Growing for good: producing a healthy, low greenhouse gas and water quality footprint diet in Aotearoa, New Zealand

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HEALTHIER LIVES | He Oranga Hauora | National SCIENCE Challenges

OUR LAND AND WATER | Toitū te Whenua, Toiora te Wai | National SCIENCE Challenges

The consequences of our diet and food system…

- A shift towards processed foods and away from plant-based diets has coincided with a rise in cardiovascular disease, cancer, and diabetes (now account for 73% of deaths worldwide).
- We can grow a lot of food (enough for 40 million people).
- International markets have long dictated what is grown in NZ (because we grow profitable food well). However, owing to imbalances in what is grown and needed, 40% of adults and 20% of children live in a household with severe to moderate food insecurity.
- Poor diets and food insecurity cost us $14B annually.

Our aim was to…

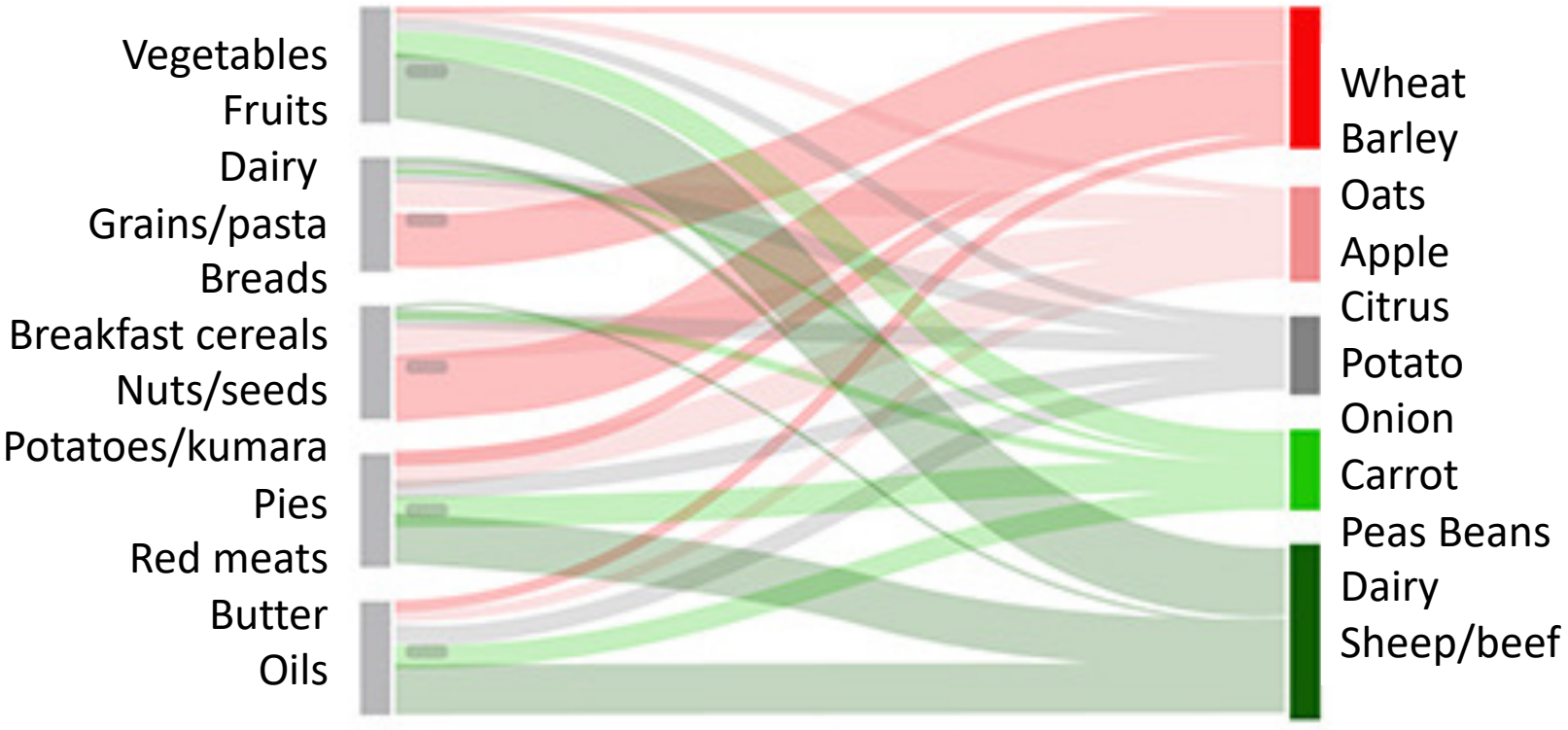
determine if NZ can produce a healthy diet while maintaining our profitable primary export sector and meet objectives for water quality and greenhouse gas emissions.

We tested two scenarios focused on land use change to:

1. reduce GHG emissions (**climate-focused**) and N/P losses to meet our diet on land use capability class 6/7 and ‘leaky’ dairy land until stock numbers were at least 13% less.
2. reduce N and P losses (**freshwater-focused**) and GHG emissions to meet our diet and NPS-FM N-P targets.

We did not include mitigation in this think-piece, because mitigation won’t achieve WQ targets everywhere!

Step 1: Derive optimal diet & map to commodity crops



Example food groups

Example commodity crops

Adjusted for loss in:

- Agricultural production
- Postharvest handling and storage
- Processing and packaging
- Distribution and retail
- Consumption

Losses 2-32% (mean = 14%)

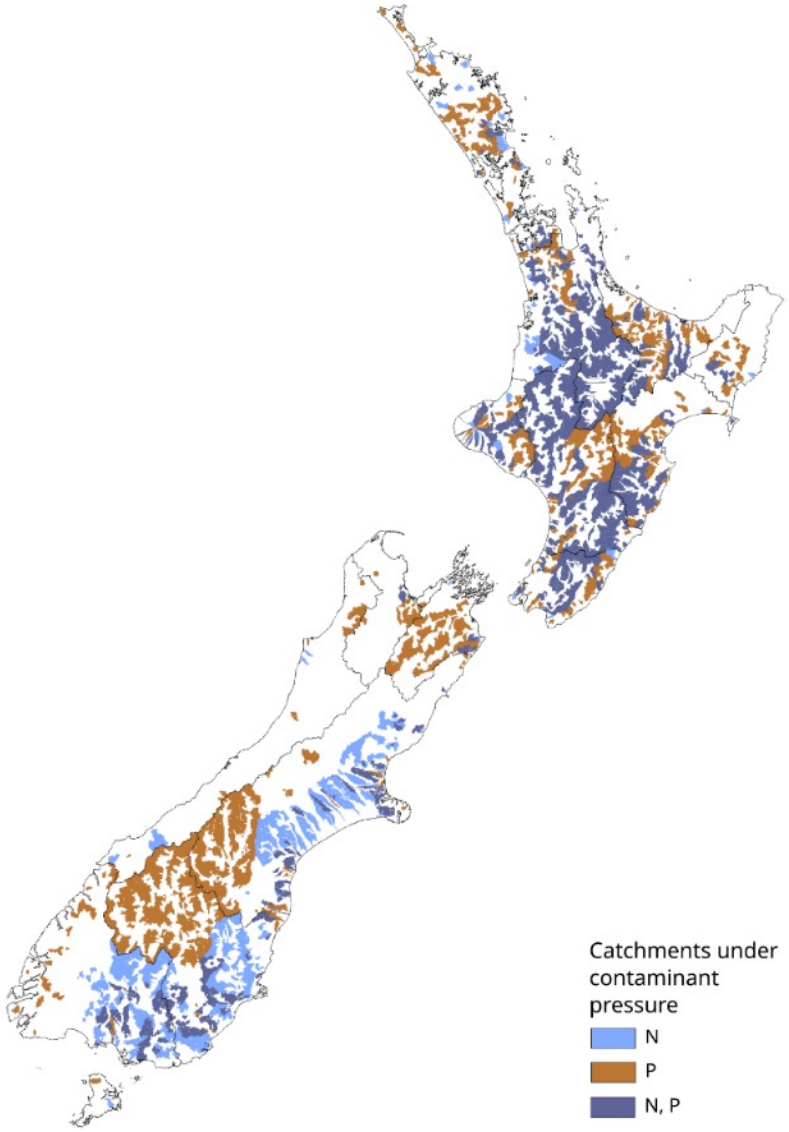
Adjusted for regional rotations

Example rotation	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Canterbury 1	Wheat	Potatoes	Wheat	Oats	Onion	Pasture	Pasture	Potatoes	Wheat	RG seed crop
Southland 1	Onion	Wheat	Oats	Pasture	Pasture	Oats	Wheat	Pasture	Pasture	Pasture

Steps 2/3: Crop performance metrics and pressure

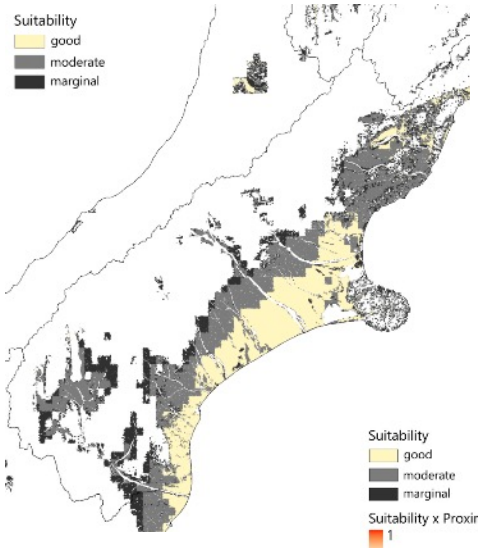
Estimated N, P, GHG, production and gross margin for widely grown and high value crops and intensities of land uses based on published, peer reviewed studies reporting observational or appropriately modelled data.

Pressure is the load of N, P or N+P above the maximum allowed under the National Policy Statement for Freshwater Management

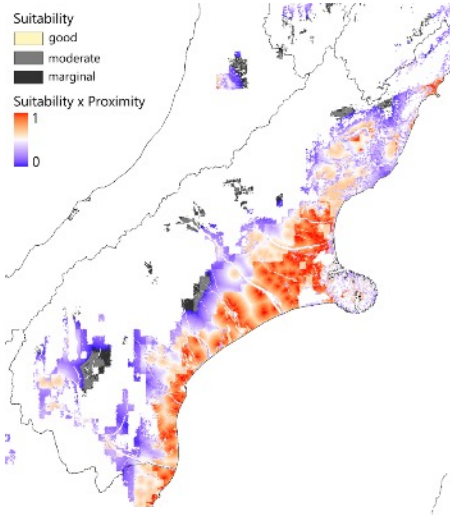


Step 4: Land suitability for crops

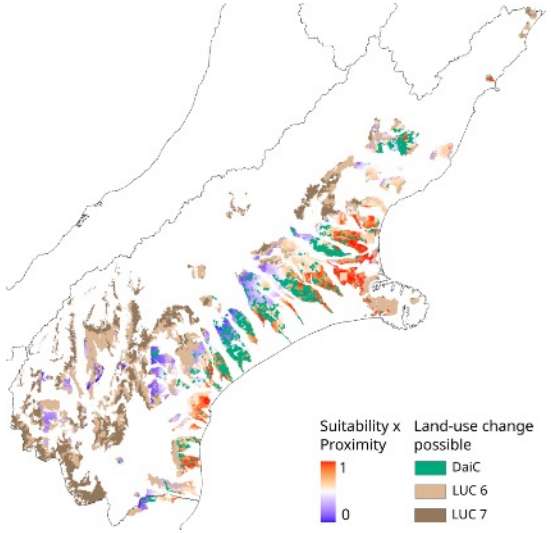
Areas suitable in rotation of, e.g., potatoes in Canterbury as defined by, rainfall, temp, drainage



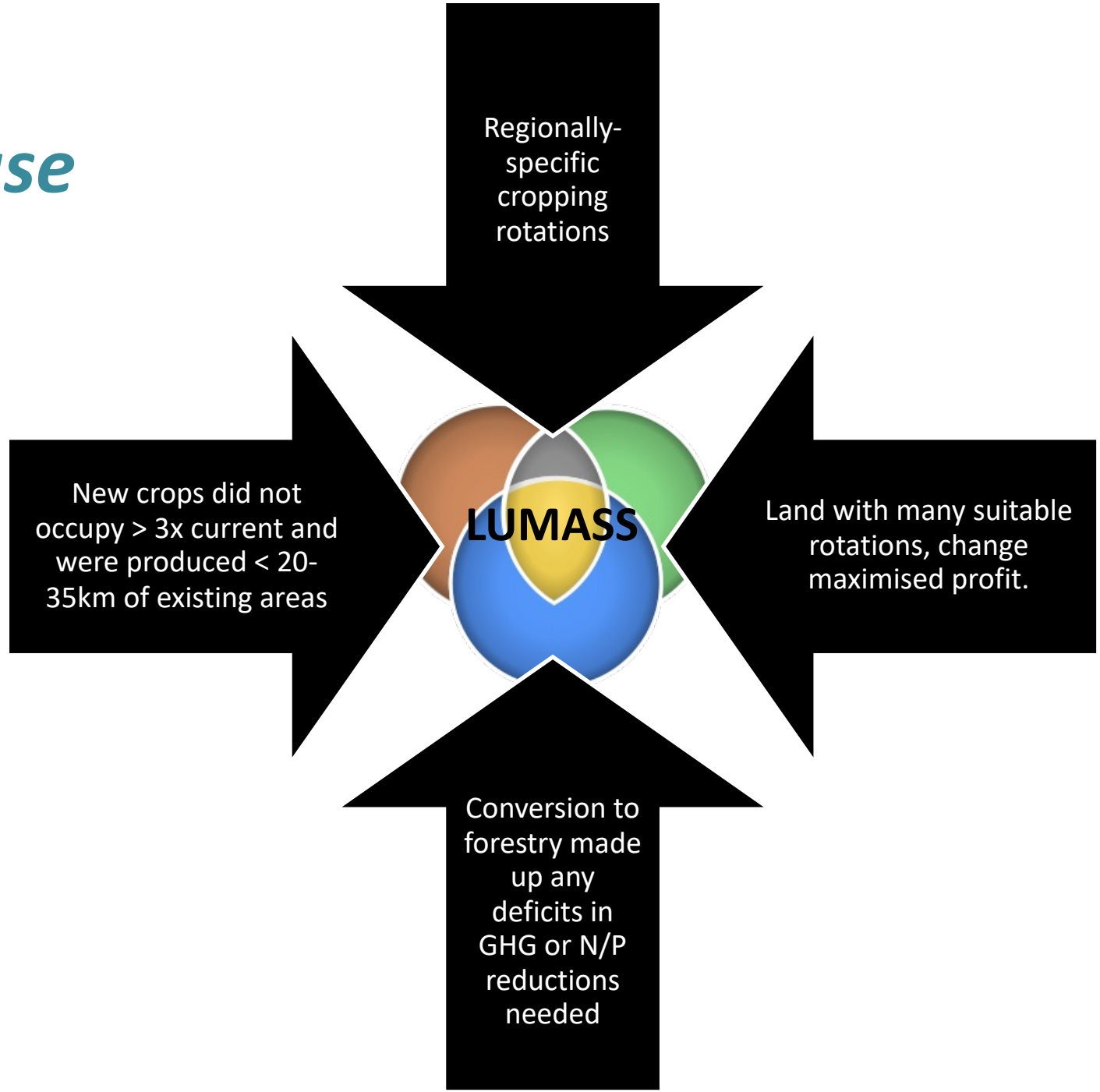
Proximity of suitable areas being grown within a 35 km radius of existing growing areas.



Suitable areas overlaid onto high polluting land uses (likely candidates for land use change), **restricted** to those catchments under N or P or N and P pressure.



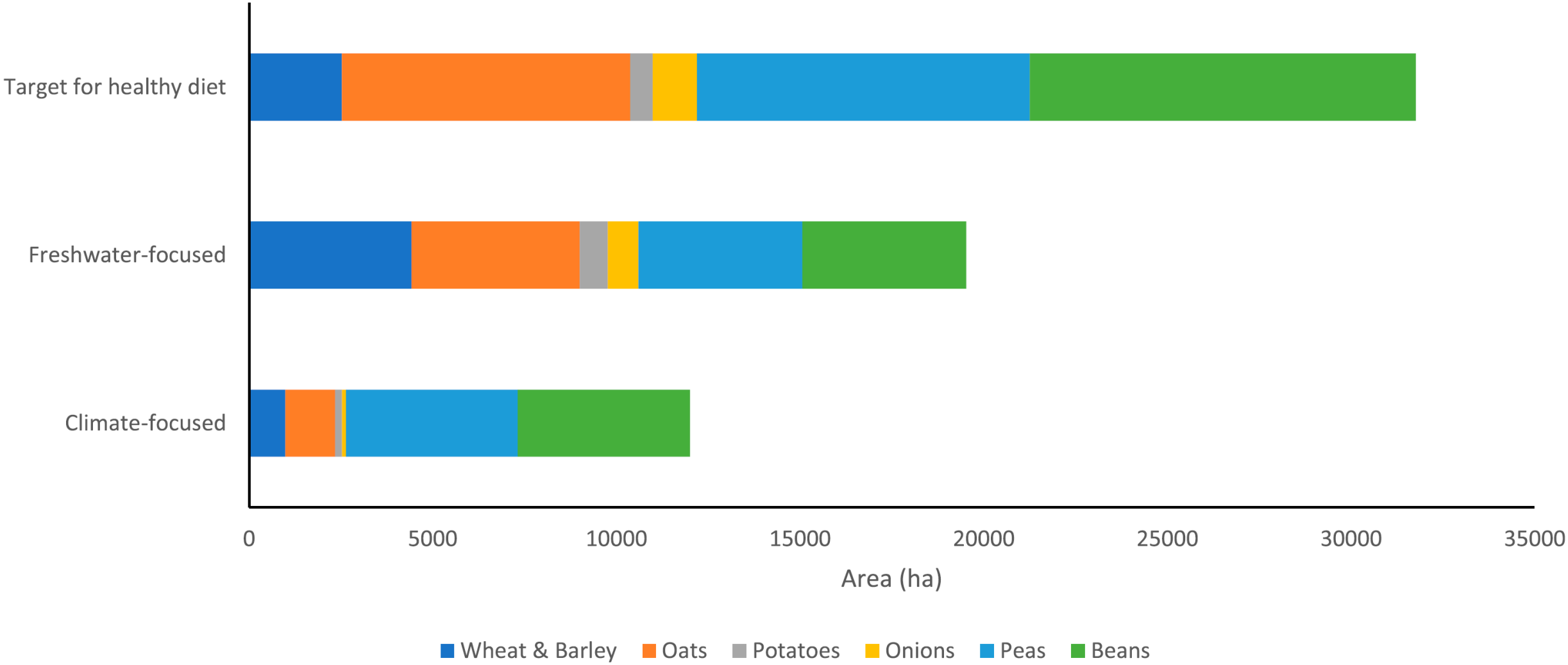
Step 5: Optimise land use



Restricted to catchments under WQ pressure as these were most likely to change.

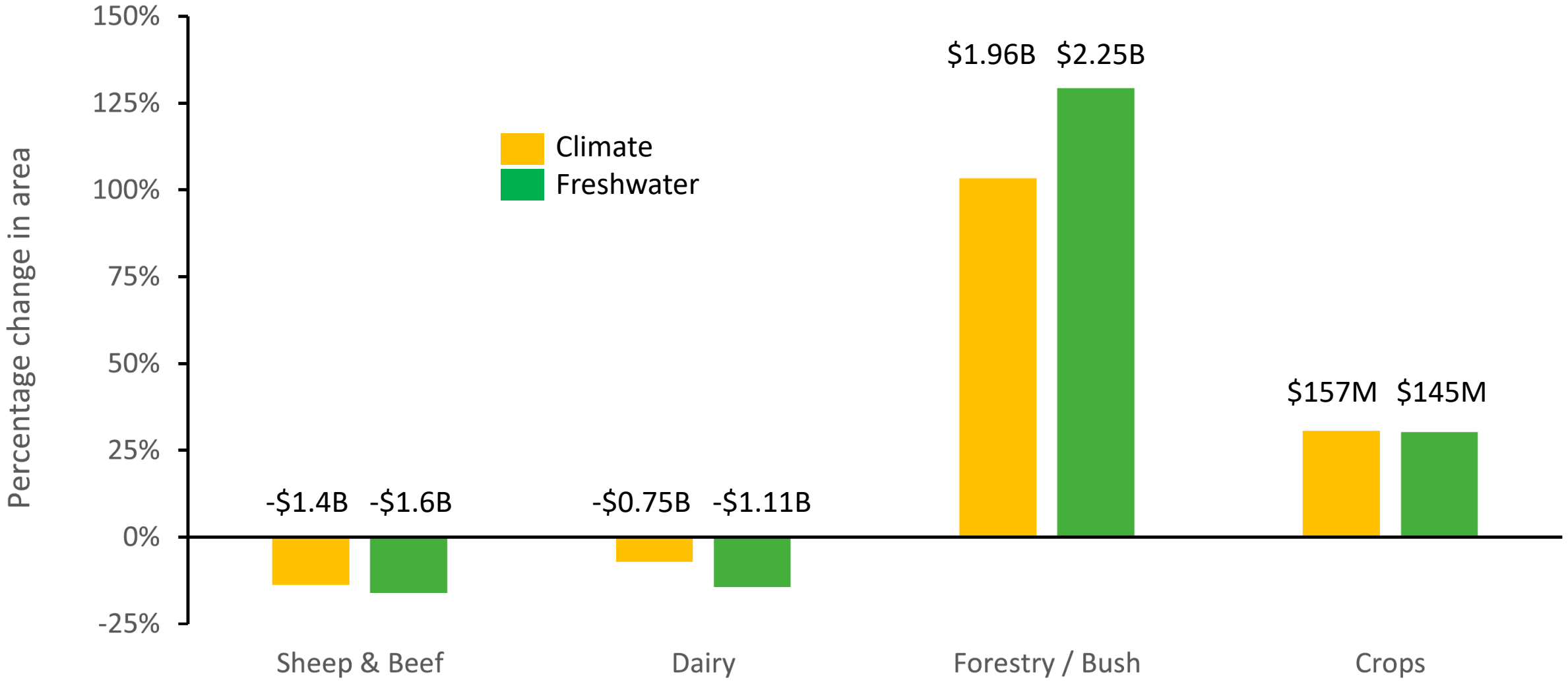
Assumed that crops required for diet would therefore be grown outside these catchments.

Land use changes in pressure catchments



Areas of different crops (not adjusted for rotations) grown in pressure catchments under both scenarios

Land use changes and gross margin across NZ



Sum result = $66M gain and $421M loss for climate and freshwater-focused scenarios, respectively

Percentage change in outputs

Area / scenario	Nitrogen load	Phosphorus load	GHG emissions	Gross margin
Pressure catchments				
Climate-focused	-19	-33	-500	0.8
Freshwater-focused	-39	-53	-300	-8.4
New Zealand				
Climate-focused	-7	-11	-210	0.3
Freshwater-focused	-9	-11	-150	-1.9

Limitations

Our analysis uses coarse data, especially for land use types and crops (but these were published and checked).

Food groups and crops may not map correctly (but this was based on ingredient lists and processor input).

We did not consider lag times in environmental response associated with land use change (but restricted our analysis to 4th order streams).

We used averages.

Our recommendation is that to improve the quality of outputs, requires more regionally-focused inputs and analysis.

Key messages

Achieving our freshwater-focused objective also achieve our climate-focused objective, but not the other way around (an additional 14-26% reduction in N and P loads would be required).

The highest loss of gross margin is <1% of the value of current primary produce. With current gains in productivity this would be quickly recouped; i.e., negligible impact on export revenue.

Our use of forestry is inclusive of native forests. It would also be wise to restrict monoculture of exotic forestry on some land. NB ~20% of current planting is in natives.

Consumption of a healthy diet is projected to save the health sector $14-20B.

Why wasn't mitigation included?

Work in 2020 derived national estimates of the effectiveness of mitigations for N and P loss (applied in the order of cost-effectiveness) from farm types.

Reductions of ~30% in N and P losses achievable.

Will meet targets in many catchments…but

Some areas still exceed targets (that relate to unacceptable periphyton growth) and the cost of implementing many mitigations was high (and slow).