

Carbon Footprint of New Zealand Beef and Sheep Exported to Different Markets



R&D Brief MIAI 2021-01

Life cycle assessment (LCA) is the process of determining the total greenhouse gas (GHG) emissions (or carbon footprint) of a system. For red meat, a full LCA starts on farm and ends after the product is eaten.

Driven by concerns for the environment, consumers, government and producers, all want to better understand their carbon footprint and how they can reduce it, both to improve the long-term future of the planet and also as part of New Zealand's commitment to reduce GHG emissions at both a national and global level¹.

In 2020 the Meat Industry Association (MIA) and Beef+Lamb New Zealand Limited (B+LNZ) commissioned AgResearch to carry out a life cycle assessment of beef and sheep produced in New Zealand and exported to different overseas markets.

The final report from this study² gives an estimate of the carbon footprint of 5 different product scenarios: frozen and chilled beef and sheep meat eaten by consumers either at home or in restaurants in the United States of America (USA), Japan, China and the United Kingdom. The measure or metric used to describe the carbon footprint is Global Warming Potential (GWP).

Understanding Global Warming Potential (GWP)

Greenhouse gases warm the earth (i.e. cause global warming) by absorbing heat (or energy) and slowing the rate at which that heat escapes to space; in other words, GHG's act like an insulating blanket for the earth. Common GHG's found in an agricultural setting are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). These gases differ in how much heat they absorb and how long they last in the atmosphere (their lifetime).

To compare all the different gases that contribute to global warming, a "Global Warming Potential" (GWP) metric is used. This GWP metric measures how much energy the emissions of 1 tonne of a particular gas will absorb over a set period of time, compared to 1 tonne of carbon dioxide, giving it a CO₂-equivalent conversion factor (CO₂e). The time-period for GWP's is commonly set at 100 years and is known as GWP100.

LCA is a complex science that requires a thorough knowledge of all aspects of the supply chain. Any calculation of GWP is only ever a best estimate of the impact of that food on global warming. LCA science is developing and there are different metrics and units used to calculate and describe GWP. We can expect, as our understanding around LCA grows, that the accepted methods for calculating GWP will continue to change and will become better equipped to reflect the processes used to create our food.

What was done in this study

In this study a baseline value for GWP100 was calculated for beef and sheep sent from New Zealand, in chilled or frozen form, to a range of different international markets. This method sums all the GHG emissions from every stage of the product life from the cradle to grave; from production and use of all inputs, raising the animals on-farm, processing, shipping and transport, and then use by the consumer, including packaging, cooking and food waste.

The base GWP100 values in this study were calculated using an internationally accepted ISO14000 standard method³. There are, however, some parts of this method that do not accurately reflect livestock farming in general or the way red meat is produced in New Zealand pasture-based production systems. Specifically, the method (1) does not adequately account for the impact of short-lived gases and (2) ignores carbon sequestration. There are also different ways of sharing emissions between meat and co-products that affect the final GWP number.

1 **Short-lived Gases:** As noted above, the base GWP100 calculation estimates the warming effect of a gas over a 100 year period compared to the same quantity of carbon dioxide, but in reality, not all GHG behave like carbon dioxide. Carbon dioxide is a long-lived pollutants that lasts for over 1000 years, and builds up over time in the atmosphere. This means what you emit today *adds to* what was already there yesterday. However, some GHG are short-lived and break down much faster. This means what you emit today *replaces* some of what was there "yesterday". If you can keep emissions of short-lived gases the same over time, or even decrease them, you should be able to slow or decrease global warming due to that gas.

The bulk of agriculture GHG emitted by animals is the short-lived gas methane, which breaks down over a period of 12 years. It is therefore important to consider the impact of short-lived gases on global warming for food produced from livestock. There are different ways to calculate GWP that allow for short-lived gases and these methods have been considered in this study.

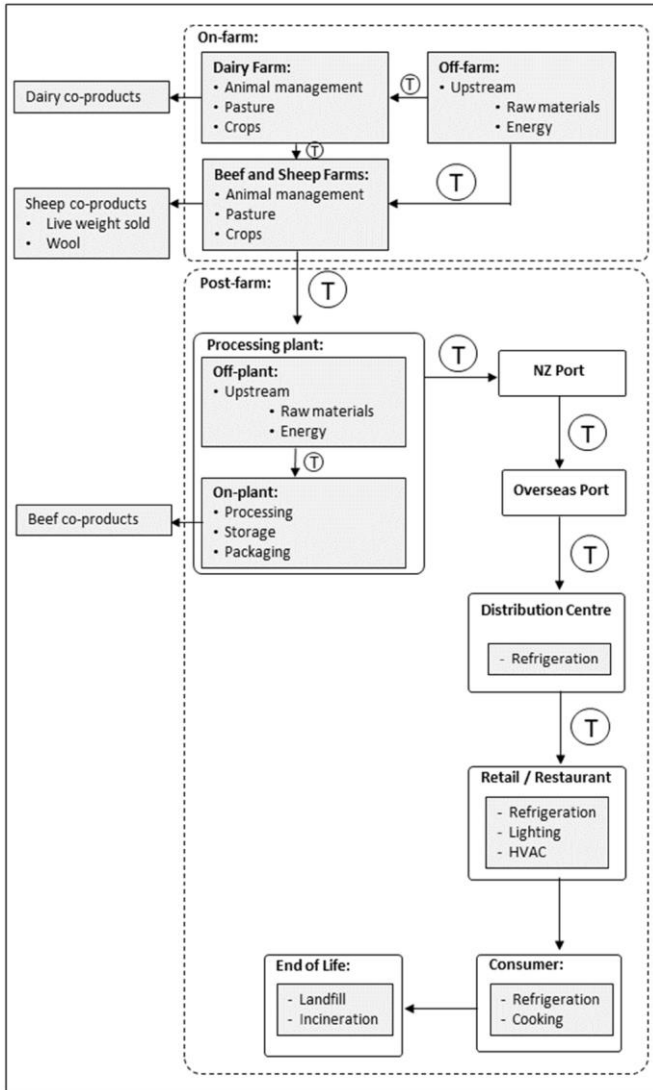
2 **Carbon sequestration** is the process of permanently capturing and removing carbon-based GHG from the atmosphere to prevent or slow global warming. Trees and wetlands are all natural "sinks" that capture and remove carbon from the atmosphere. New Zealand farmers are working to build native vegetation and biodiversity on their farms to counter global

warming. The base GWP100 method used in this study looks at gross emissions from trees but does not consider the impact of carbon sequestration, so an assessment of net carbon sequestration by trees on-farm was included.

3 When a production system makes more than one product, **emissions are shared among products**. The way those emissions are shared has a strong impact on the footprint of individual products. In this study, emissions across the value chain were shared between (1) beef and sheep on mixed stock farms (2) wool and meat on sheep farms (3) milk and meat on dairy farms and (4) meat and co-products at the processing facility. Specifically in this study, Researchers compared different ways of sharing emissions between meat and co-products and its effect on GWP100.

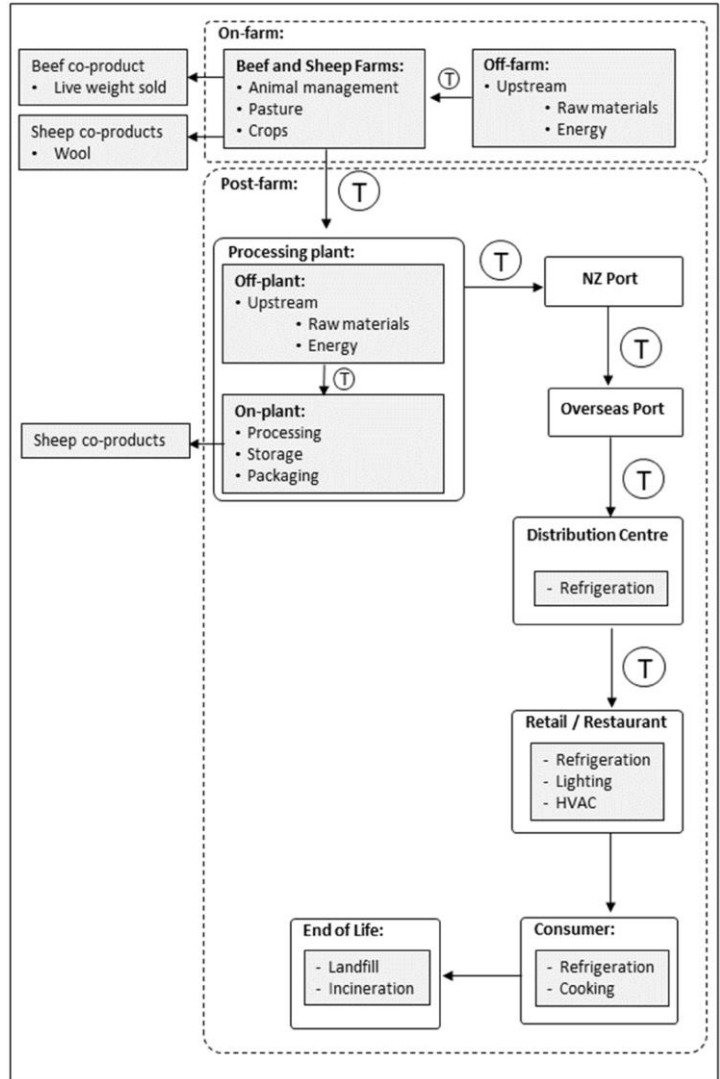
Main life-cycle stages for Beef (cradle to grave)

(Where T = Transport)



Main life-cycle stages for Sheep (cradle to grave)

(Where T = Transport)



What was found

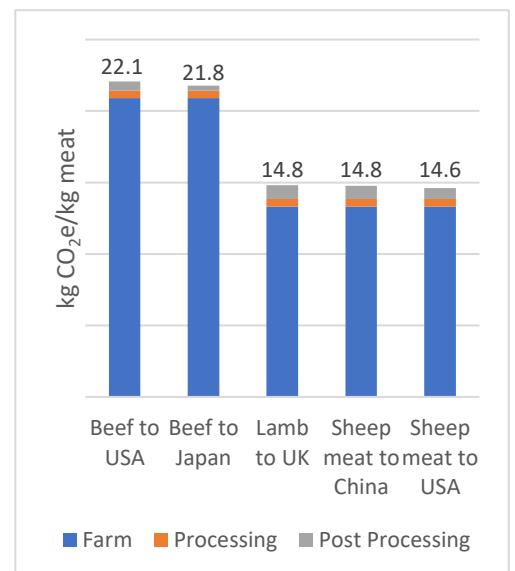
Using the ISO14000 methods for calculating GWP100, the base value full life cycle carbon footprint for New Zealand beef is approximately 21.9 kg CO₂e/kg meat and for sheep meat is approximately 14.7.

Published values for beef range from 20.6 to 35.1 and for sheep from 16.1-19.7

In addition, the study also found that emissions for beef and sheep have reduced over the last 20 years.

90-95% of the total carbon footprint from red meat comes from on-farm activities. GHG's from the farm are largely made up of methane (69-76%) and nitrous oxide (6-10%)

Dairy beef has a lower footprint than traditional beef. Emissions for dairy beef are shared with milk as a co-product.



Sheep meat has a lower footprint than beef, due in part to the fact that 30% of emissions from sheep production are shared with wool as the co-product.

Meat processing contributes 2-4% to the total carbon footprint of red meat.

Post-processing activities (shipping, transport and consumption) contributes 2-6% to the total carbon footprint of red meat.

When accounting for short-lived gases and the negligible change in methane during the past 20 years (or decrease for sheep), the GWP values for beef and sheep are significantly reduced compared to the base GWP100 values.

When including the impact of net carbon sequestration by trees on farm, the GWP100 values for beef and sheep drop by 30% on-farm and 20-27% across the full product life cycle compared to the base GWP values.

In the base calculation of GWP100, emissions at the processing stage are shared between meat and co-products based on their economic value. However, if emissions are allocated by weight, the GWP values for meat processing drop by 51-56%, because a greater share of the emissions are allocated to co-products like hides, tallow, renderables, which while low in value, make up almost half the weight of a carcass.

Conclusions

The Global Warming Potential for New Zealand beef and sheep, shipped either chilled or frozen to markets in Asia, Europe and America, when calculated using internationally accepted standard methods, is low and on the bottom range of published values for global beef and sheep production, despite our distance from markets.

In addition, the GWP figures for beef and sheep meat are significantly reduced when sequestering of carbon on-farm and metrics/methodologies better suited to livestock products, that account for the differing warming behaviour of short-lived gases like methane, are used to calculate the carbon footprint of meat produced in New Zealand.

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To read the reports associated with this research see www.mia.co.nz or contact Meat Industry Association info@mia.co.nz or phone 04 495 8375



References:

1. Our Climate Change Targets, New Zealand Ministry for Foreign Affairs and Trade, Page visited May 2021 (<https://www.mfat.govt.nz/en/environment/climate-change/meeting-our-targets/#:~:text=to%20reduce%20greenhouse%20gas%20emissions,below%201990%20levels%20by%202050>).
2. Carbon Footprint of New Zealand Beef and Sheep Exported to Different Markets. Stewart Ledgard, Shelly Falconer, Andre Mazzetto, AgResearch Client Report RE450/2021/006, May 2021
3. Attributional LCA methodology in accordance with ISO 14040:2006 and 14044:2006 standards