

World Avocado Conference 2023, Auckland

Life Cycle Assessment and other methods to measure sustainability

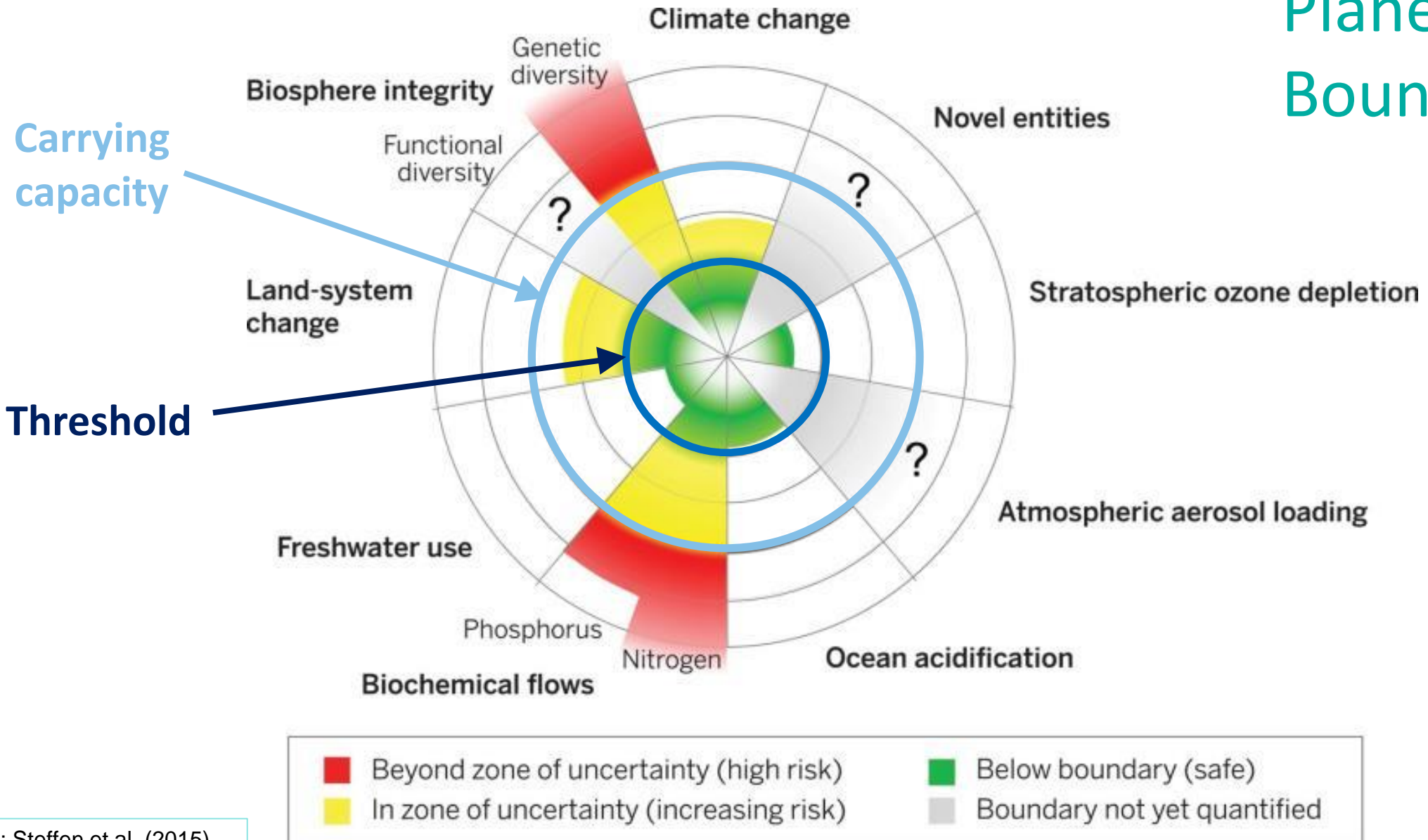
Sarah McLaren



Outline

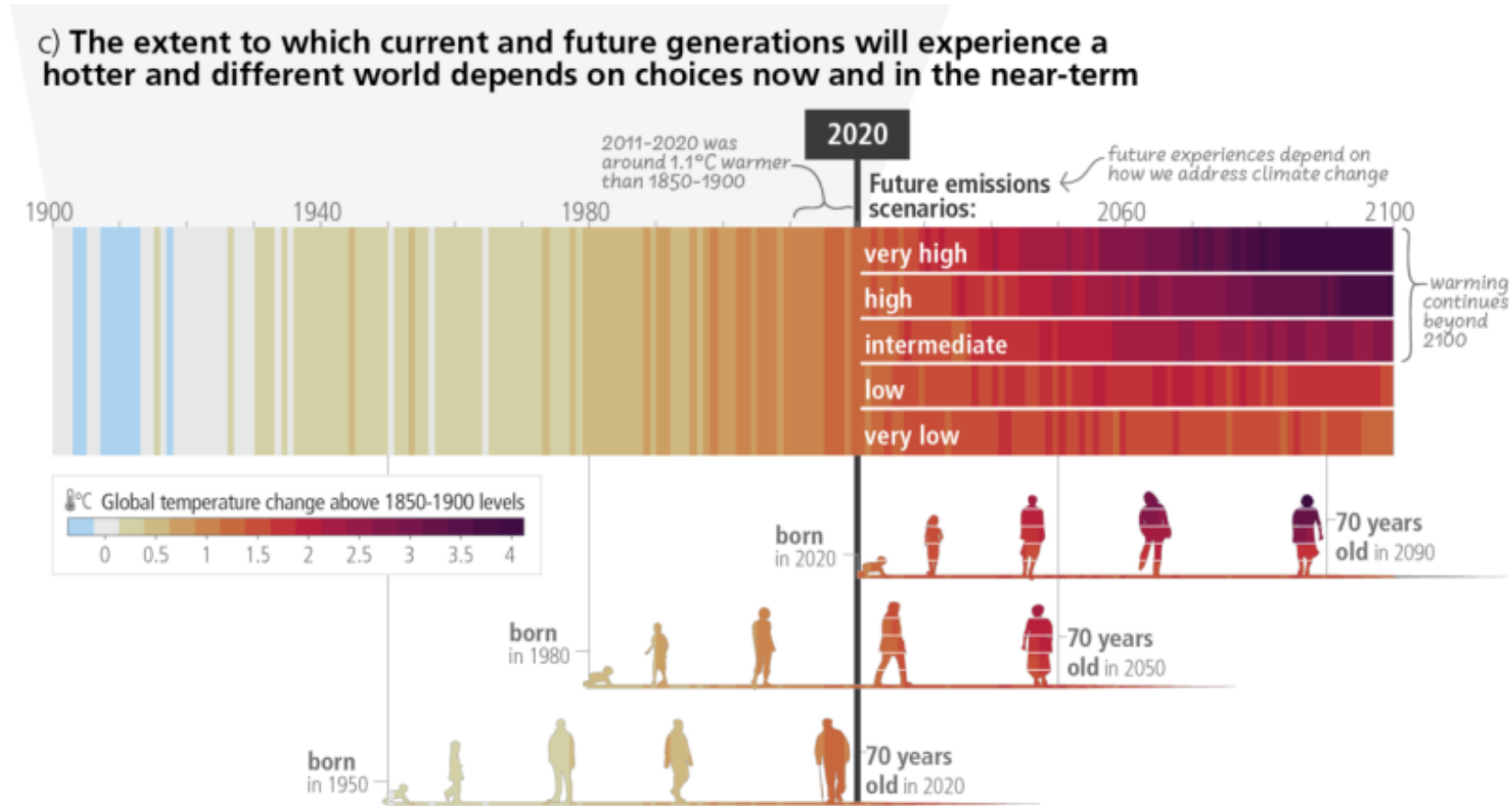
1. Sustainability – Why?
2. Framing sustainability
3. Assessment of sustainability: LCA of avocados
4. Moving forward

Planetary Boundaries



Source: Steffen et al. (2015).
Science 2015;347:1259855

Climate Change

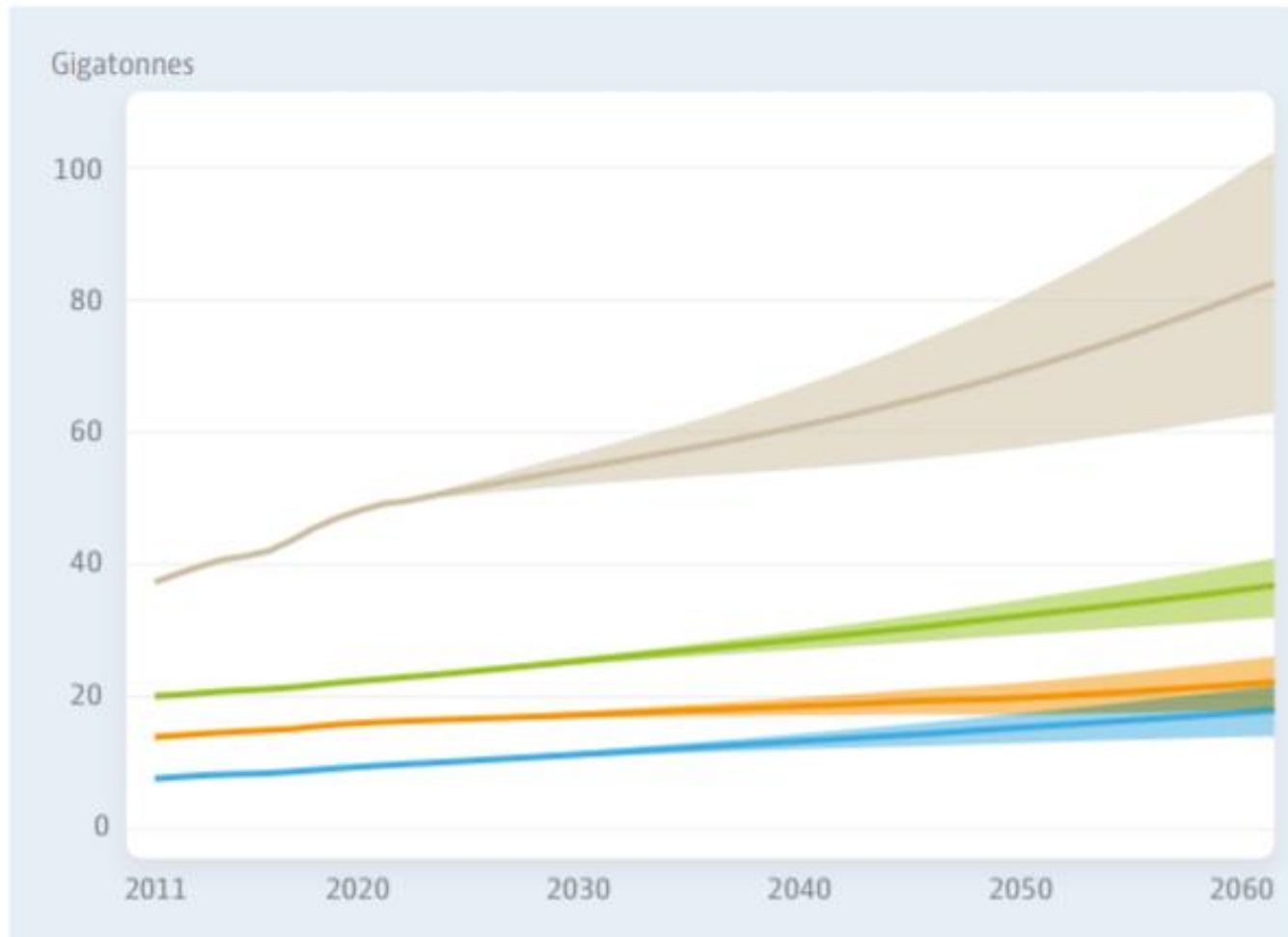


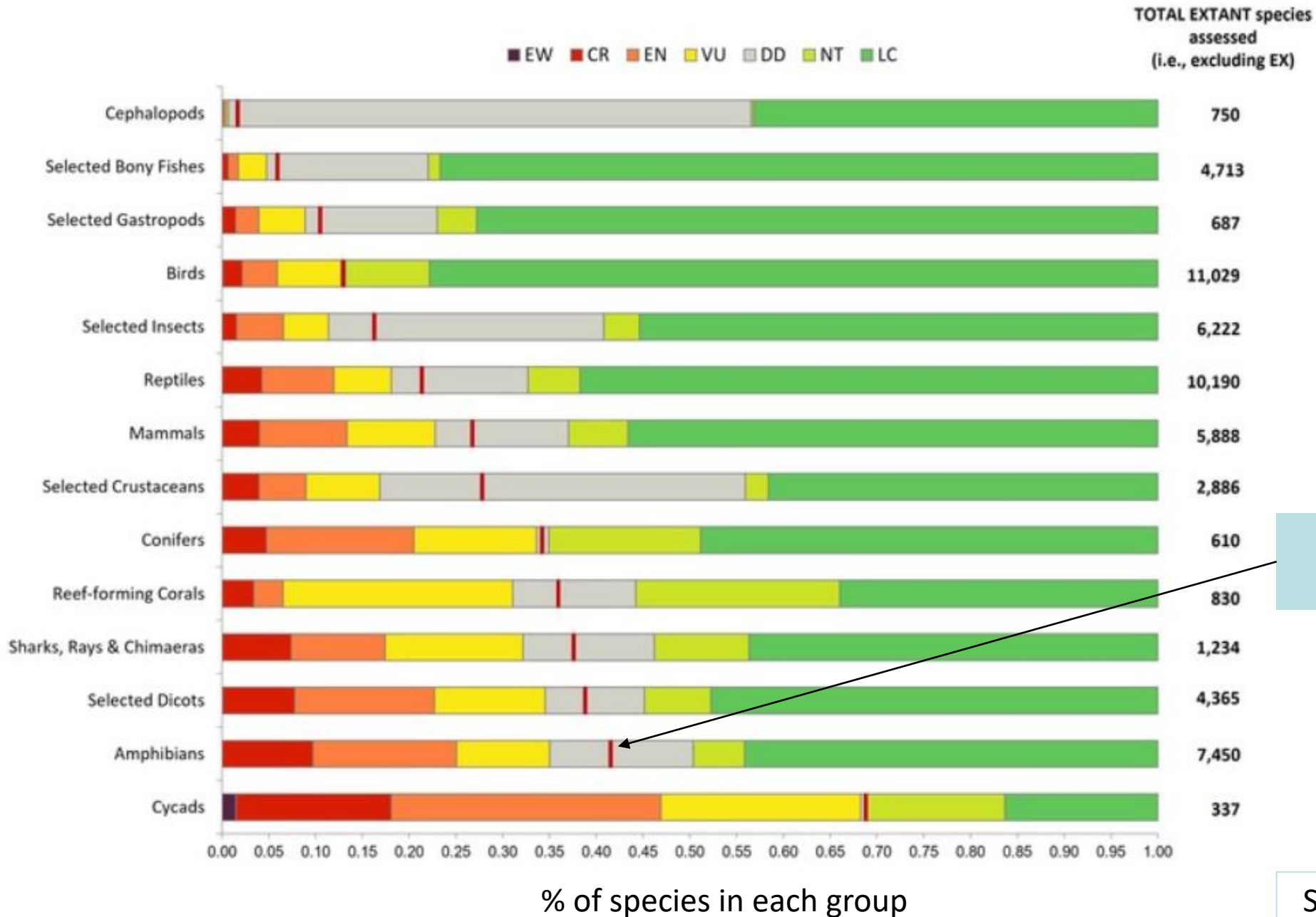
“B.5.3 If the annual CO₂ emissions between 2020–2030 stayed, on average, at the same level as 2019, the resulting cumulative emissions would almost exhaust the remaining carbon budget for 1.5°C (50%)”

Demand for materials growing ...

Figure 6. **Growth in materials use depends on population and economic growth assumptions**

 Biomass  Fossil fuels  Metals  Non-metallic minerals





Proportion threatened with extinction (EW, CR, EN, VU)

Source: [IUCN Red List, 2022-2](#)

Role of food systems

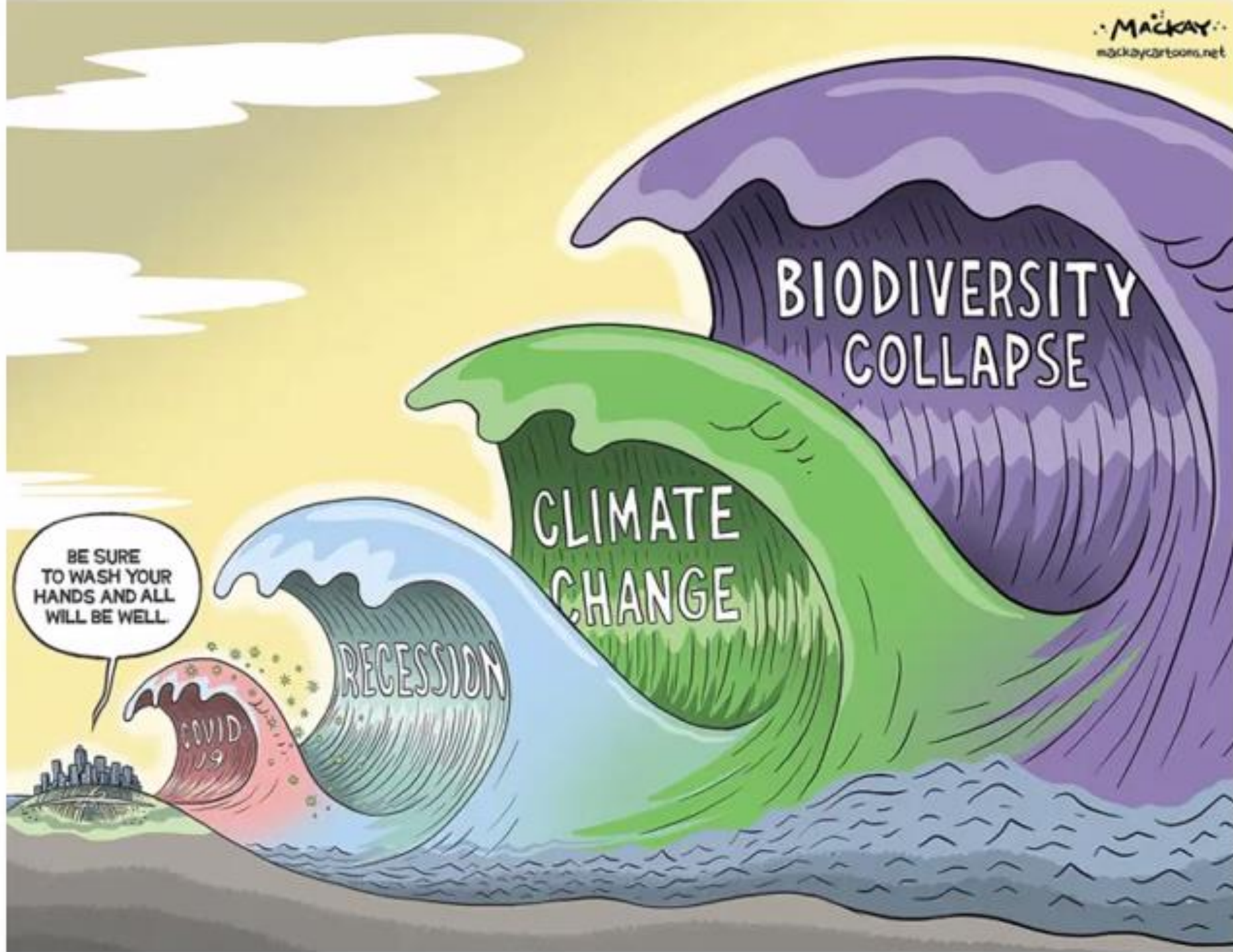
Global agri-food sector:

- Uses >30% energy
- Contributes approx. 22% greenhouse gases
- Agriculture alone uses >70% of world's total freshwater withdrawals
- Causes almost two-thirds of biodiversity loss
- Land water degradation, depleting fish stocks ...

Around one-third of food produced currently is lost in storage and at retail/consumption stage

And food consumption ...

- Nearly 811 million people suffer from chronic hunger (2020)
- Global prevalence of obesity increased to 13.1 % in 2016; 39 % of adults overweight
- Micronutrient deficiencies common globally - regardless of weight
- More than 3 billion people cannot afford a healthy diet: healthy diet two to five times more expensive than an energy (caloric) sufficient diet, and up to two times more expensive than a nutrient sufficient diet
- By 2050, 2 billion more people than there are today



BE SURE
TO WASH YOUR
HANDS AND ALL
WILL BE WELL.

COVID
19

RECESSION

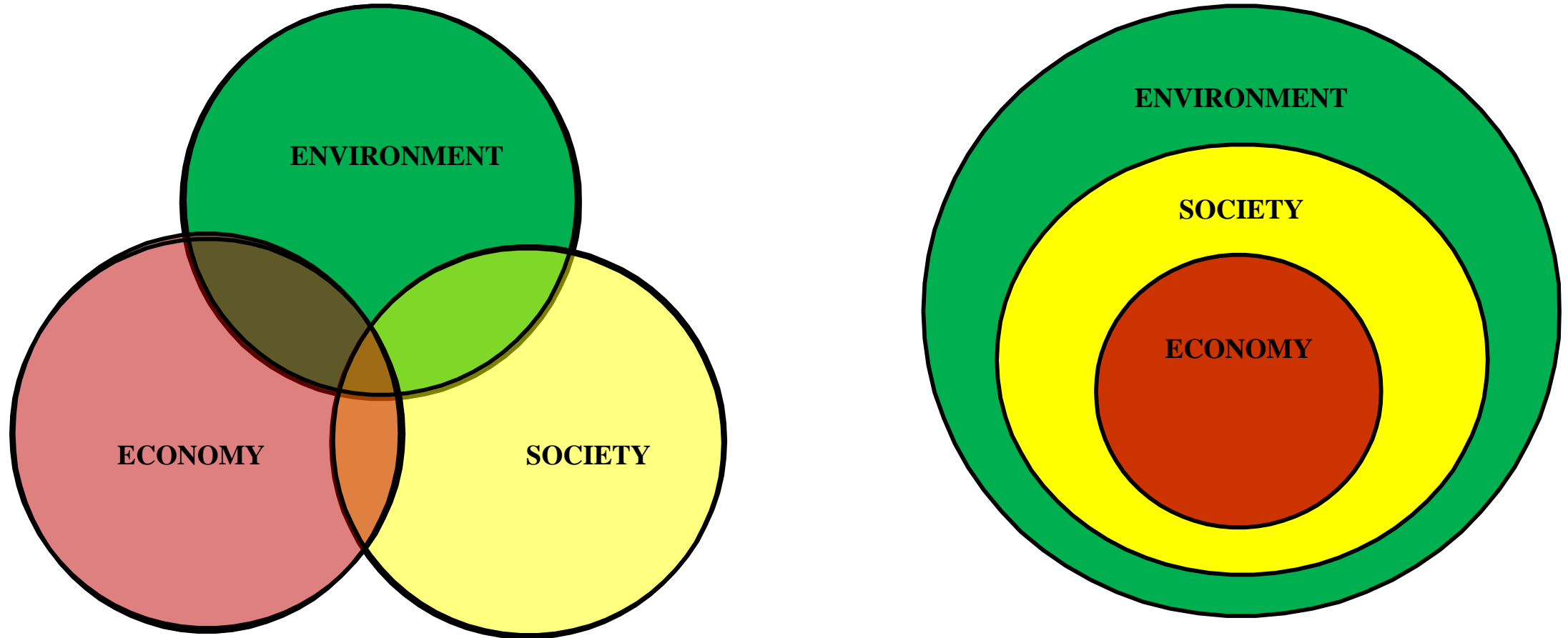
CLIMATE
CHANGE

BIODIVERSITY
COLLAPSE

Responses

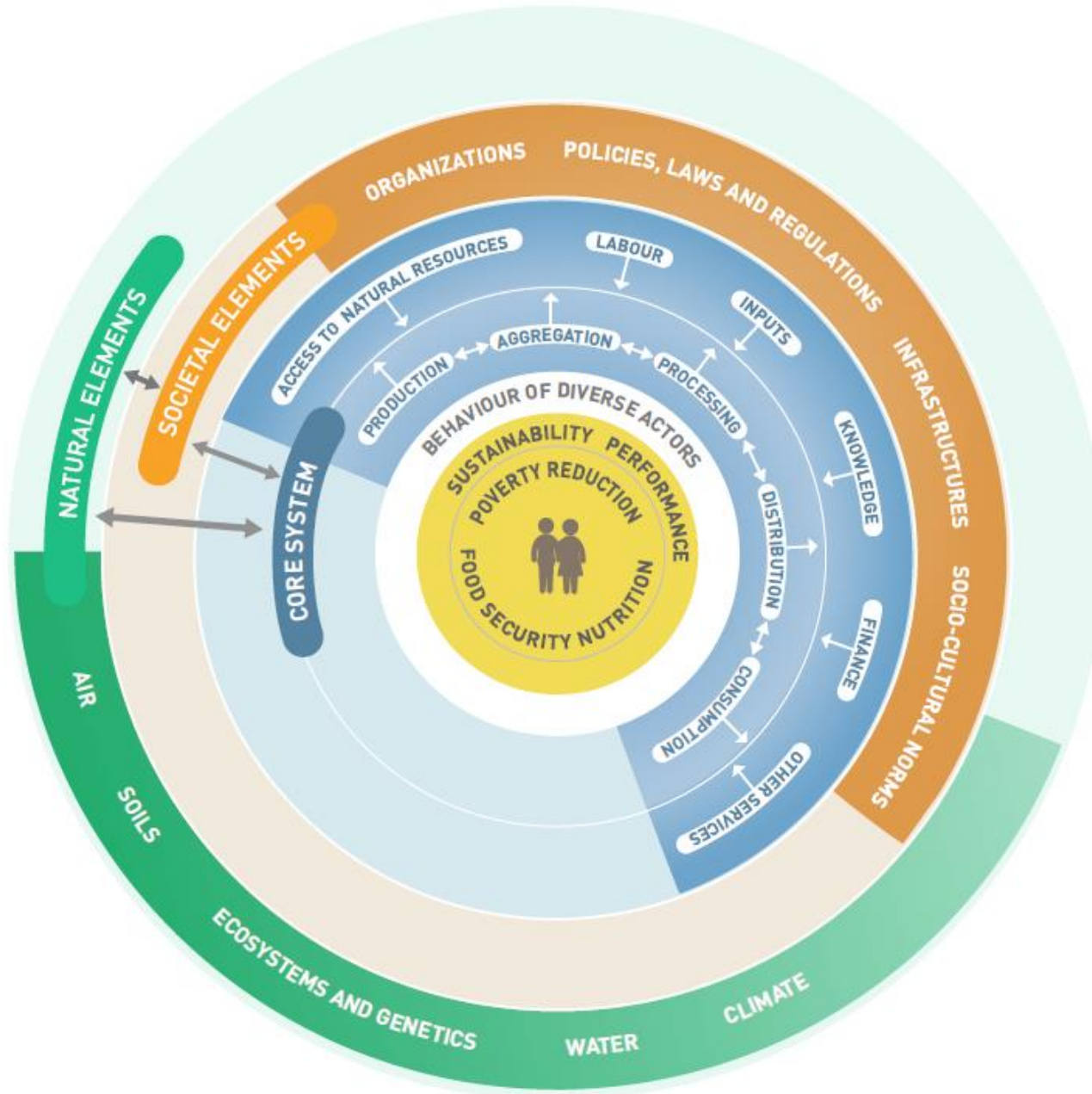
1. I don't believe any of it – there are no significant problems.
2. OK so there are problems but humans are ingenious and we will invent our way out of these problems. Nothing needs to be done differently.
3. These are significant problems. We need to take action now to change things.
4. These problems are overwhelming and anything I do won't make a difference. I will leave them to someone else to deal with.

2. Framing sustainability



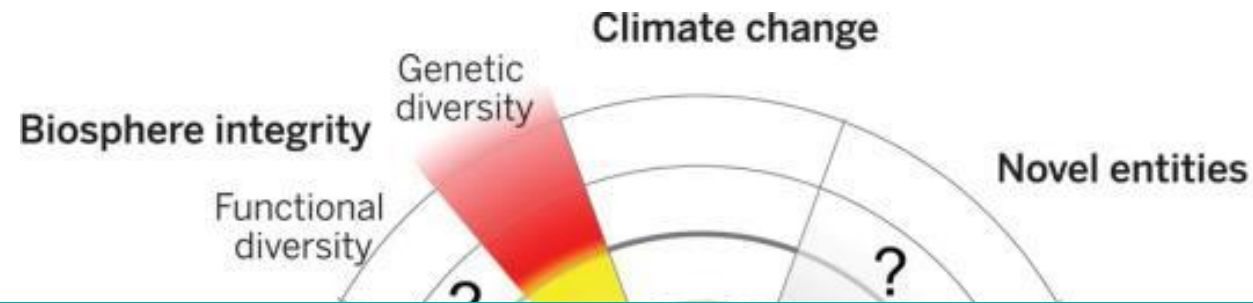
As defined in Daly (1991); Costanza and Daly, 1992)

FIGURE 1 THE FOOD SYSTEM WHEEL



Source: "Sustainable Food Systems" (FAO, 2018)

Planetary Boundaries



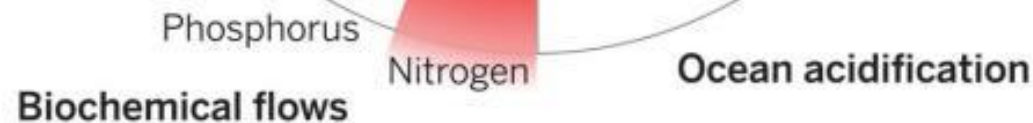
Business as usual is not an option

Call for transformation of food systems

Requires assessment of alternatives

ozone depletion

nitrogen loading



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)

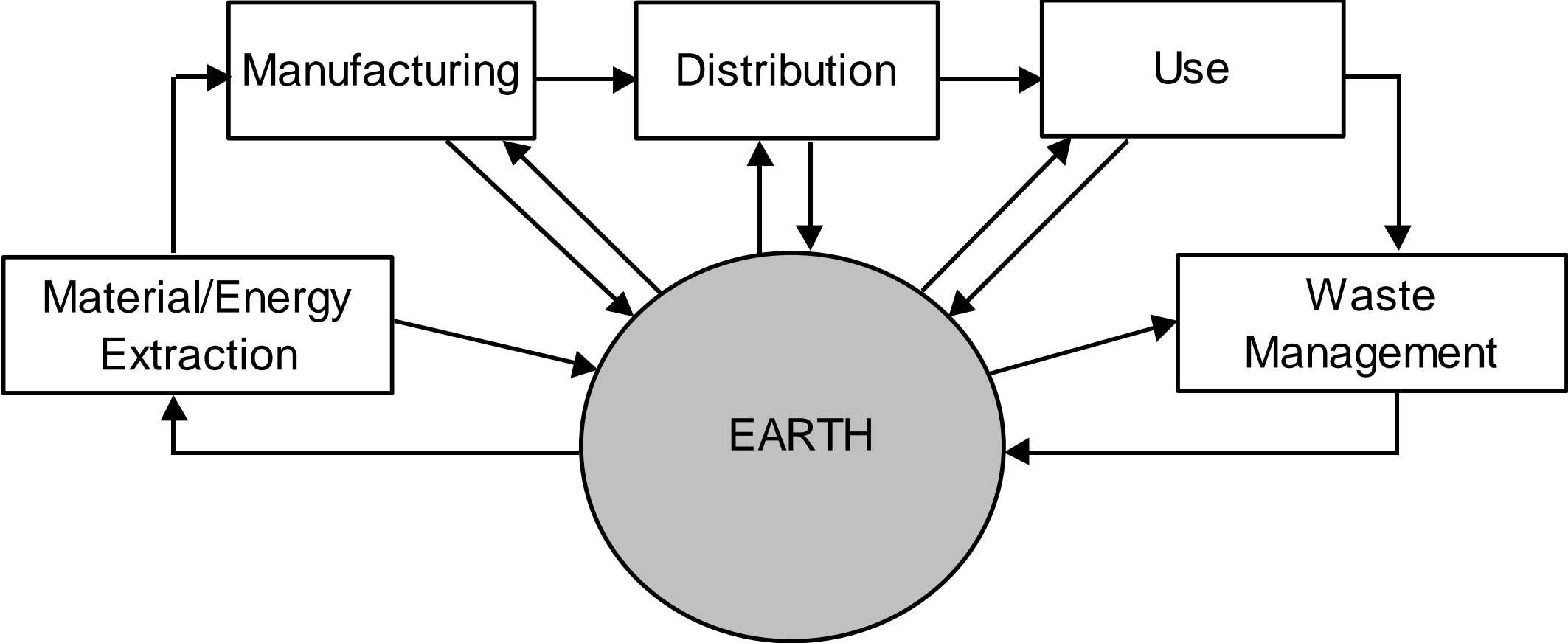
- Below boundary (safe)
- Boundary not yet quantified

Source: Steffen et al. (2015).
Science 2015;347:1259855

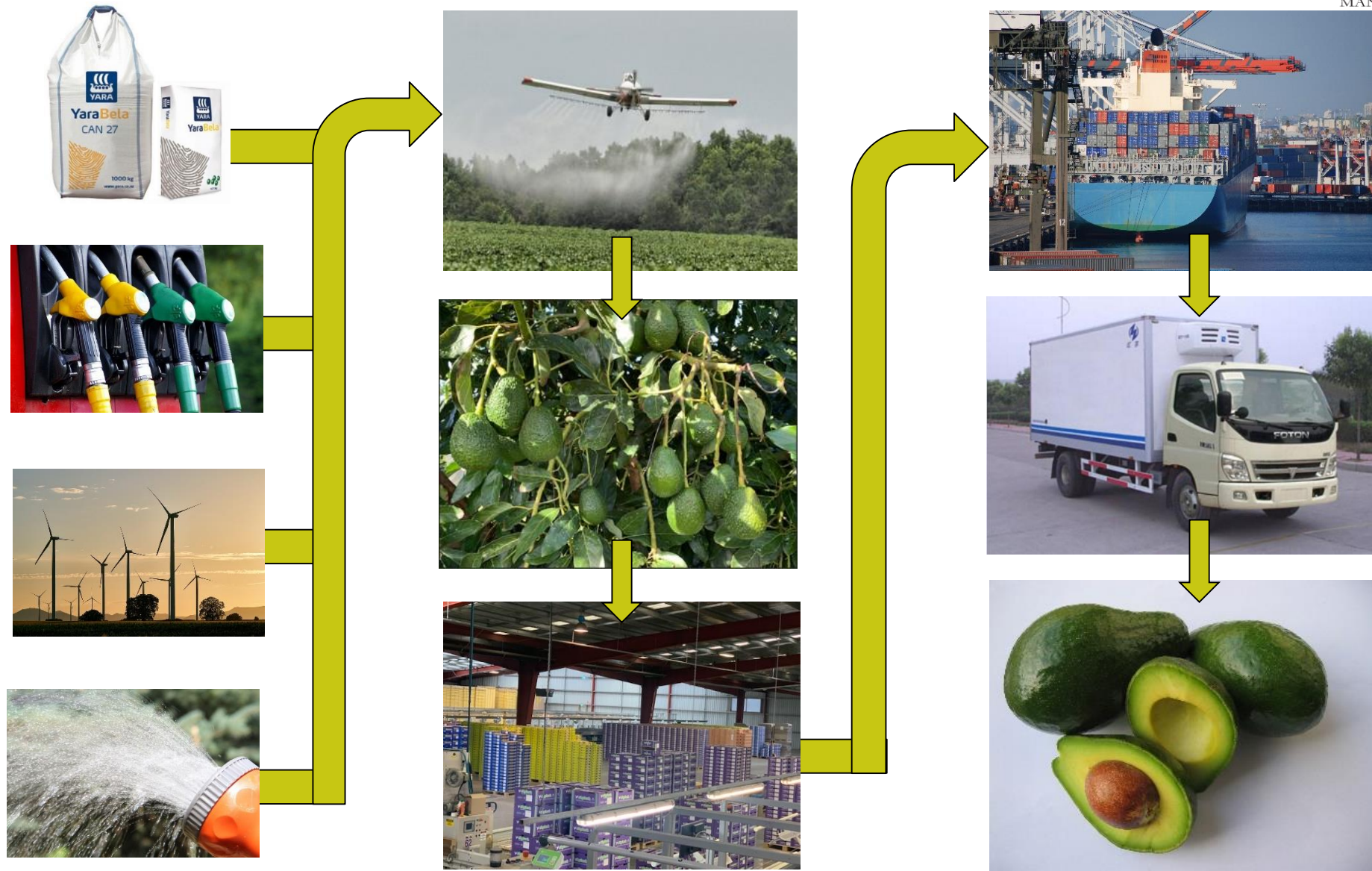
3. Assessing sustainability: LCA of avocados

- **Life cycle perspective**
- **Production perspective:**
 - Incremental change: commitment to continuous improvement
 - Step change: innovation/transformation
- **Consumption perspective:**
 - Nutritional Life Cycle Assessment

Life Cycle Thinking



Avocado production perspective



LCA avocados produced in Aotearoa/New Zealand

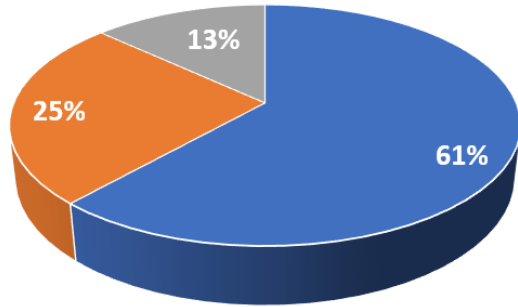


Aims

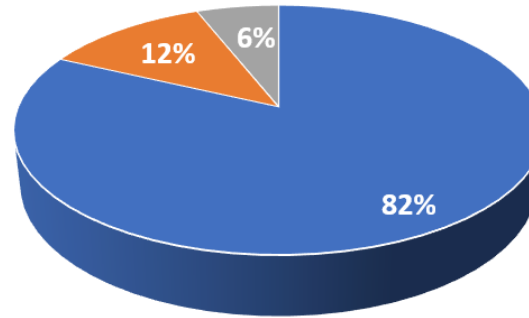
- Understand the environmental impacts of conventional avocado production and packaging in New Zealand, and distribution to local and international destinations
 - Environmental impacts: Climate Change, Water Use, Eutrophication, Ecotoxicity (Freshwater and Terrestrial)
-
- Orchards: stratified sampling: for three regions, three production practices, three orchard sizes (49 sampled orchards in the baseline)
 - Packhouses: two packhouses
 - Main exporter: shipping or air freight to Australia, South Korea

LCA results: life cycle stages

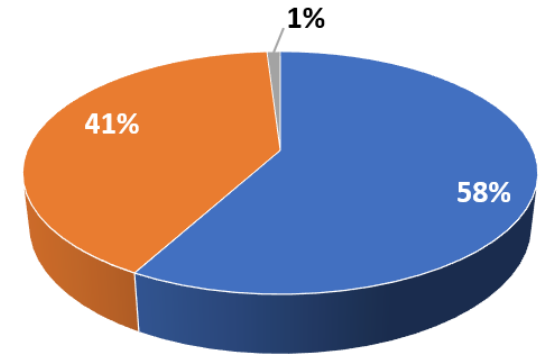
Climate Change



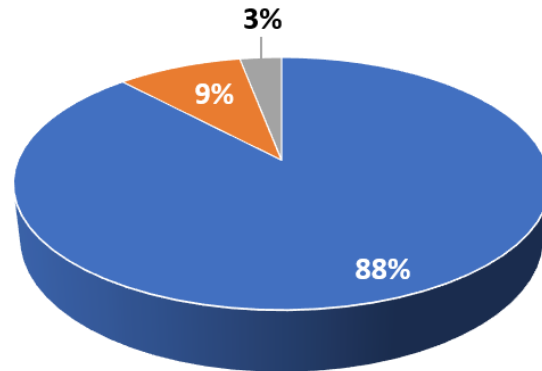
Eutrophication



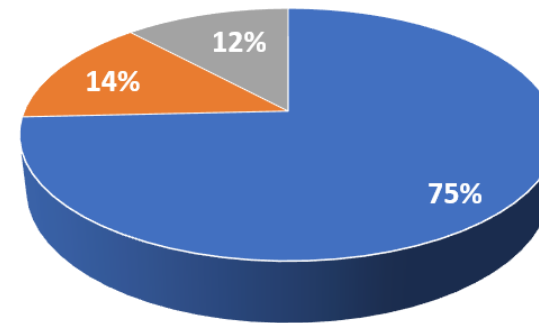
Water Use



Freshwater Ecotoxicity



Terrestrial Ecotoxicity



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

LCA results: main contributors

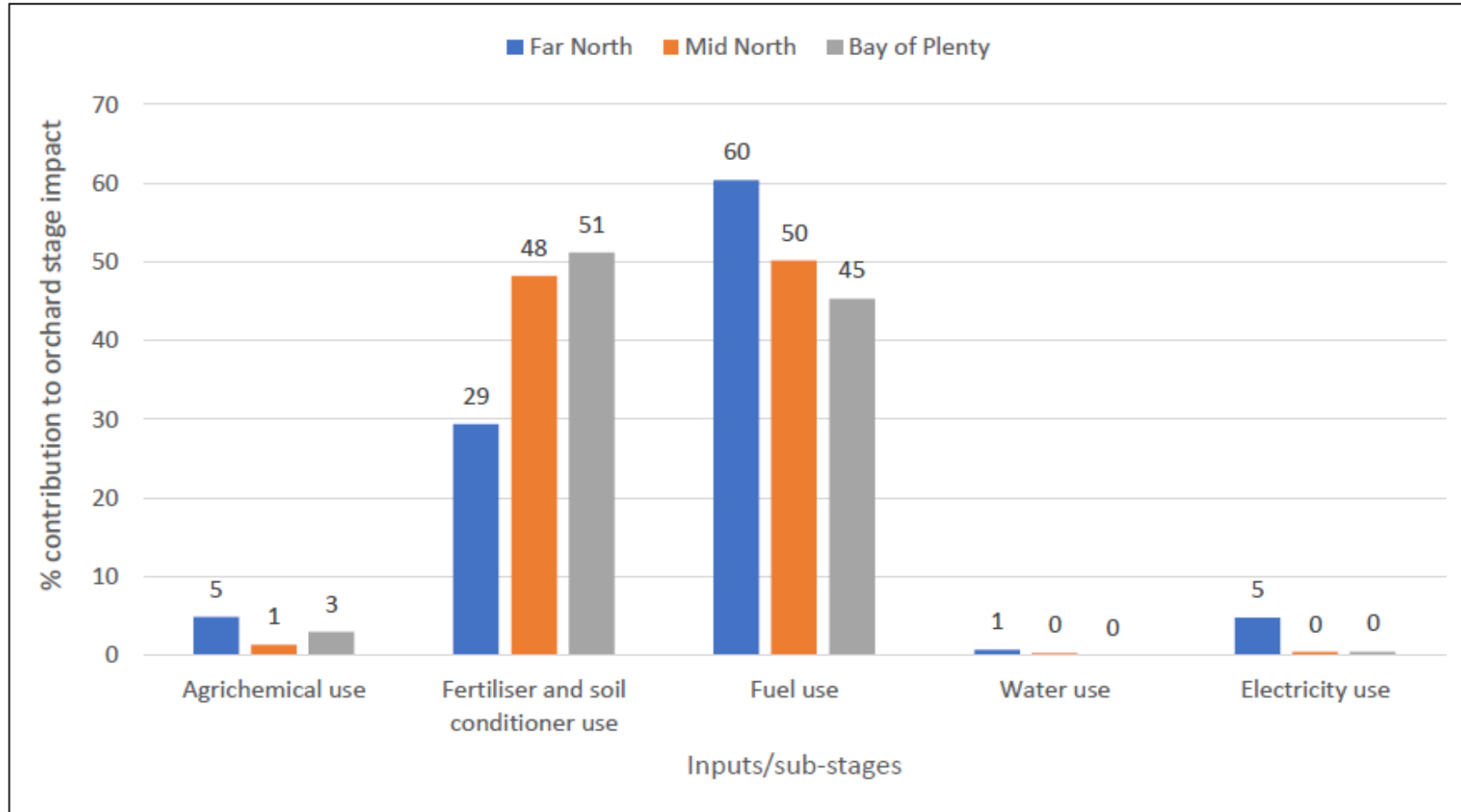


Figure 11 Contribution (%) of Inputs/sub-stages to overall climate change impact of the orchard stage

Source: "Environmental Life Cycle Assessment of NZ Avocados (Majumdar and McLaren, 2021)

Avocado LCA results: insights (distribution)

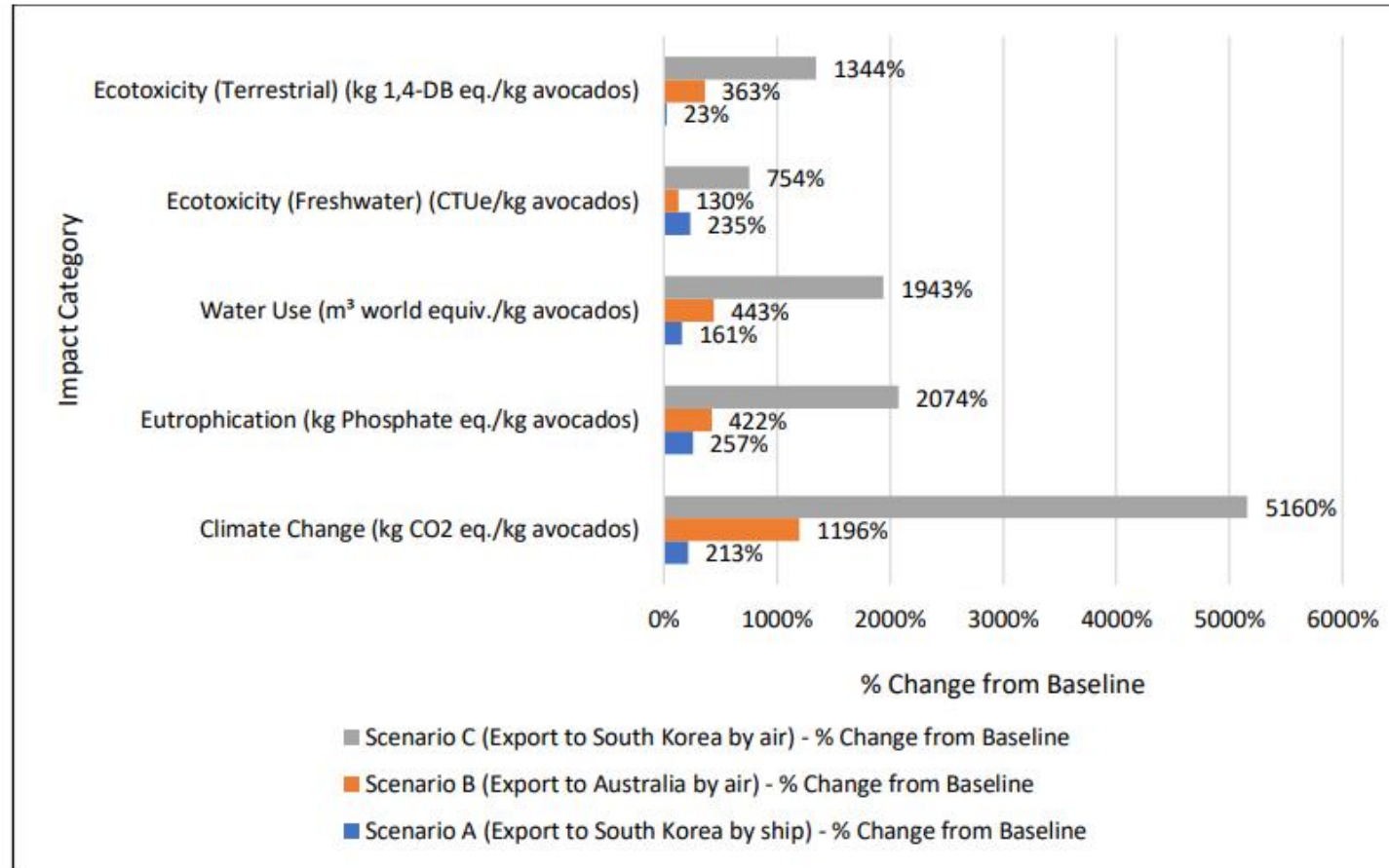
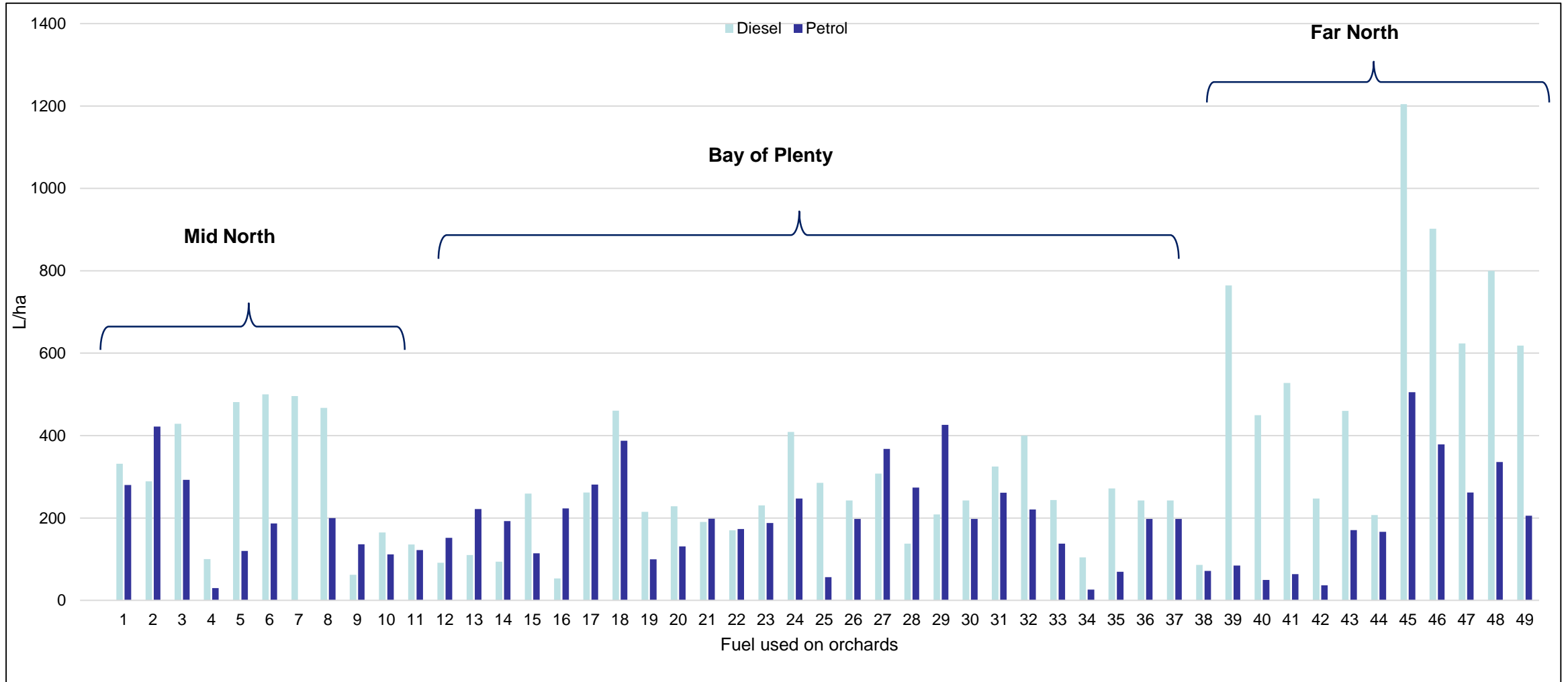


Figure 55 Changes in impact scores (%) of Scenario A, B, and C, from the distribution stage levels of the baseline model

Source: "Environmental Life Cycle Assessment of NZ Avocados (Majumdar and McLaren, 2021)

Avocado LCA results: insights (variability)



LCA results: insights (carbon sequestration)



**Approx 10% of carbon
footprint of 1 kg avocado
(avocado trees + shelterbelt)**

Avocado consumption perspective



- Food waste
- Serving size? How typically eaten?
- Nutritional value?

Nutritional Life Cycle Assessment?

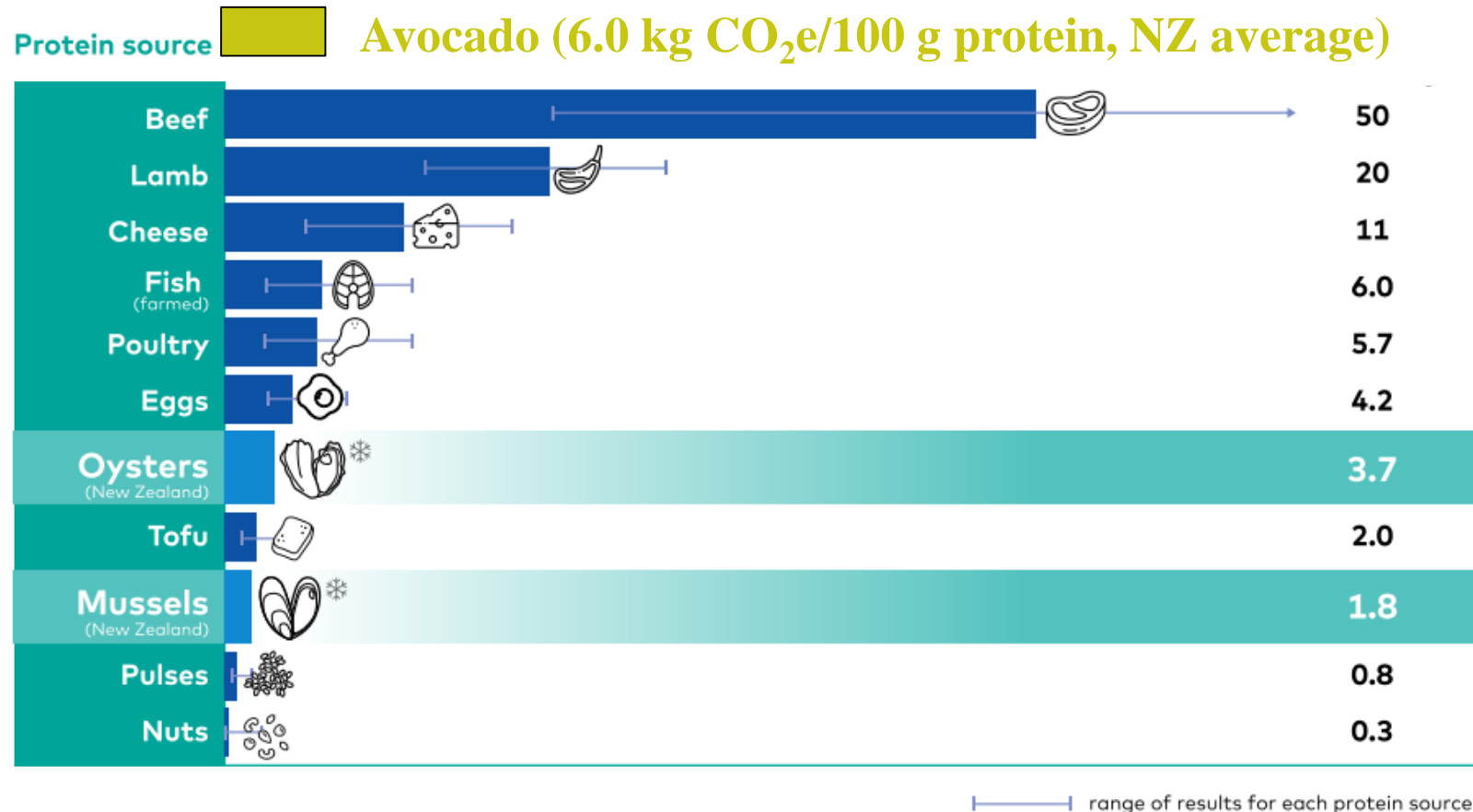
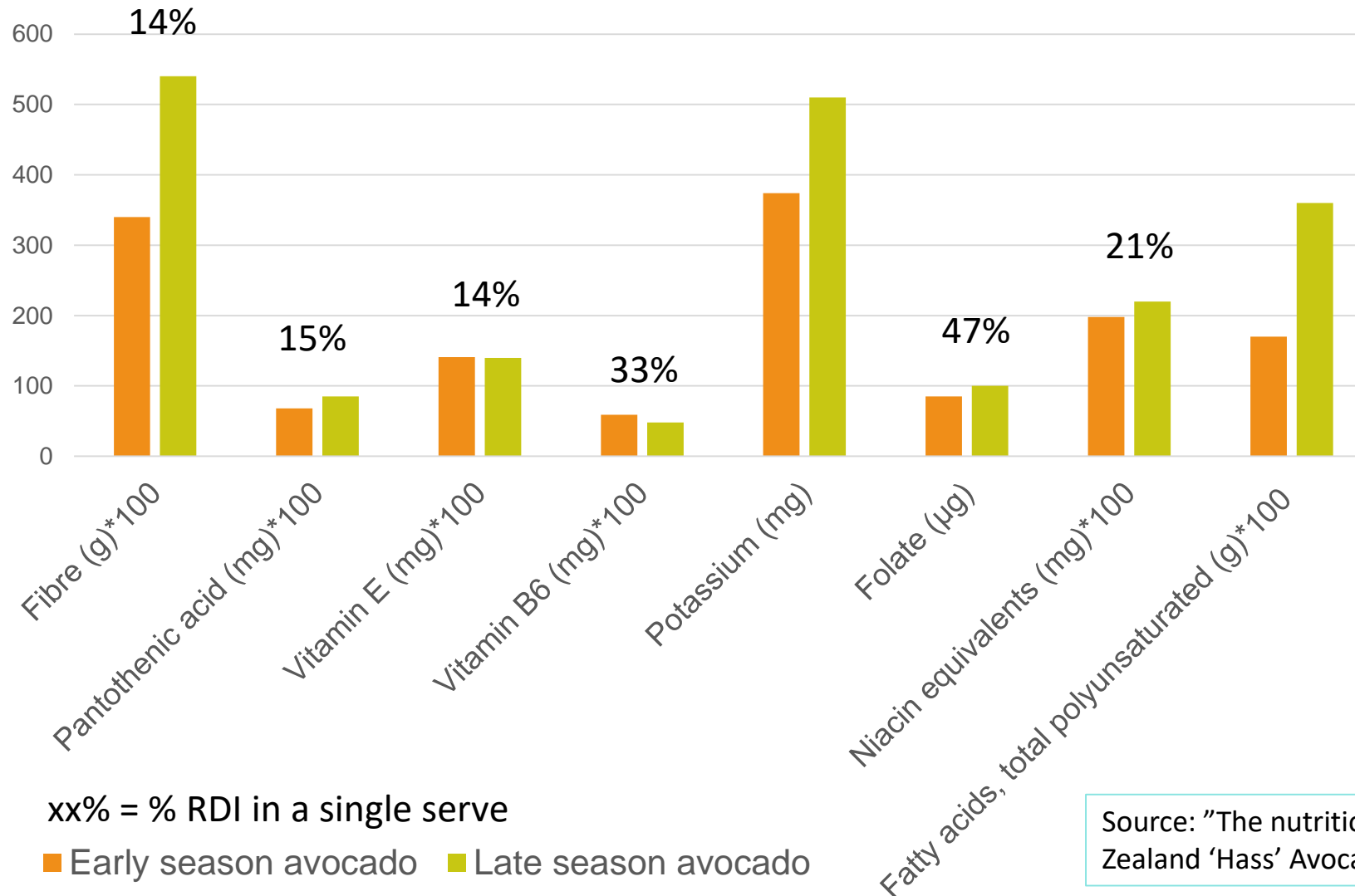


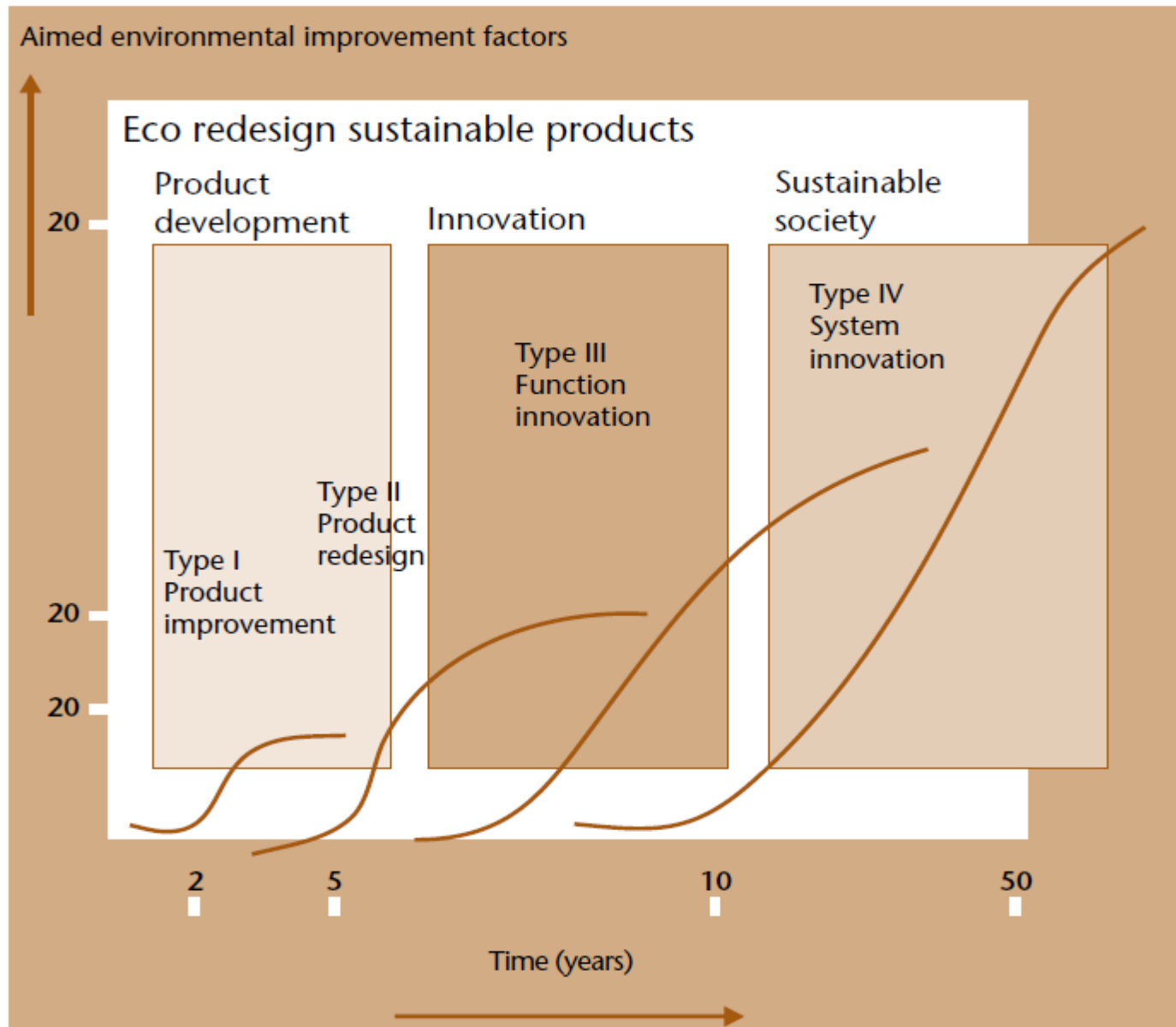
Figure 1: Carbon footprints of different dietary proteins on the global market – farming to retail only ‡

Source: “LCA of NZ Mussels and Oysters” (thinkstep ANZ, 2021)

Nutritional value: dietary contribution



Source: "The nutritional composition of New Zealand 'Hass' Avocados" (Lister, 2021)



4. Moving forward: levels of change

Figure 3.2 Four types of environmentally friendly product service development [Korbijn, 1999].

Source: Zbicinski et al., 2006, p.57

SUBSCRIBE AND SAVE ON DELICIOUSNESS



Home

About Us

Avocados

Skincare

Tea

Gift

Sizes

Quantity

Frequency

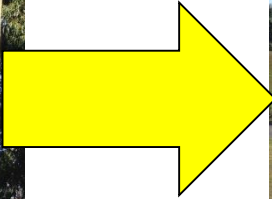
Dispatch Day

Dispatch Date

Choose your Avocado size...



From possible for these taste-bud pleasers.
hand-picked avo's from our orchard to
your door. Let's go shopping...



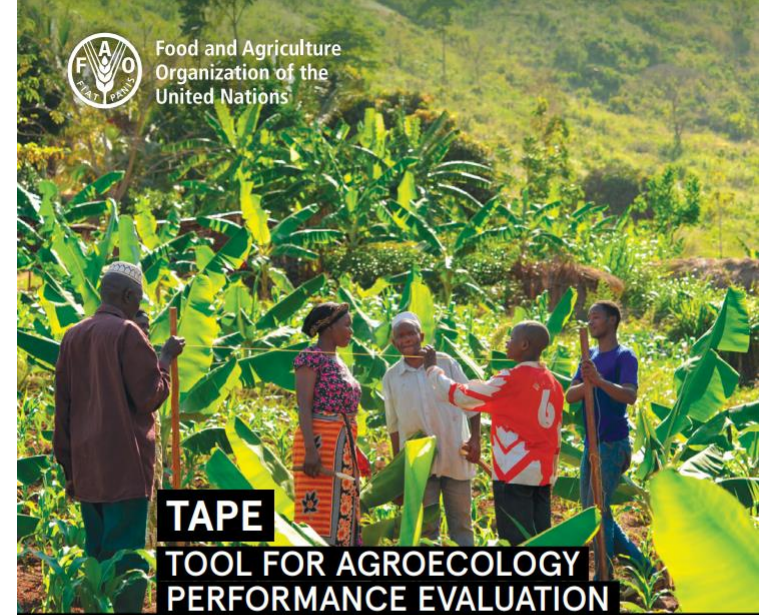
NEW ZEALAND
LIFECYCLE
MANAGEMENT CENTRE





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TAPE TOOL FOR AGROECOLOGY PERFORMANCE EVALUATION

PROCESS OF DEVELOPMENT AND GUIDELINES FOR APPLICATION

TEST VERSION



- FAO's Work on Agroecology
- 10 elements
- Scaling up Agroecology Initiative
- Social process
- Agroecology and the

Overview

What is Agroecology?

Agroecology is a holistic and integrated approach that applies ecological principles to the design and management of agricultural systems, emphasizing the interactions between plants, animals, humans, and the environment. It aims to create equitable food systems within which people can thrive. Agroecology is concurrently a science, a set of practices, and a social movement. In recent decades to expand in scope from a focus on fields and farms to encompass the entirety of agriculture and food systems. It now represents a transdisciplinary field that includes the ecological, socio-cultural, technological, economic

Source: [FAO website](#)

Conclusions

- Position sector for a sustainable future – supported by robust scientific data
- Balance: measurement **and** action
- Change – at different scales:
 - Micro: incremental changes (continuous improvement)
 - Meso/macro levels: step changes
- Life cycle **sustainability** assessment: nutritional, cultural, socio-economic ...

