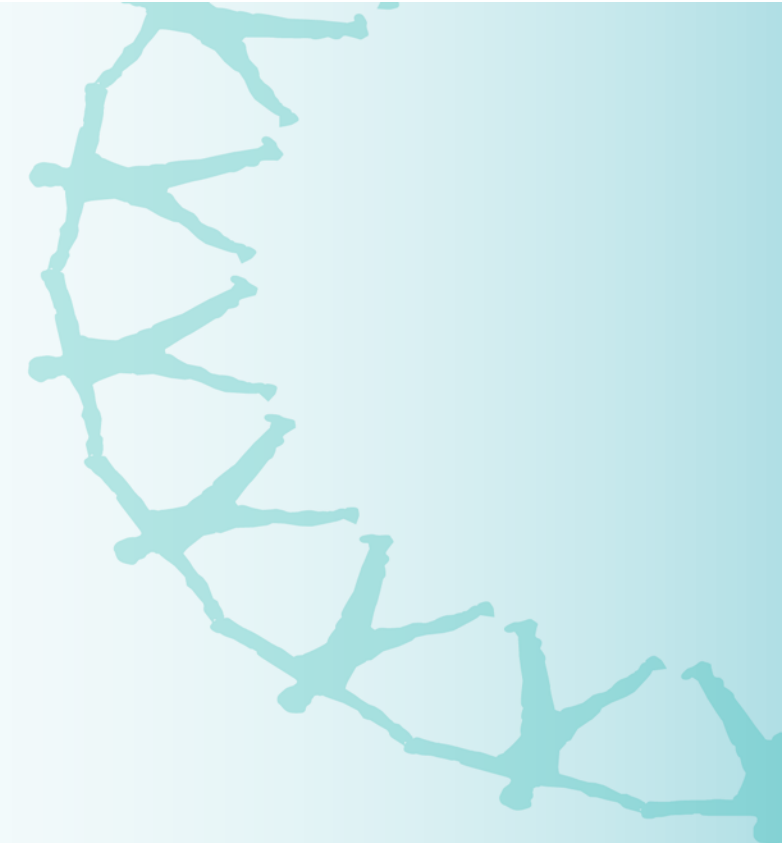


Environmental Life Cycle Assessment of New Zealand Avocados



Shreyasi Majumdar, New Zealand Life Cycle Management Centre, Massey University

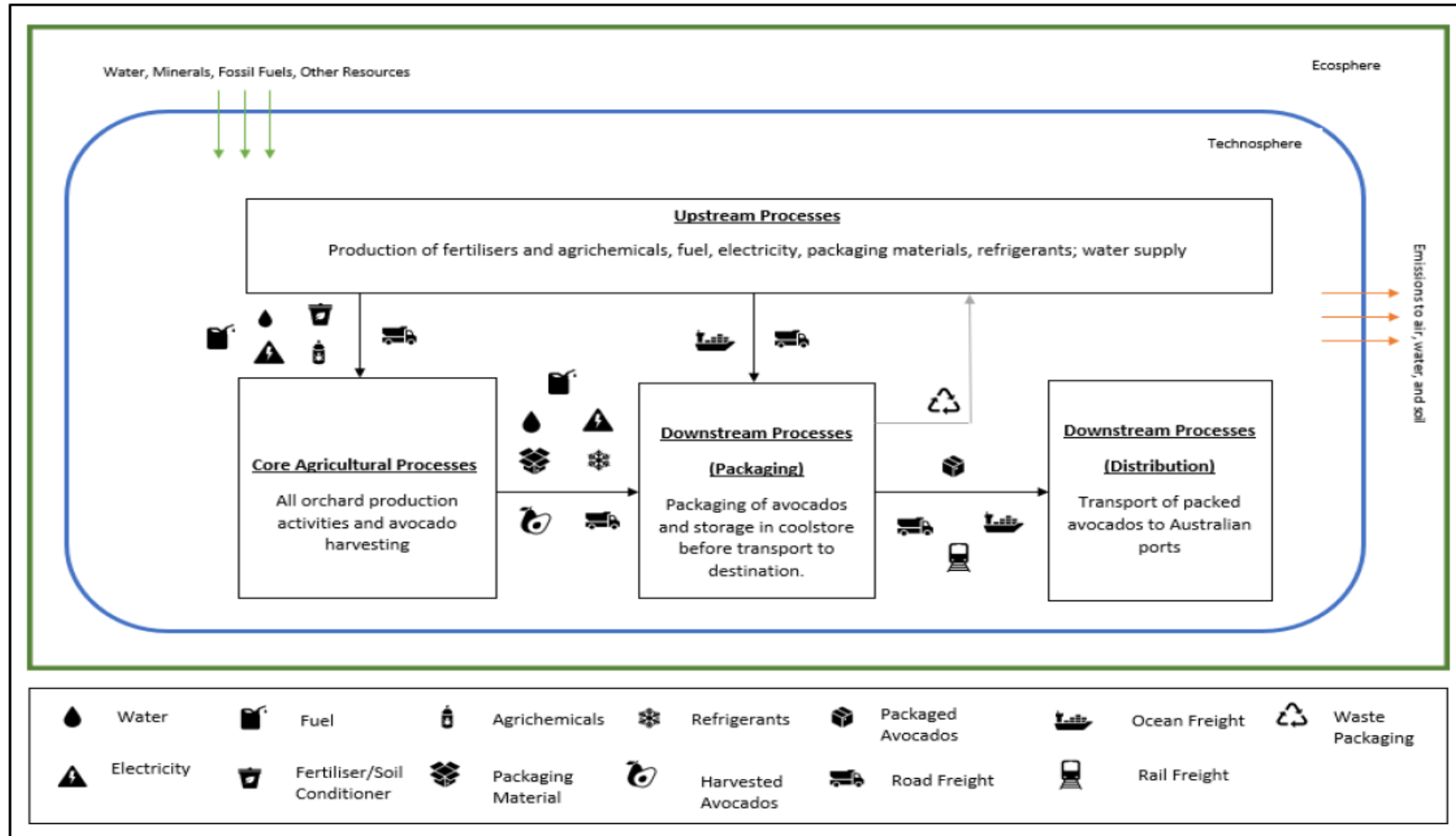
Sarah McLaren, New Zealand Life Cycle Management Centre, Massey University

Brad Siebert, New Zealand Avocado

Research funded by New Zealand Avocado

Goal and Scope – Baseline

Functional unit: 1 kg Hass avocado grown and packaged in New Zealand and delivered to Australia



Sampling and Data Collection



- Stratified sampling strategy: 3 regions, production practices, sizes
- 49 sampled orchards in the baseline
- 'Tier 1' and 'Tier 2' categories – data quality (CQI score)



- Two packhouses in the Bay of Plenty
- 3 different grades of fruit
- Reject fruit – oil, feedstock
- Waste packaging – recycled
- Inputs for five sub-stages



- Pallets with packed avocados → refrigerated containers → ports / airports / distribution centres
- Baseline modelled for shipping to Australia
- Sensitivity analysis for:
 - ~ export to Australia and South Korea
 - ~ domestic transport – North Island and South Island

Methodology

- LCA – as per ISO standards (ISO 14040 and ISO 14044)
- Model development choices – International EPD System PCR (EPD International, 2019)



Individual Orchards
Score

Tier 1 and 2 Orchards
score

Regional score

National score



Packhouse 1 & 2
Individual Scores

National Score

+

Total National
Score

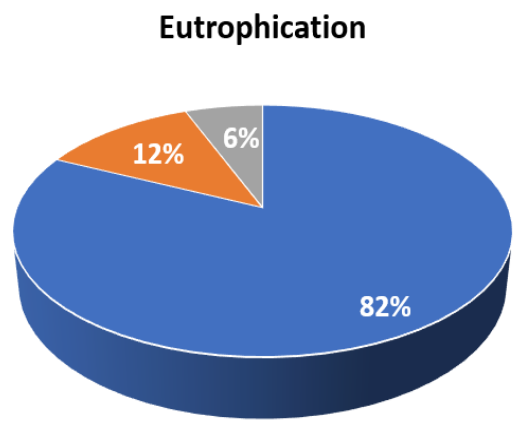
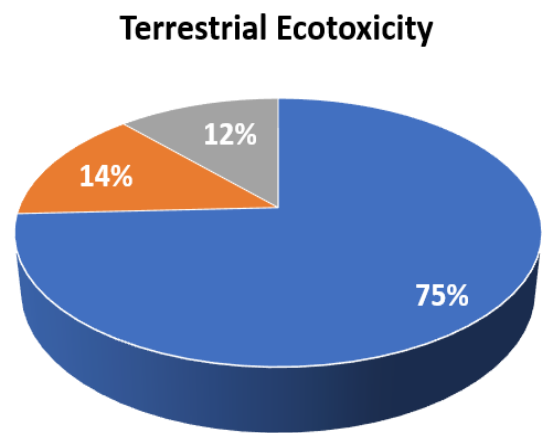
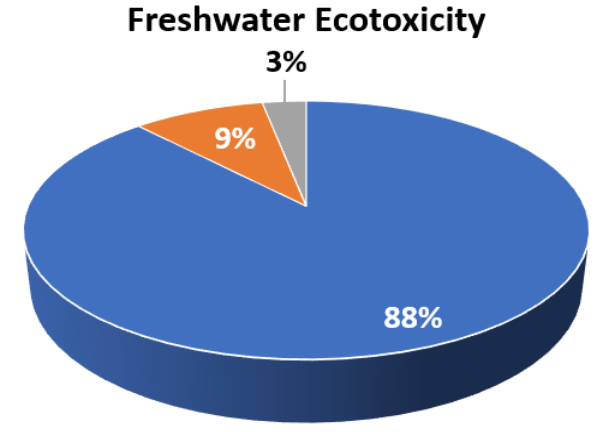
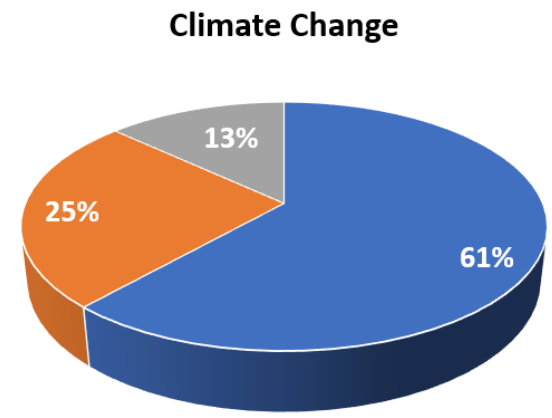
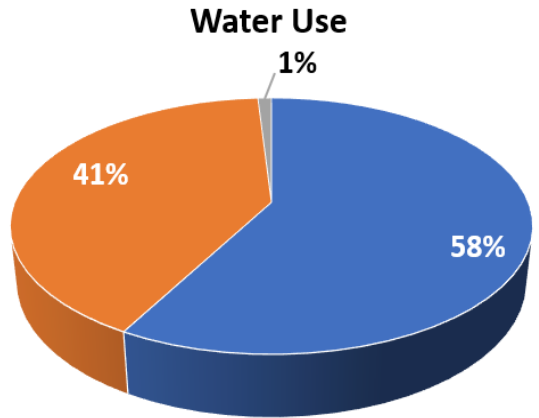


Packhouse to New
Zealand Port

+

New Zealand Port to
Australian Port

National Score



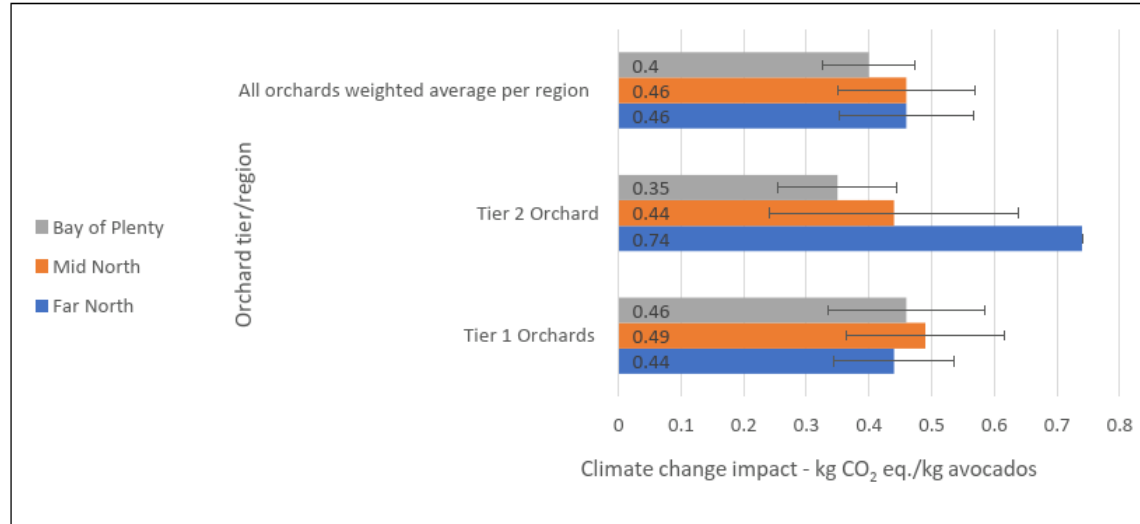
■ Production (Orchard) Stage ■ Post-Harvest Transport and Packaging Stage ■ Distribution Stage



Orchard Stage – largest contributor

LCIA Results – Climate Change

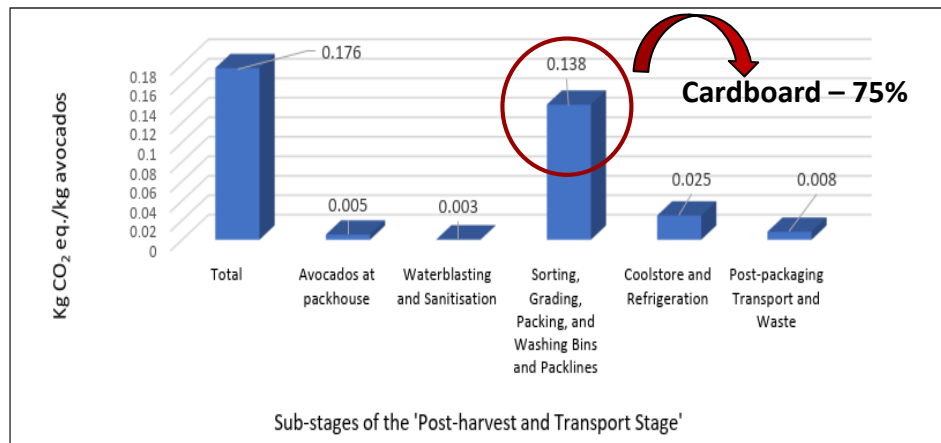
Weighted averages of climate change impacts by orchard tier and region



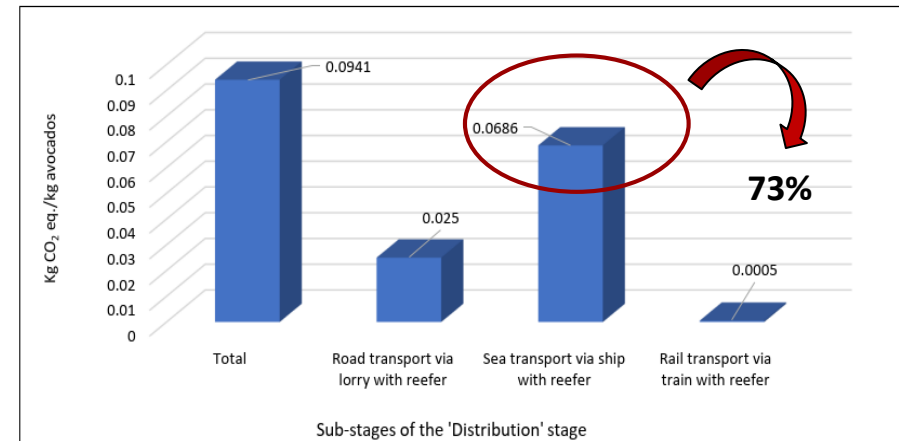
Main impacts – fertiliser/soil conditioner, and fuel

Fertiliser impacts – >62% from production/transport

CAN, NPK, Potassium Nitrate



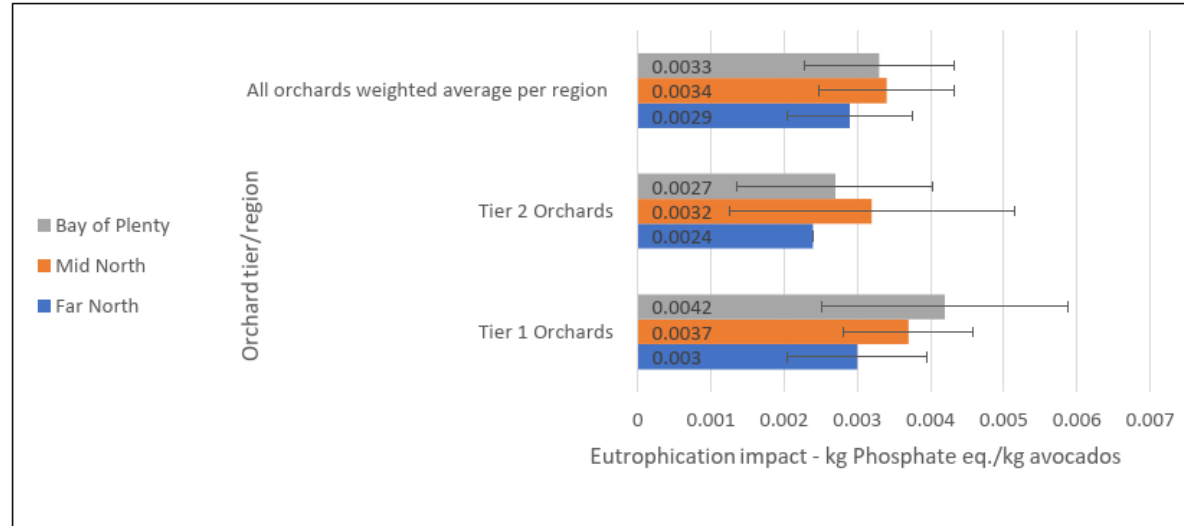
Climate change impact of the 'Post-harvest and Transport' stage



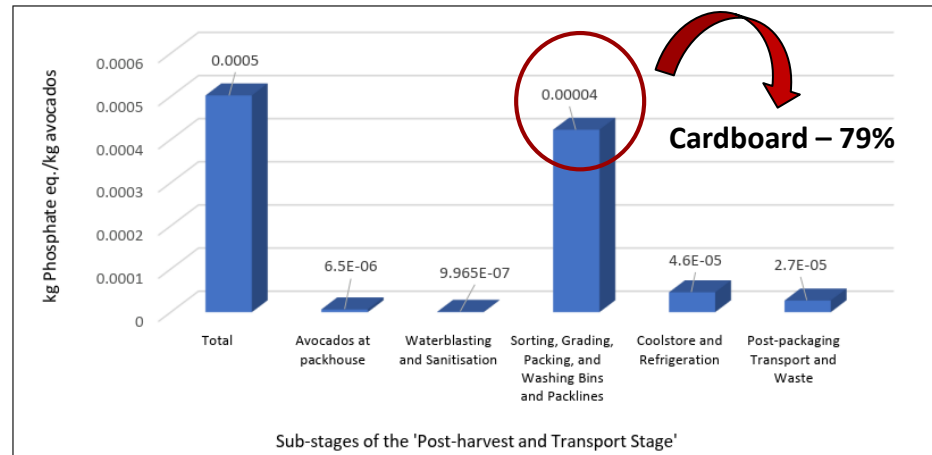
Climate change impact of the 'Distribution' stage

LCIA Results – Eutrophication

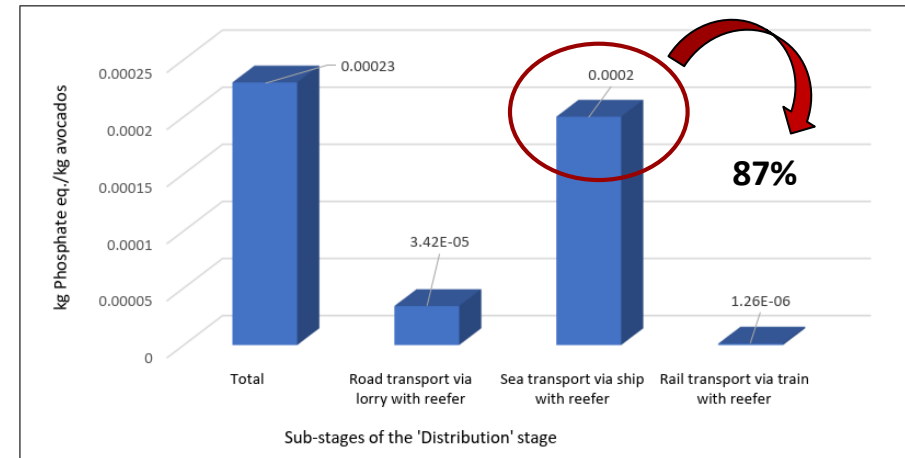
Weighted averages of eutrophication impacts by orchard tier and region.



- Mid North largest impact
- Fertiliser / soil conditioner
- Fertiliser use – 80% ‘application’ impacts



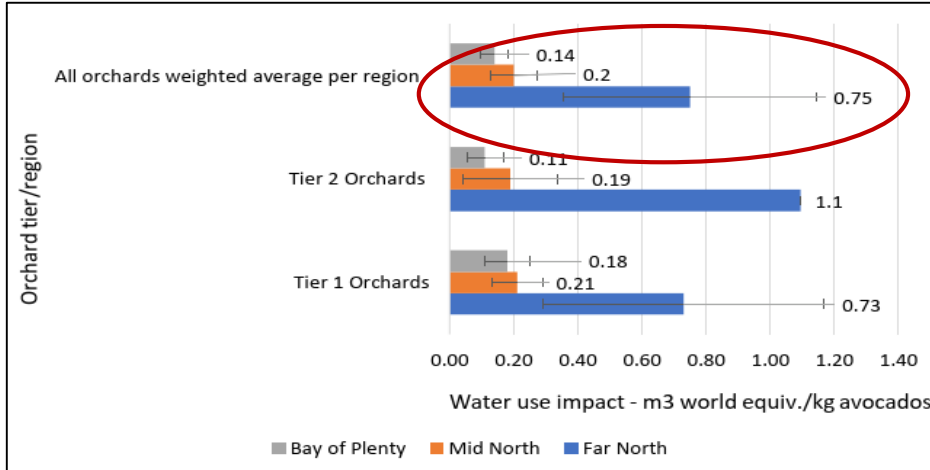
Eutrophication impact of the ‘Post-harvest and Transport’ stage



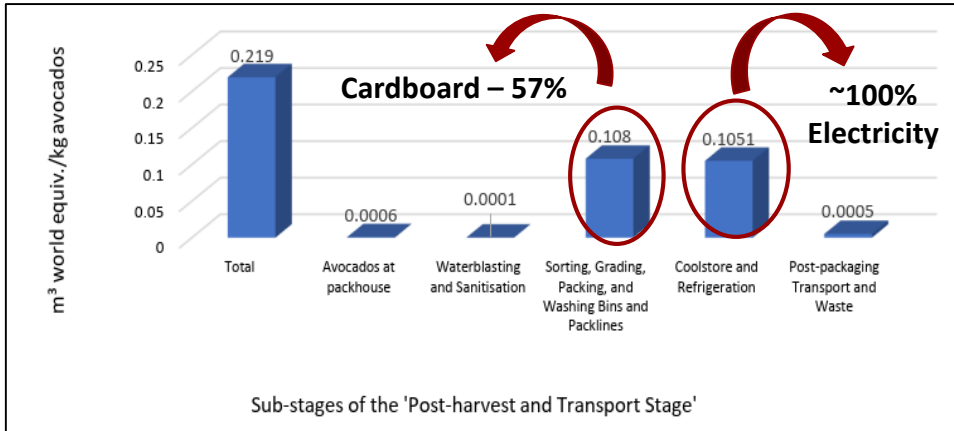
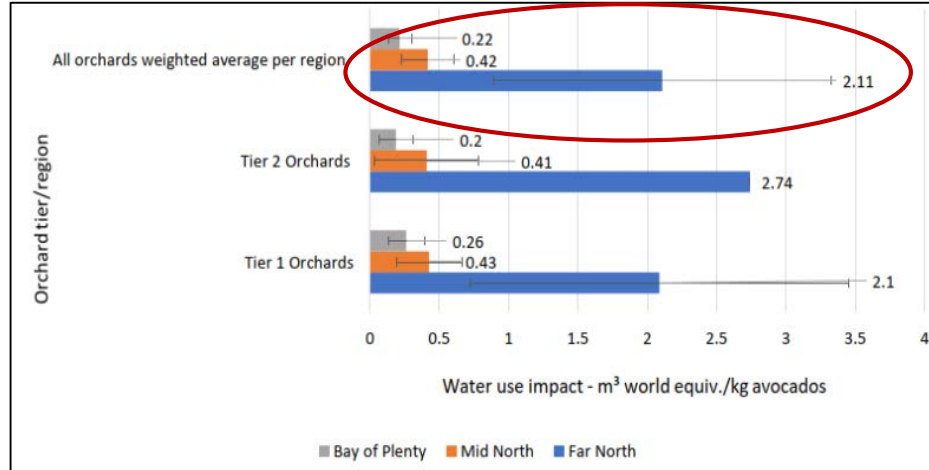
Eutrophication impact of the ‘Distribution’ stage

LCIA Results – Water Use

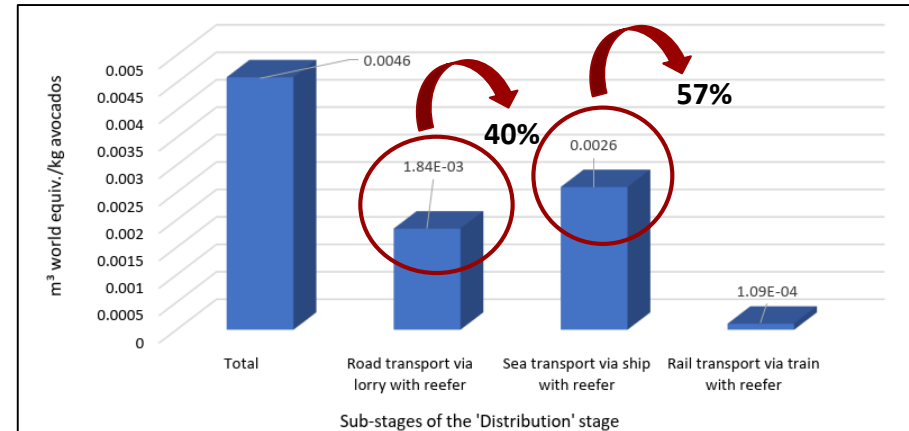
Weighted averages of total water use impacts by orchard tier and region (sub-national CFs)



Weighted averages of total water use impacts by orchard tier and region (national CFs)



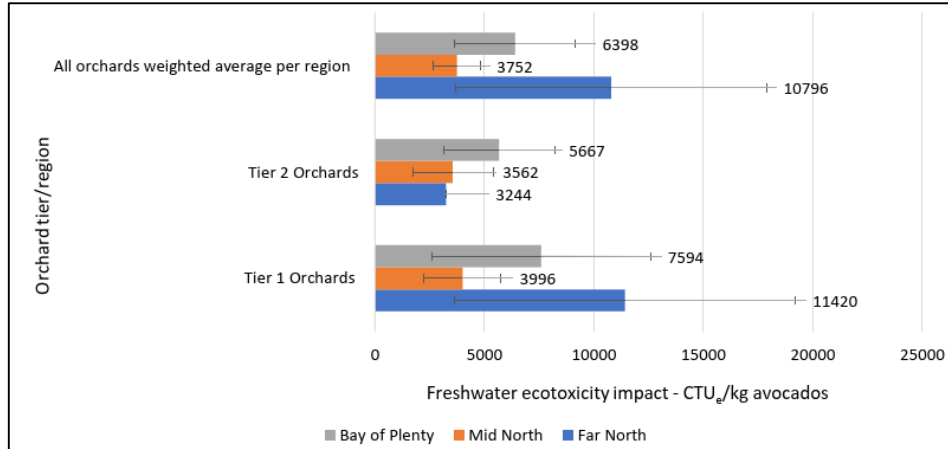
Water use impact of the 'Post-harvest and Transport' stage



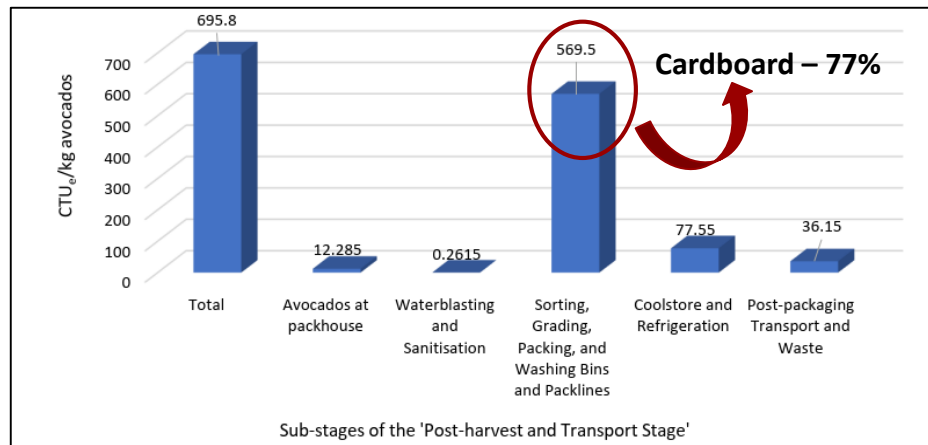
Water use impact of the 'Distribution' stage

LCIA Results – Freshwater Ecotoxicity

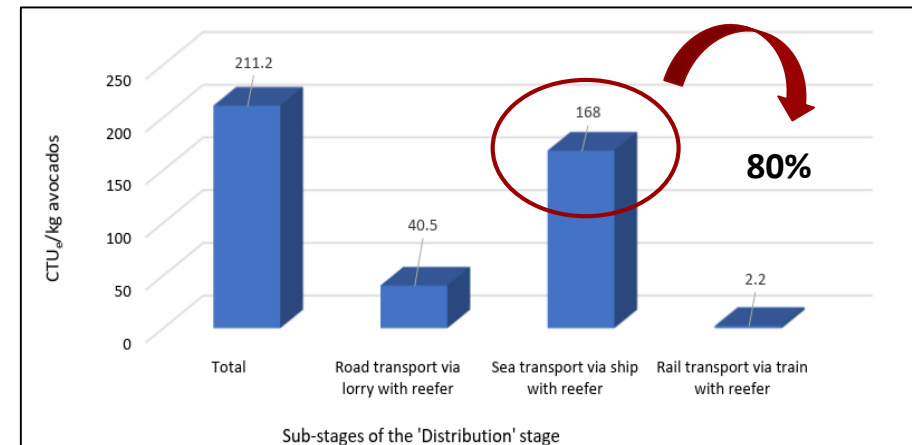
Weighted averages of total freshwater ecotoxicity impacts by orchard tier and region.



- Highest Far North, Lowest Mid North
- Agrichemical, fertiliser/soil conditioner, fuel use



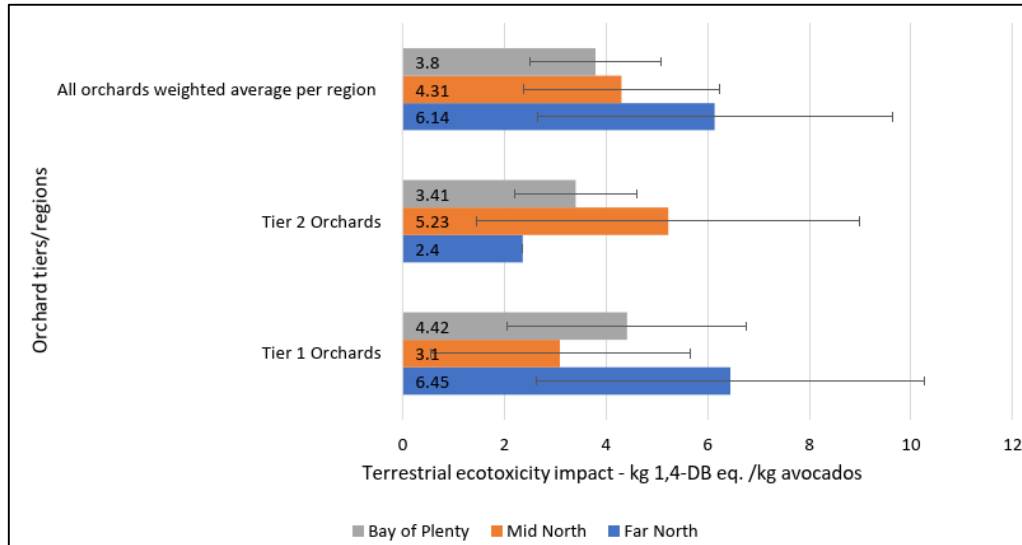
Freshwater ecotoxicity impact of the 'Post-harvest and Transport' stage



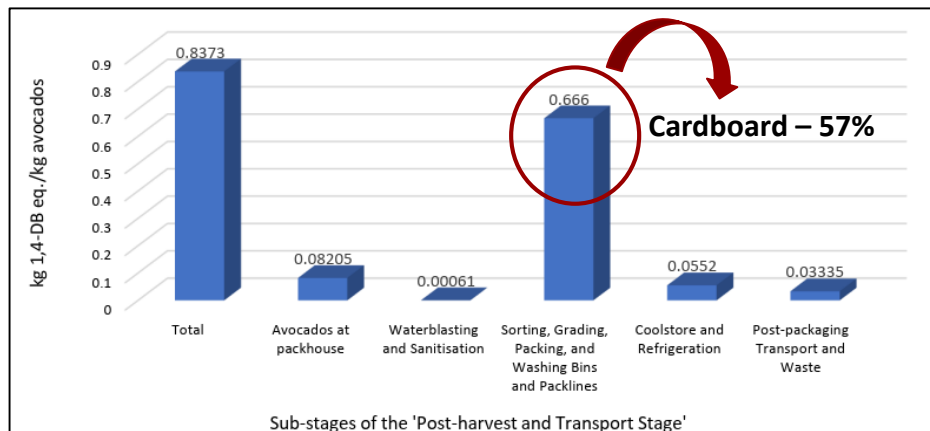
Freshwater ecotoxicity impact of the 'Distribution' stage

LCIA Results – Terrestrial Ecotoxicity

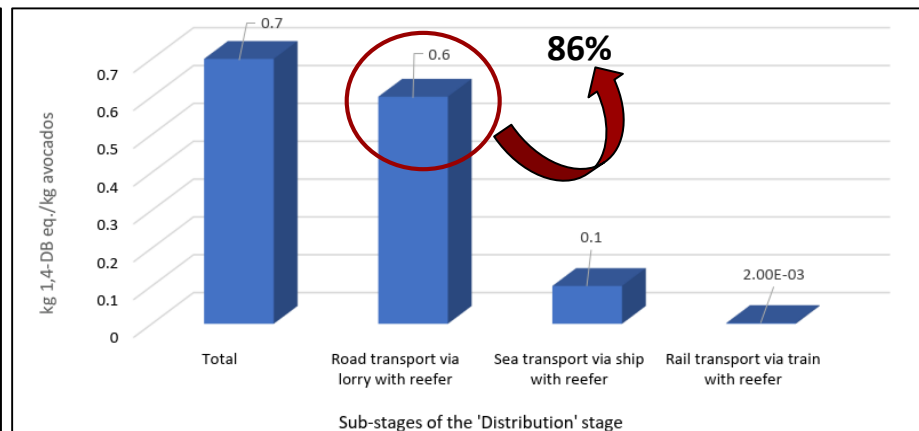
Weighted averages of total terrestrial ecotoxicity impacts by orchard tier and region.



- Highest Far North, Lowest Bay of Plenty
- Agrichemicals and fertilisers/soil conditioners
- Fuel use



Terrestrial ecotoxicity impact of the 'Post-harvest and Transport' stage



Terrestrial ecotoxicity impact of the 'Distribution' stage

Interpretation



Orchard Stage:

- ↑ Variability
- Tier 1 and 2 orchards similar
- Fertiliser/soil conditioners, fuel, and agrichemicals
- Water use impacts: Far North ~ 4 and 5 times the values of the Mid North and Bay of Plenty respectively

Post-harvest Transport and Packhouse Stage:

- Packline sub-stage
- Cardboard manufacturing



Distribution Stage:

- Transoceanic container ship (reefer)
- Export Scenarios – biggest change in climate change impact when air freighting
- Local distribution to North Island ↓ all impact scores except terrestrial ecotoxicity
- Transport to South Island ↑ all impact scores

Where next? Recommendations for Future Research



Improve temporal and spatial resolution for toxicity and water use impact categories



Focused study on cardboard manufacturing, transport and use options



Improve primary data quality for important inputs (fertiliser source of origin, transport distance and backhauling etc.)

Include additional impact categories



Include temporal aspect of orchard life



Account for carbon sequestration in avocado orchards



Obtain data from additional packhouses



Include more stages in the value chain (nursery, retail, consumer)



Thank You

For enquiries regarding this project,
please contact Shreyasi Majumdar at
s.majumdar@massey.ac.nz