Landcare Research
Manaaki Whenua

Greenhouse Gas Emissions from Intensive Dairying- Beacon Farm

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The importance of dairy production to NZ

- **Local importance**
  - 16 billion litres of milk pa
  - 95% of dairy produce is exported
  - Export revenue $12.1 billion pa, 25% of export earnings

- **International importance**
  - 2% of total world production of milk
  - 44% of all traded butter
  - 30% of all traded milk powders
  - Overseas farms

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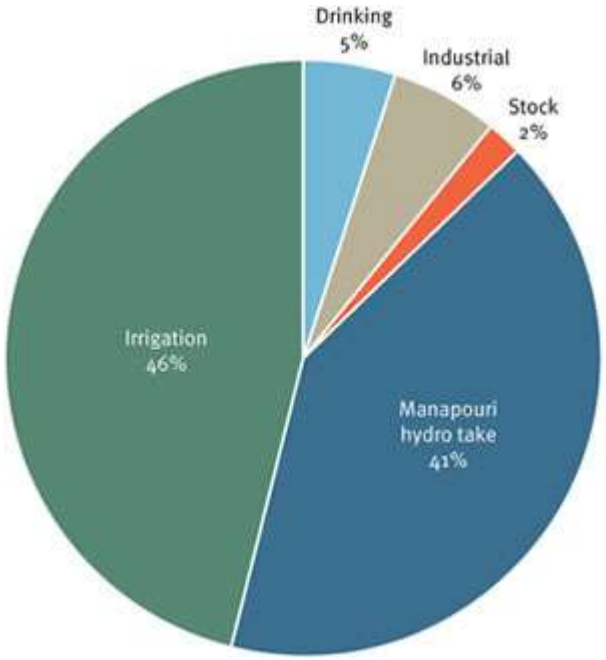
Potential impacts of increased dairy production

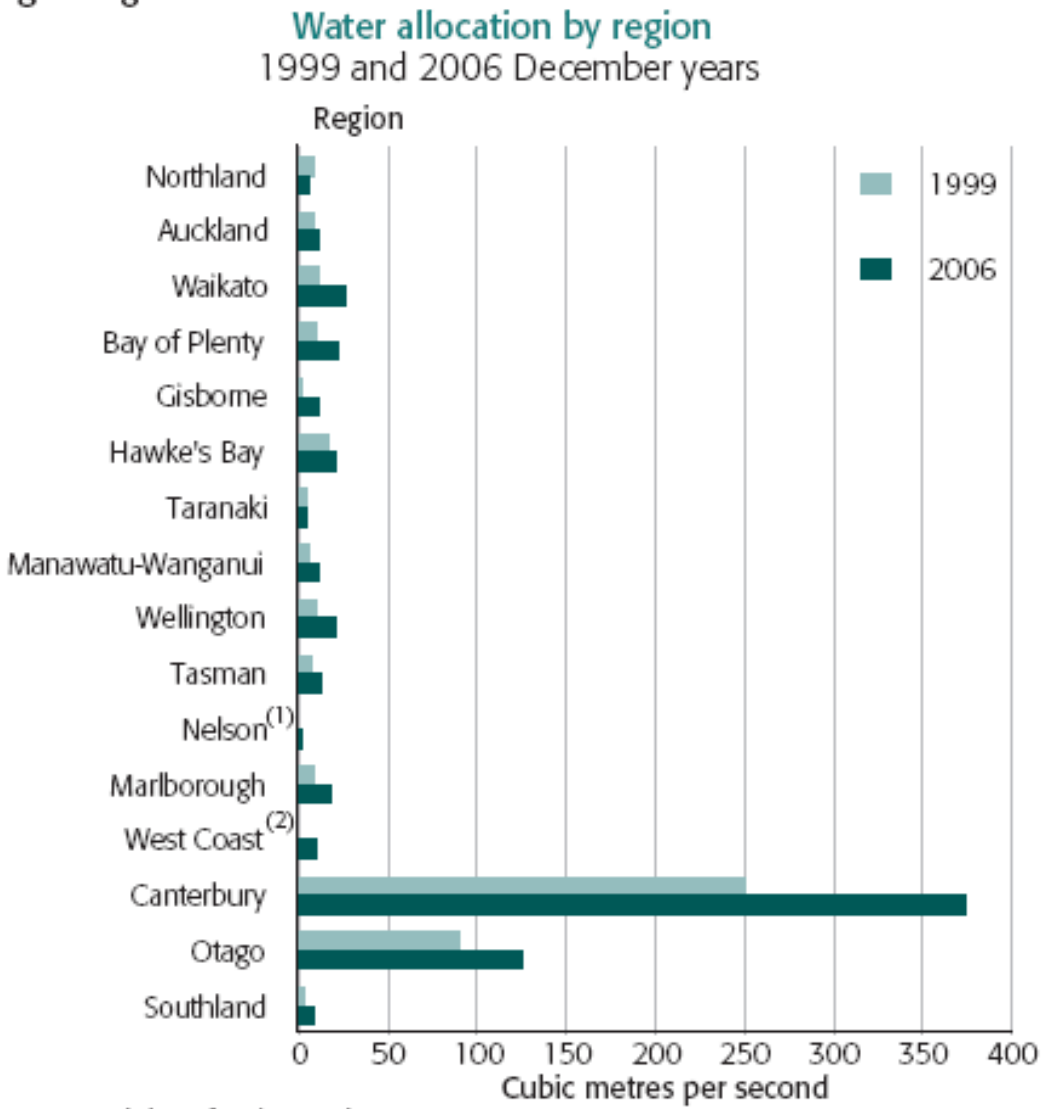
- Water use
- Methane production
- Nitrous oxide production, urine + fertilizer
- Nitrate leaching into stream/ground water
- Carbon exchange
- Soil carbon

Water use



Use of allocated water in New Zealand, 2010

Figure 4g

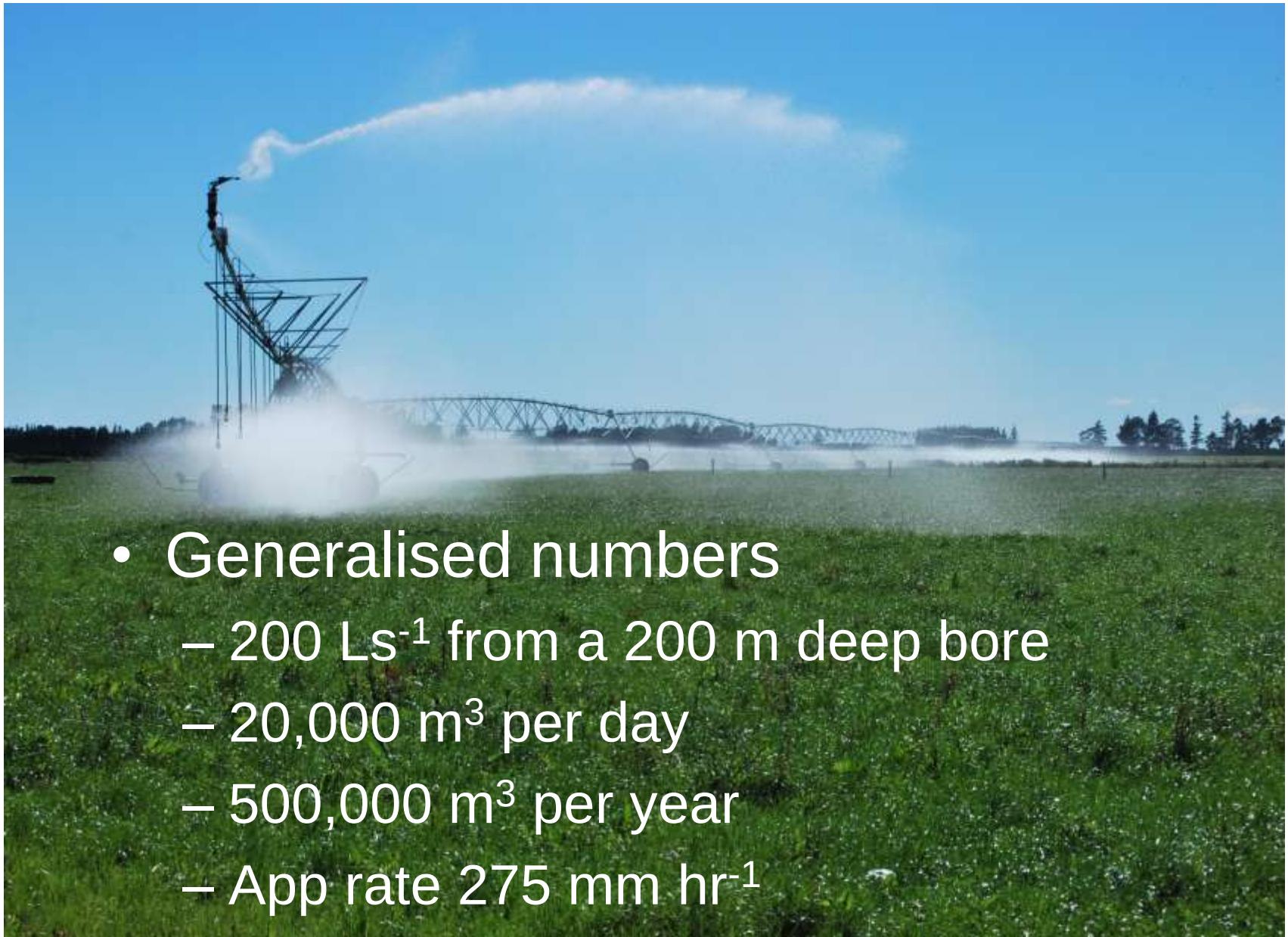


Source: Ministry for the Environment

(1) No 1999 data for Nelson.

(2) No 1999 data for West Coast.

So how much water does a dairy farm use?



- Generalised numbers
  - 200 Ls^{-1} from a 200 m deep bore
  - 20,000 m^3 per day
  - 500,000 m^3 per year
  - App rate 275 mm hr^{-1}

Objectives – Beacon farm

A research platform to:

- Measure effects of conversion from dryland to intensive dairy on GHG emissions and soil carbon storage.
- Measure water and nitrogen-use efficiency.
- Determine major driving environmental variables for each gas and investigate mitigation strategies.

Deans Rd
Otira Hwy
77
Darfield
73
Kirwee
Johns Rd
74
Fendalton Rd
Yaldhurst Rd
73A
Hororata
Rolleston
1
Rakaia Hwy
Lincoln
Landcare Research
Manaaki Whenua
Dunsandel
75
Bankside
Rakaia
Chertsey
Lake Ellesmere
14.9 km
© 2012 Cnes/Spot Image
Image © 2012 DigitalGlobe
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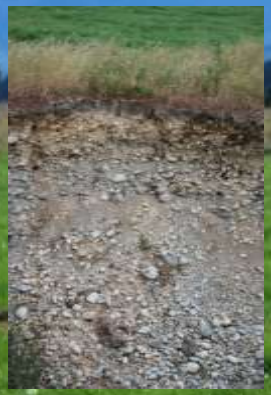
Image © 2012 GeoEye
Google earth


Map
Photos
Cleared forest
Dry site
Irrigated site

Soil C



N_2O

CH_4

H_2O

CO_2

Carbon and water fluxes

Li 7200 closed path CO_2/H_2O analyser
Gill sonic anemometer
3 soil moisture profiles (4 depths each)
Aquaflex soil moisture probe
Rain gauge
App rate 275 mm hr^{-1}

Methane/N_2O fluxes

- FTIR – measures CO_2 ,CH_4, N_2O, CO, $\delta^{13}C$ simultaneously
- Slow response, use gradient method
- Use EC CO_2/heat/momentum flux to calculate diffusivity coefficient

Soil carbon and N leaching

- Measure carbon storage
- Use $\delta^{13}C$ to trace and partition carbon sources for soil respiration
- New lysimeter design to measure water and N flux
- Soil respiration to partition above vs below ground C fluxes
- Stable isotopes to partition water sources and ecosystem respiration.

Energy and other auxiliary variables

- Solar radiation
  - PAR, Dir/Dif,
  - 4 component net rad, HF plates
- Air temp/RH
- Wind speed and dir
- Vegetation
  - NDVI, albedo, clipping, LAI, LWS, surface temp
- Cow sensors

Conclusions

- Science questions and hypothesis well formulated
- Driven by different needs to Australian sites
- Installed 1 EC and FTIR
- Installation will be completed next week
- Develop a research platform for carbon/water/nutrient fluxes