



**Landcare Research**  
**Manaaki Whenua**

# Environmental impacts of large scale afforestation

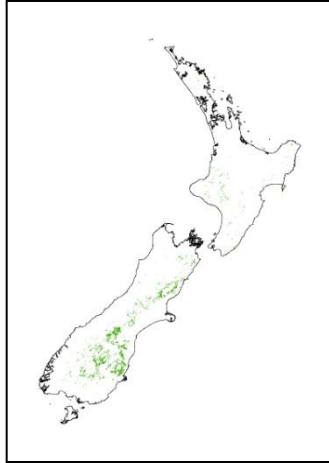
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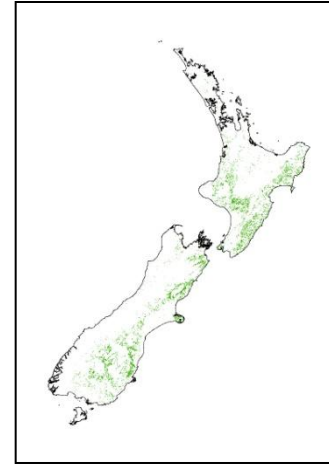
# Scenarios



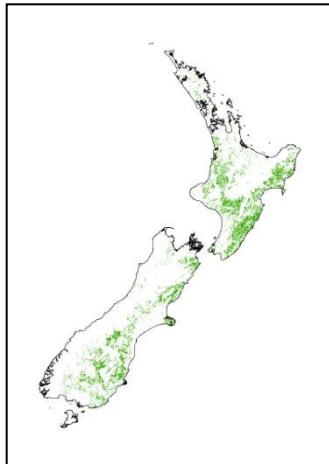
**Scenario 1: 0.8 Mha**



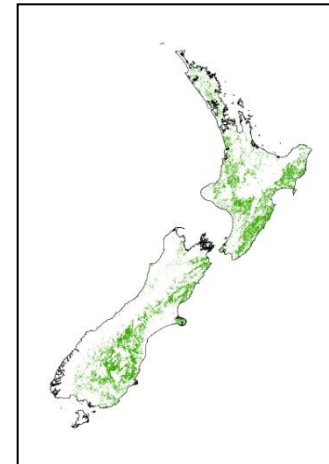
**Scenario 2: 1.9 Mha**



**Scenario 3: 3.5 Mha**



**Scenario 4: 4.9 Mha**

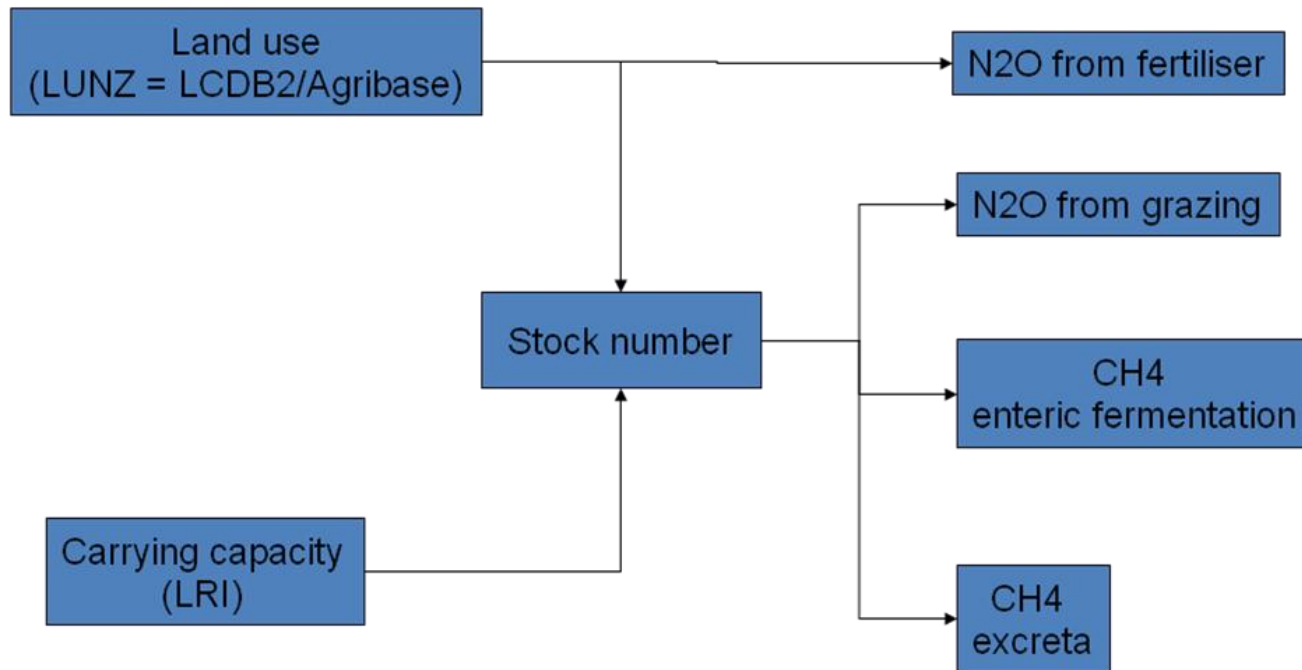




# Environmental Impacts

- Agricultural greenhouse gas emissions
- Carbon storage
- Water quality
- Water quantity
- Erosion and sedimentation
- Biodiversity

# Agricultural greenhouse gas emissions



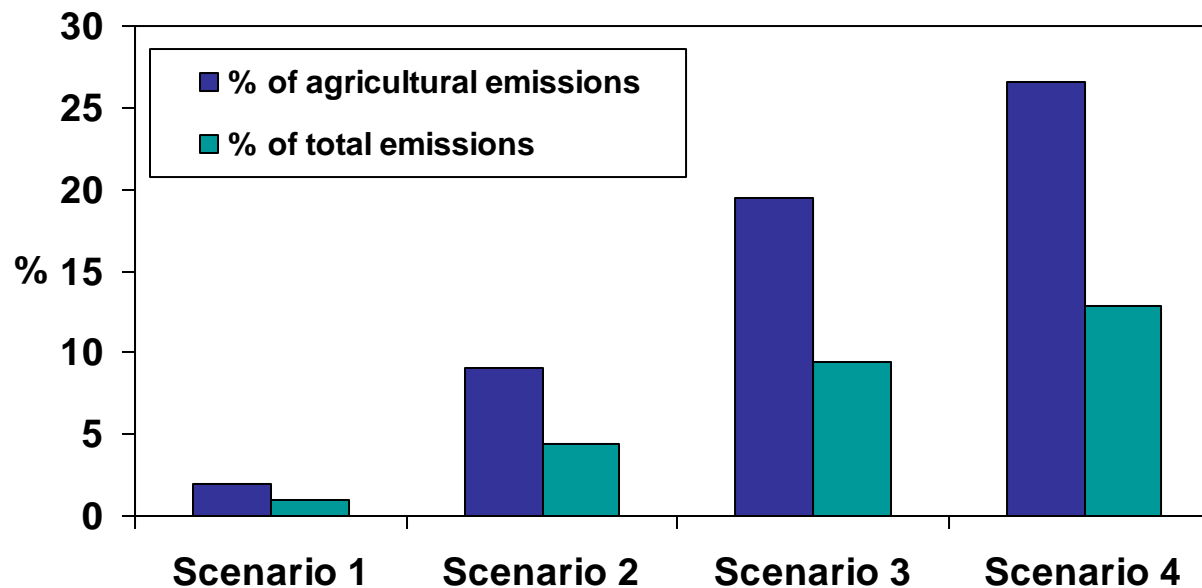
Data used in greenhouse gas emission calculations

## Reduction in national animal numbers



	Scenario 1	Scenario 2	Scenario 3	Scenario 4
<b>Beef cattle</b>	3.0%	15%	33%	47%
<b>Dairy cattle</b>	0.1%	0.8%	2.0%	3.5%
<b>Deer</b>	2.0%	11%	15%	27%
<b>Sheep</b>	2.8%	15%	32%	42%

## Reduction in annual agricultural greenhouse gas emissions relative to New Zealand's 2006 emissions

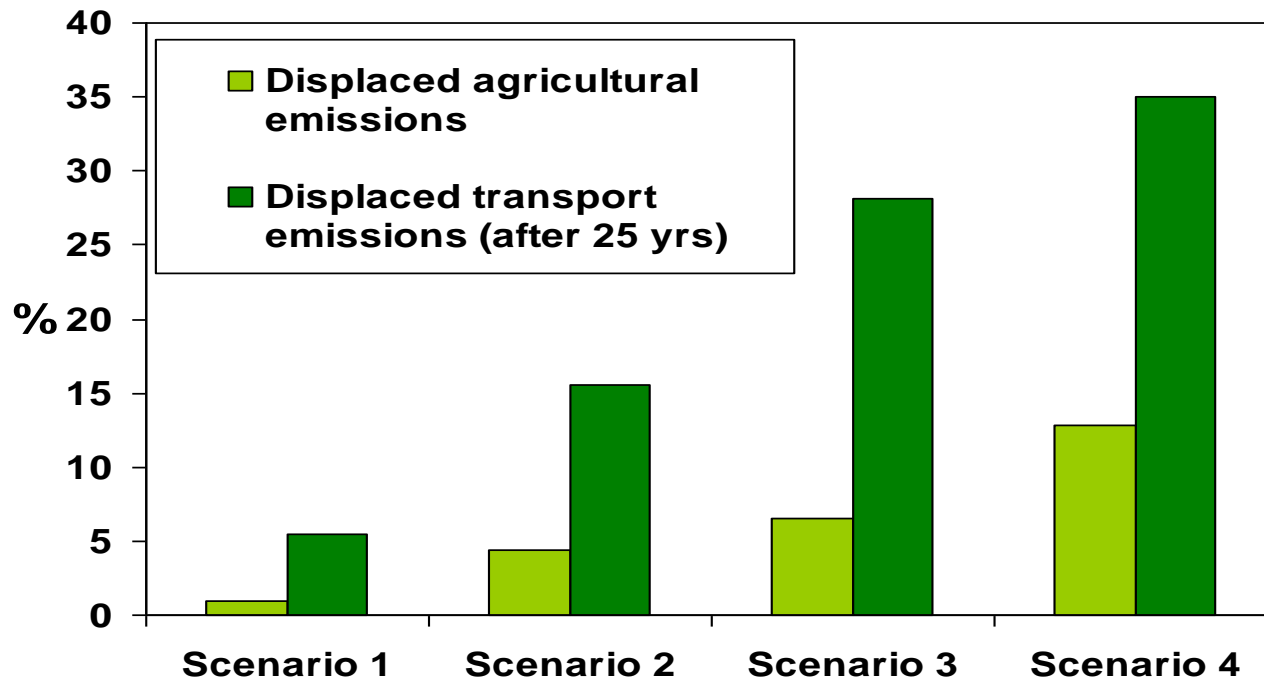


# Carbon storage



- After 25 years net increase in carbon stocks equivalent to the removal of 208, 651, 1189 and 2040 MtCO<sub>2</sub>e for scenarios 1-4 (equivalent to 2.7, 8.4, 15.3 and 26.3 times the total emissions for 2006).
- Also change in land-use reduces agricultural GHG emissions and biofuel production reduces transport GHG emissions

## Reductions in annual agricultural and transport GHG emissions as a percentage of New Zealand's total 2006 emissions

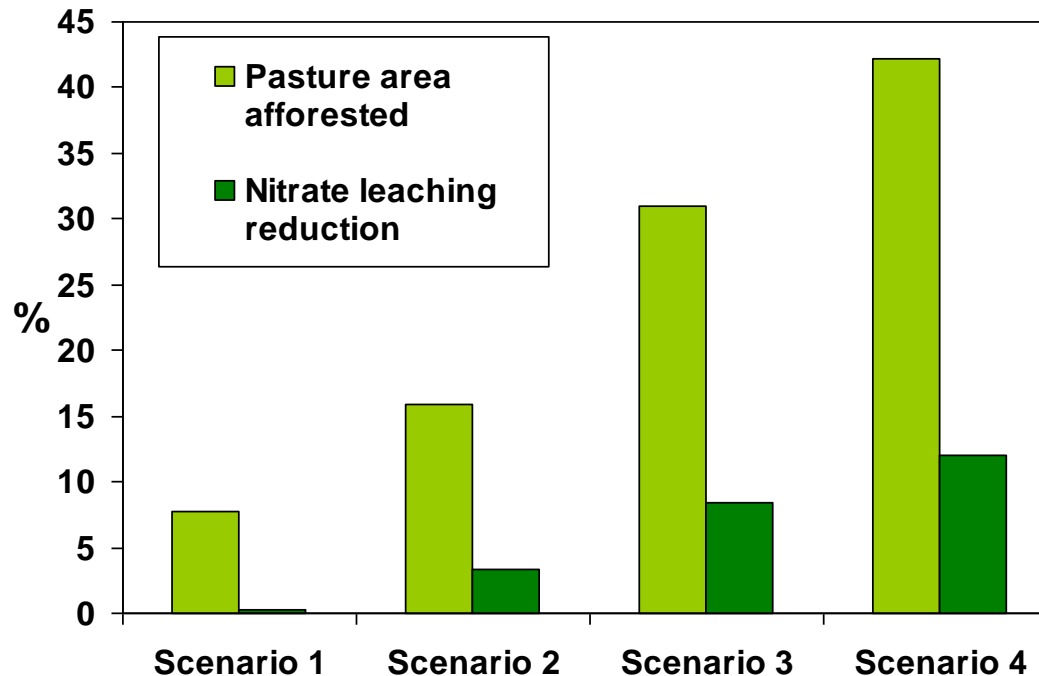


# Water Quality



- Nitrate leaching from agricultural land use was calculated regionally for each land use for both flat/rolling and hill country land.
- Conversion of pasture to forestry will reduce nitrate leaching. However, the land targeted for afforestation tends to be less intensively farmed.
- There can be a significant time lag between afforestation and the reduction of leaching rates

## Percentage pasture land afforested and reduction in nitrate leaching

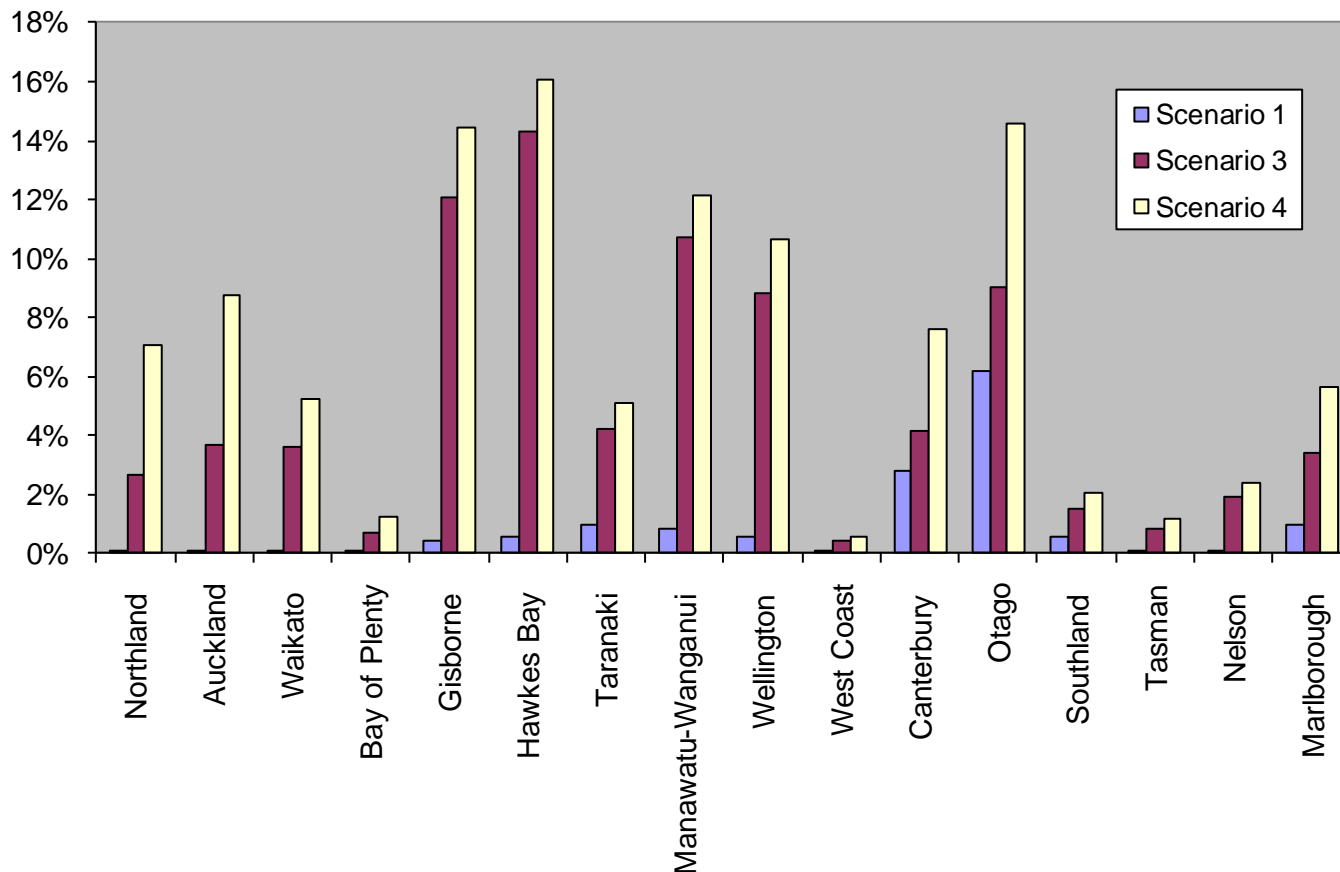


# Water Quantity



- WATYIELD model used to predict hydrological effects of land cover change at a regional level.
- Significant reductions in available water in many regions.

Regional reduction in water relative to water balance

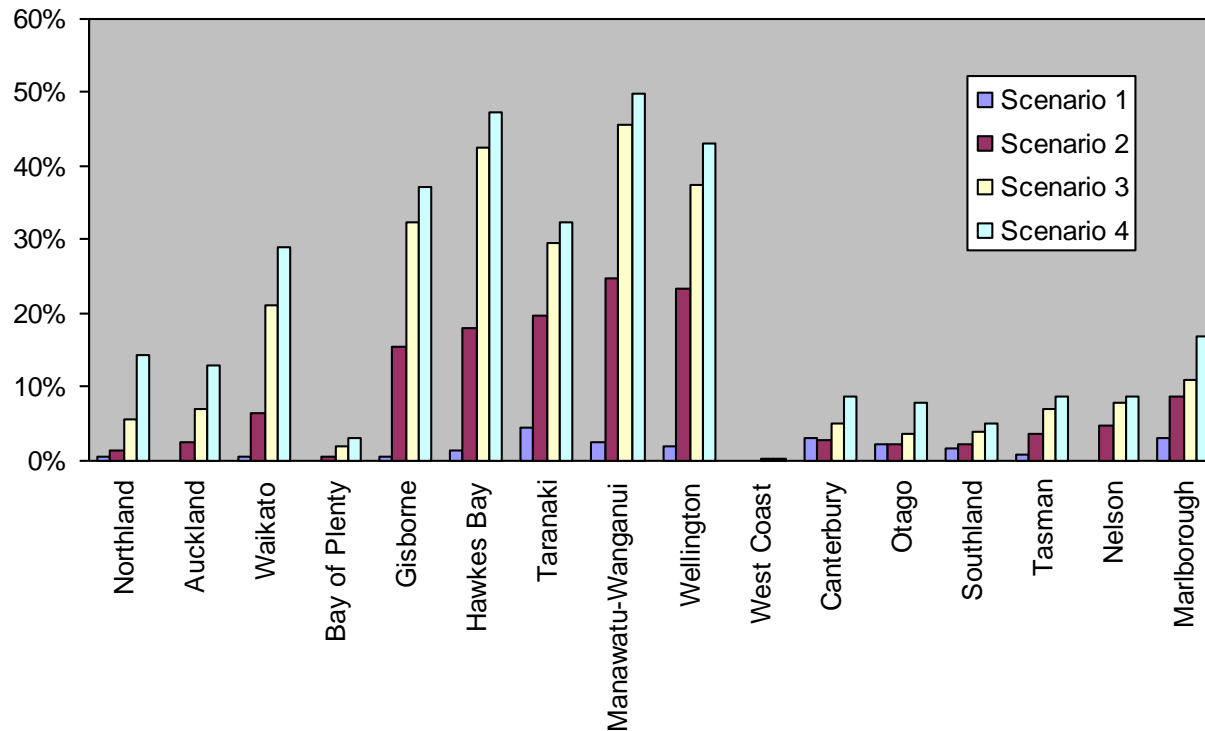


# Erosion and sedimentation



- New Zealand Empirical Erosion Model (NZEEM) used to predict erosion rates.
- Bioenergy scenarios could produce reductions in annual erosion of 2.6, 18, 38 and 46 Mt/y respectively for scenarios 1-4

Percentage reduction in erosion rates by region



# Biodiversity



- Afforestation can have both positive and negative biodiversity impacts.

## **Negative Impacts**

- Some areas might revert to native forest if left undisturbed
- Planting area of native grassland that were not historically forested would be undesirable.
- Potential spread of wilding pines and other weeds

## **Positive Impacts**

- Plantation forest can provide a habitat to a range of native terrestrial and aquatic species.
- Improved connectivity between currently fragmented native forest remnants
- Environmental services provided by forest (e.g. soil conservation, improved water quality)

# Conclusions



- The bioenergy scenarios would have a positive impact on New Zealand's net GHG emissions by increasing carbon stocks and displacing agricultural and transport GHG emissions.
- The conversion of low productivity agricultural land to forestry would also have positive impacts on nitrate leaching and erosion.
- While there are some positive biodiversity impacts, it would not be desirable to afforest native tussock grassland in Otago.
- Water availability could be a key constraint in some regions, such as Canterbury and Otago.