Carbon footprinting of New Zealand lamb from an exporting nation’s perspective

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Outline of talk

1. Drivers?
2. NZ sheep farm system
3. Methods
4. Results
   - sensitivity analyses
   - NZ and French case study systems
   - potential effects of mitigations
Drivers?

International:

- Food-miles → Carbon footprinting
- Supermarkets - *Eco-labelling*
- Becoming a supply requirement

NZ is world’s largest exporter of lamb
(c. 40% of total)
Drivers?

Within NZ:
• Emissions Trading Scheme
  - Carbon payment for tree planting
  - Carbon tax on fuel & electricity (c. 4-5%)
  - Animal CH$_4$ & N$_2$O tax in 2013 or 2015
Features of NZ sheep farming

• simple farm systems (mixed sheep & beef)  
  - average > 4000 sheep equivalents

• permanent perennial grass/clover pastures

• reliance on clover-N with little fertiliser-N

• all outdoors; no brought-in feed

• dual-purpose meat & wool sheep

• Seasonal production  
  - spring lambing to match pasture growth pattern  
  - opposite season to the Northern Hemisphere
Life cycle of lamb to the U.K.

Sheep & Beef farms (breeding & finishing) → Meat processing plant → Shipping (refrigerated container) → Retail distribution Centre → Supermarket → Household Consumption

- Fertilisers: Lime, Fuel, Electricity
- Fuel
- Electricity
- Refrigerants
- Packaging
- Co-products: Wool, Mutton, Beef
- Hides, Wool, Blood, Offal, Renderables, Tallow
- Meat waste
- Packaging waste
- Waste water
- Based on international standards (e.g. ISO 14040s norms; PAS 2050)
METHODS: data

Farms:
• survey farm data (>460 farms over 7 farm classes)
• tier-2 method to estimate feed energy intake
• some NZ-specific E.F.s e.g. 20.9 g CH₄/kg DM intake

Meat processing plants:
• survey data from 11 plants (>40% all lambs)
• covered energy use, waste-water processing, refrigerants, consumables etc.

Transport/retail/consumer/waste:
• mainly 2° data modified for country-specific emissions
METHODS: co-products

Farms:
• biological allocation between animal types on-farm
• economic allocation within sheep for meat and wool

Meat processing plants:
• economic allocation between meat and co-products
  - skins, blood, renderables, tallow
RESULTS:

Effects of method of allocation between meat and wool

<table>
<thead>
<tr>
<th>Method</th>
<th>GHG (CO₂-equiv per FU for lamb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>6</td>
</tr>
<tr>
<td>Mass</td>
<td>8</td>
</tr>
<tr>
<td>System expansion</td>
<td>10</td>
</tr>
</tbody>
</table>

GHGs: CO₂, N₂O, Methane
Lamb carbon footprint = 19 kg CO$_2$-equiv./kg meat
Waste-water treatment:
Changing from anaerobic processing to either aerobic processing or methane capture could reduce processing emissions by 22-38%, although this is only c. 1% of the total carbon footprint.
SENSITIVITY ANALYSES: consumer

Cooking method:
roasting had 11% higher consumer/retail emissions than frying, or a 1% increase in total carbon footprint

Inclusion of consumer travel gave an increase of up to 7% in the total carbon footprint (> all other transport stages combined)
Case study of NZ and French sheep farm systems

Lorinque, Ledgard, Gac, Boyes & Le Gall, unpubl.
How can we reduce emissions?

i. increase animal production efficiency

Compared to 1990, NZ sheep farms in 2009 produced slightly more lamb meat, but from a 43% smaller flock.
Hypothetical mitigation scenarios on case study farms

<table>
<thead>
<tr>
<th>% reduction in farm GHG emissions/kg lamb</th>
<th>Effect on profit</th>
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<tbody>
<tr>
<td>↑ lamb growth: <em>finish 1 month earlier</em></td>
<td>4-12 ++</td>
</tr>
<tr>
<td>↓ replacement rate: <em>ewes last 1 yr longer</em></td>
<td>5-7 +</td>
</tr>
<tr>
<td>↑ lambing%: <em>by ~ 20%</em></td>
<td>3-5 ++</td>
</tr>
<tr>
<td><em>ewe hogget lambing</em>: 80%</td>
<td>2-5 +</td>
</tr>
<tr>
<td>no N fertiliser use on pasture</td>
<td>1-3 -</td>
</tr>
<tr>
<td>nitrification inhibitor use (DCD)</td>
<td>~ 9 - -</td>
</tr>
</tbody>
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Summary:

Carbon footprint of NZ lamb of 19 kg CO$_2$-equiv./kg meat:

- covers whole life cycle, but dominated by farm stage
- depends on methodology choices
- lower from low-input grazing systems
- decreased over time with increased feed conversion efficiency
- potential reduction with some mitigations