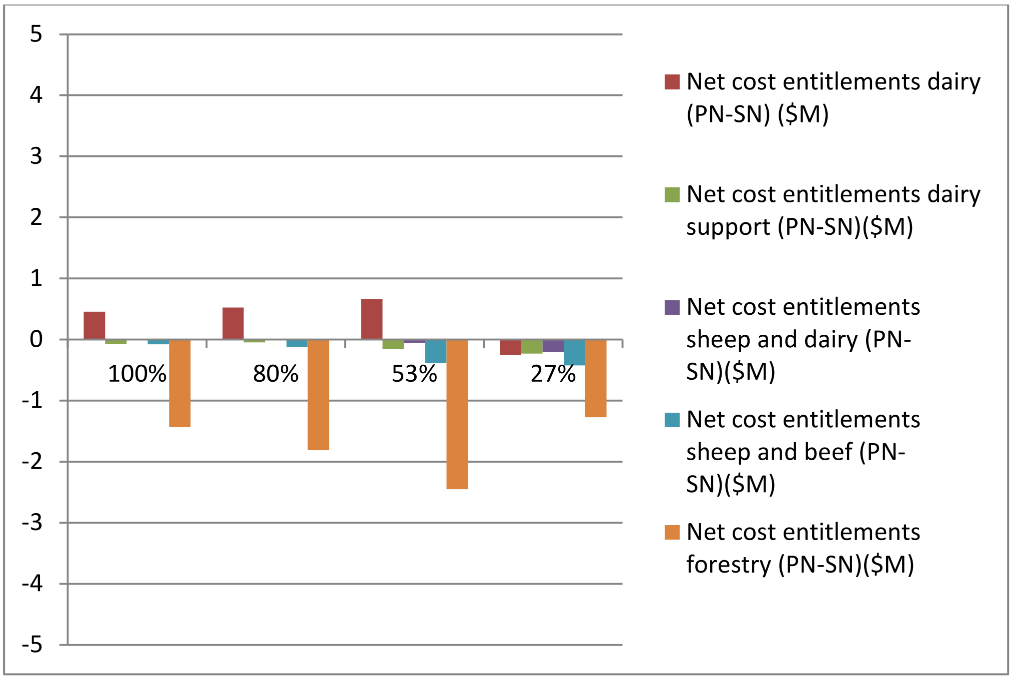
Changes in profit

*Note the increases in profit per hectare in some sectors across some land uses. This does not mean an increase in overall profit or revenue. Rather this reflects that some more marginal land has converted and sold off N allowances, which increases the average profit per hectare of the remaining land.

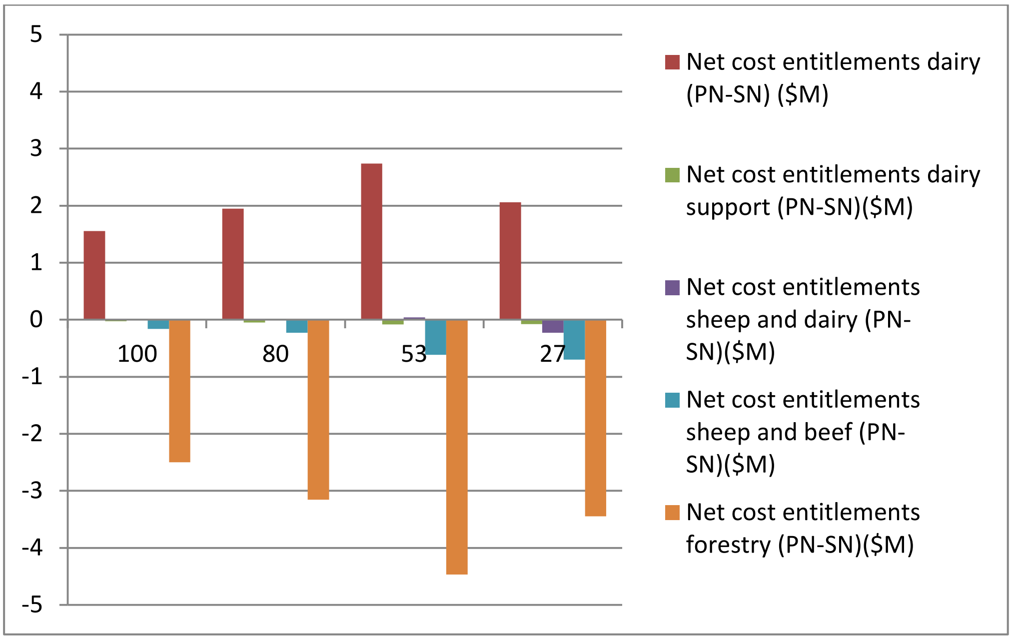


Effects of inefficient trading

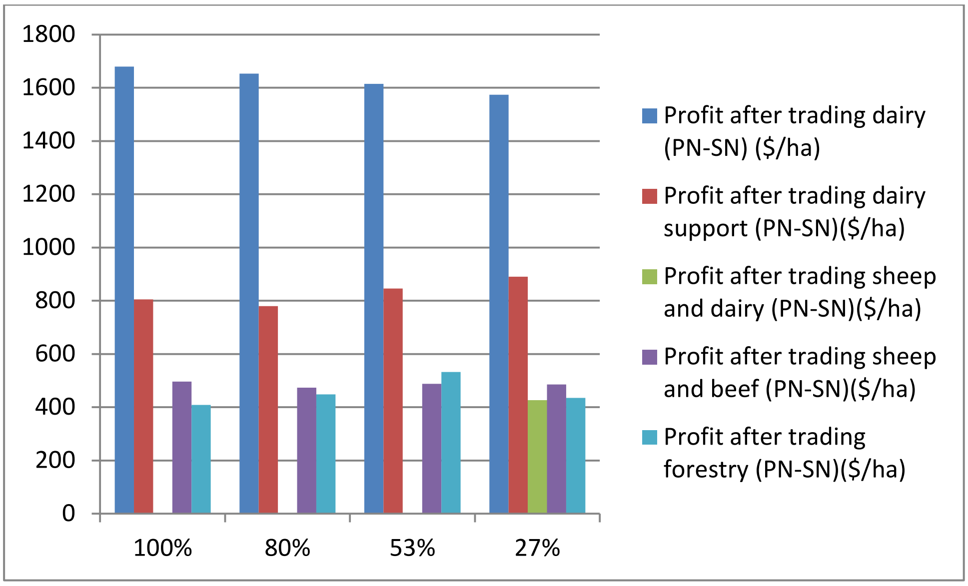
Distribution of money spent on N allowances for <u>Sector Range scenario</u> with different levels of the optimum land use change



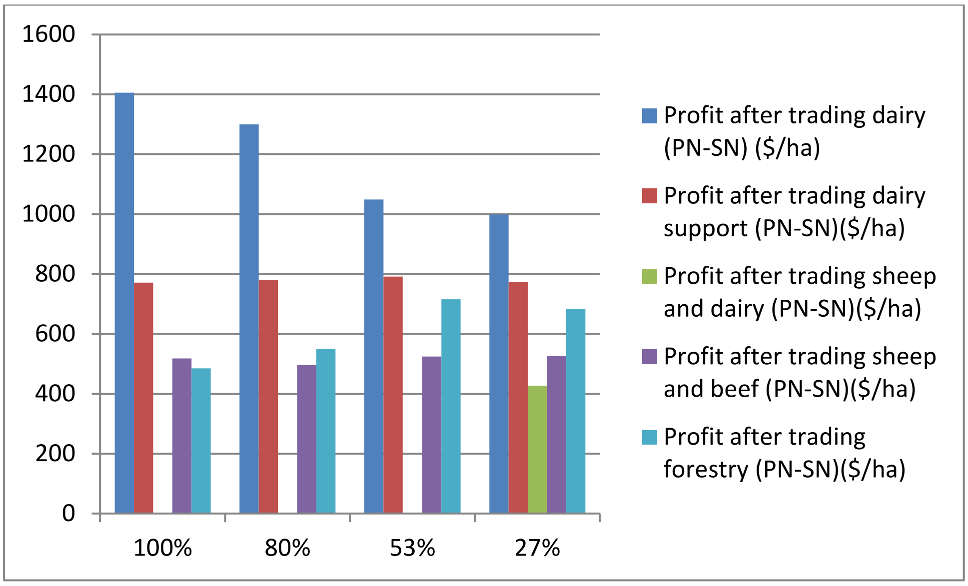
Distribution of money spent on N allowances for Equal Allocation scenario with different levels of the optimum land use change



Profit per hectare for Sector Range scenario with different levels of optimum land use change

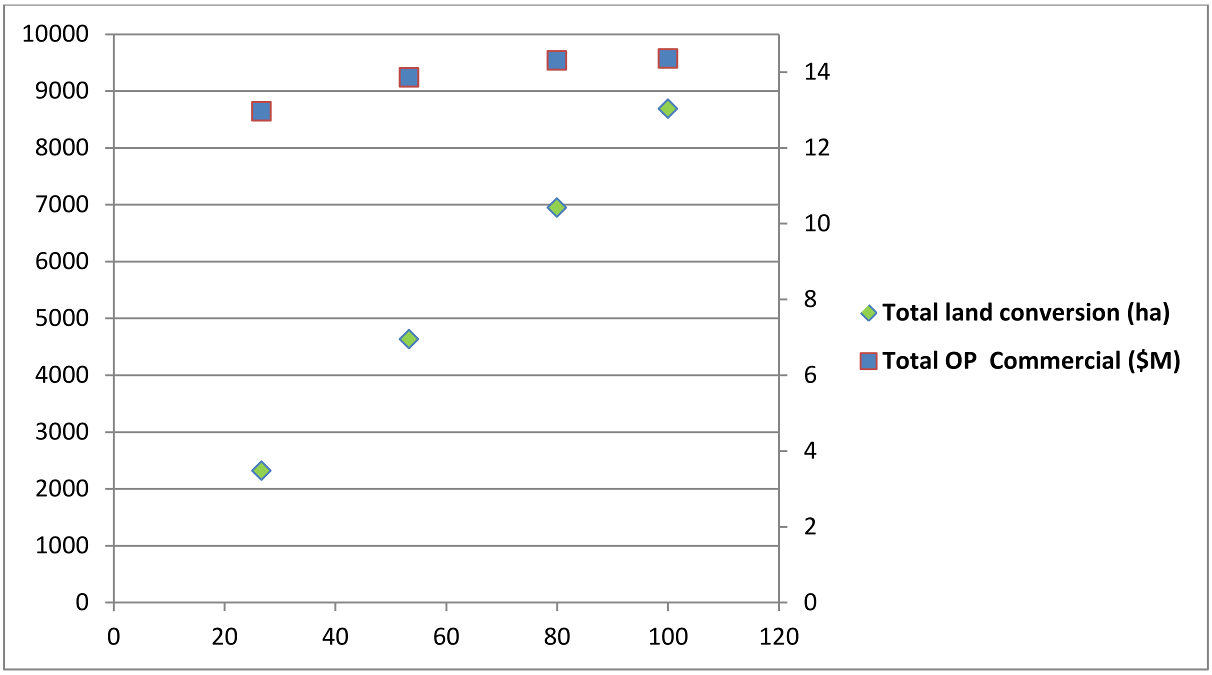


Profit per hectare for Equal Allocation scenario with different levels of optimum land use change



Total catchment profit for Equal Allocation scenario with different levels of optimum land use change

*Note this needs to be followed up with scenarios featuring catchment revenue, as well as profit. Other studies indicate that revenue falls much faster than profit.



Price of N for Equal Allocation scenario with different levels of optimum land use change