# Nutritional LCA methods—a review of opportunities in a rapidly developing field

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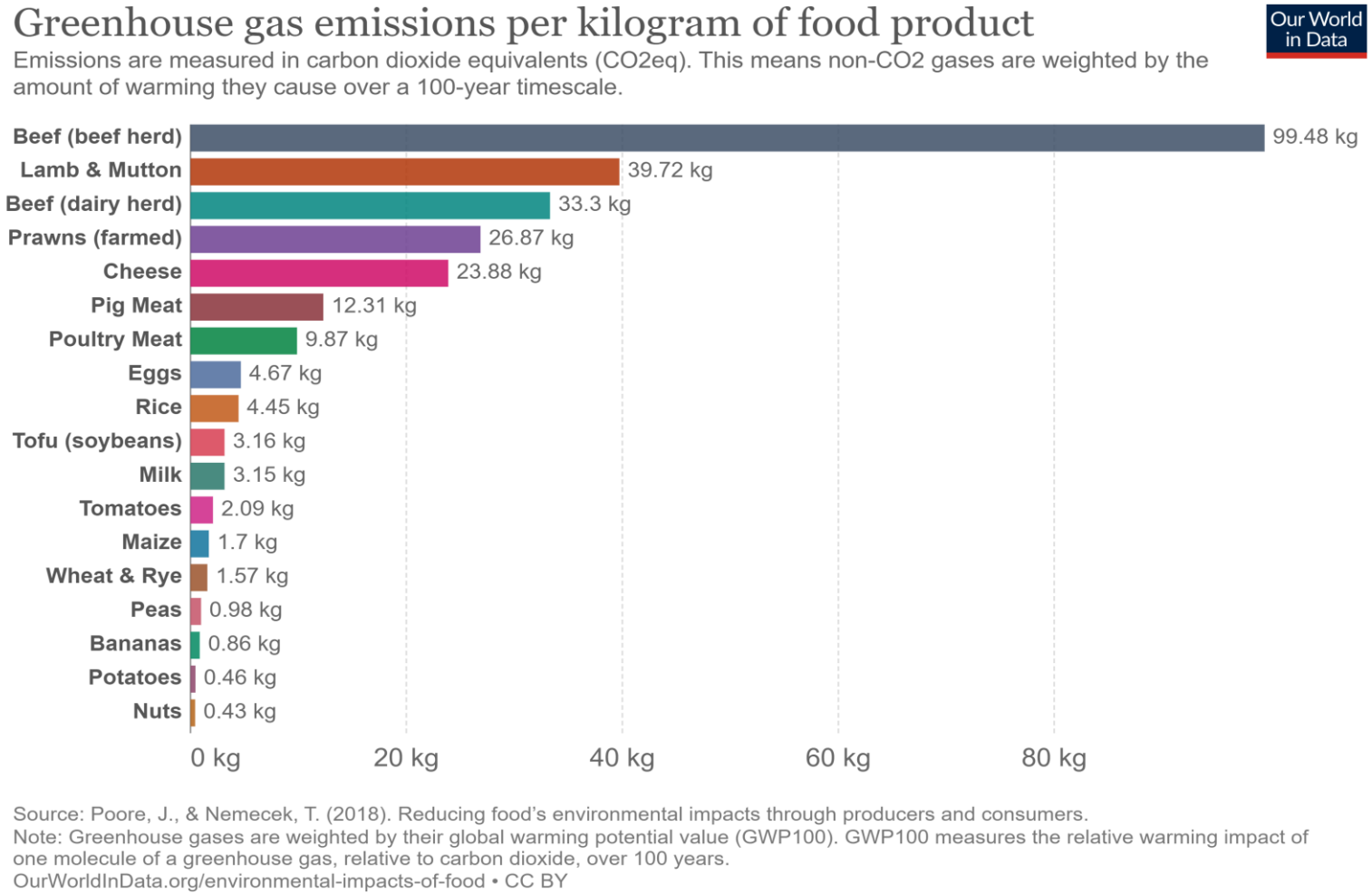
NEW ZEALAND LIFECYCLE MANAGEMENT CENTRE


# The environmental impact of food

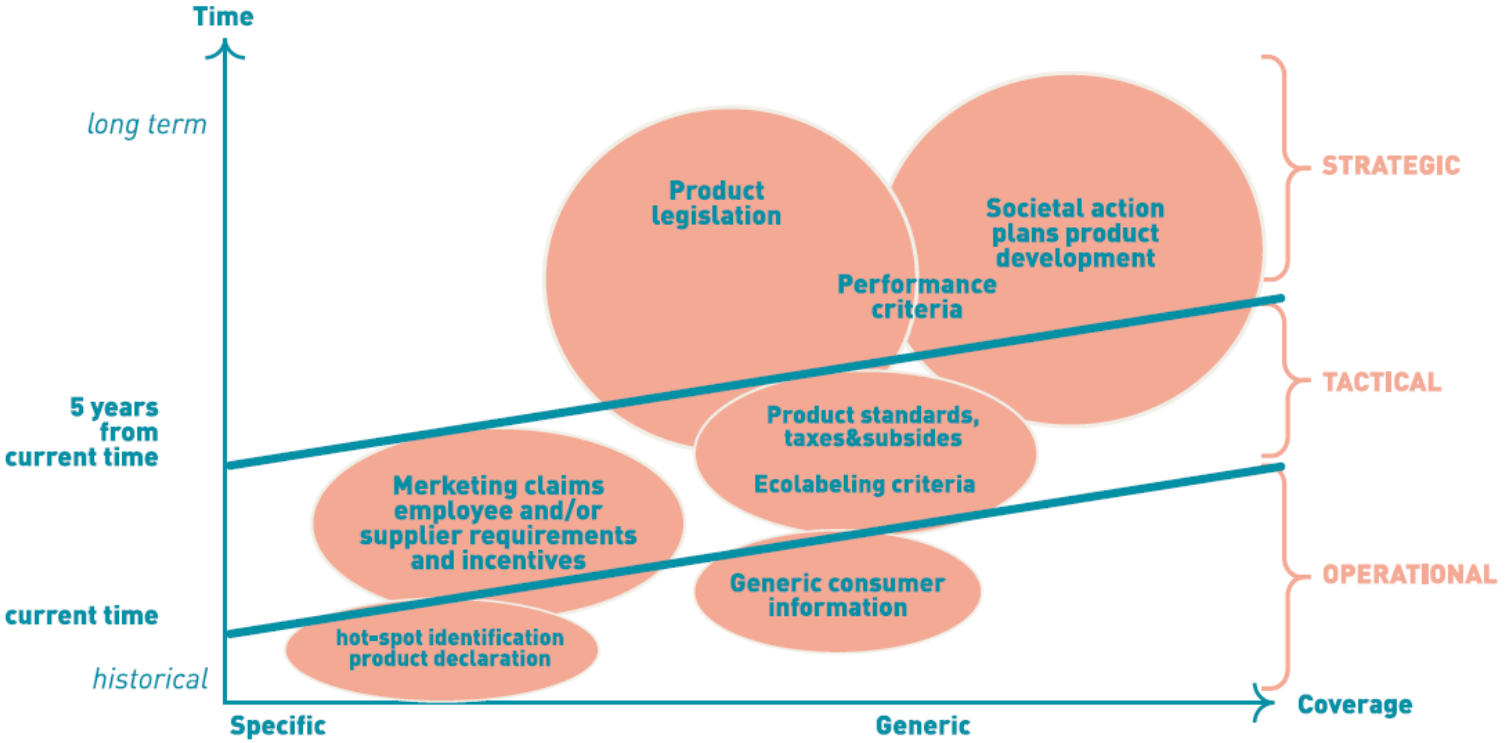
From: One Blue Dot, www.bda.uk.com

# Which foods are associated with the highest levels of Green House Gas emissions?



# Many different reasons for mapping environmental & nutritional impacts of foods

- Science: knowledge & understanding, methods development
- Policy making, regulation, product labelling, dietary guidelines
- Consumers: informed food choice, education
- NGO: communication and lobbying
- Businesses: hot-spot identification, process improvements, product development, market claims, labelling
- Industry organisations: product standards (e.g. PEF in EU), labelling (e.g. Eco-Score), lobbying




McLaren S, et al. FAO 2021

# Integration of environment and nutrition in life cycle assessment (LCA) of foods

Food and Agriculture Organization of the United Nations


SCAN ME

McLaren, S., Berardy, A., Henderson, A., Holden, N., Huppertz, T., Jolliet, O., De Camillis, C., Renouf, M., Rugani, B., Saarinen, M., van der Pols, J., Vázquez-Rowe, I., Antón Vallejo, A., Bianchi, M., Chaudhary, A., Chen, C., CooremanAlgoed, M., Dong, H., Grant, T., Green, A., Hallström, E., Hoang, H., Leip, A., Lynch, J., McAuliffe, G., Ridoutt, B., Saget, S., Scherer, L., Tuomisto, H., Tyedmers, P. & van Zanten, H. 2021. *Integration of environment and nutrition in life cycle assessment of food items: opportunities and challenges.* Rome, FAO.

https://doi.org/10.4060/cb8054en

**Free download**: www.fao.org/3/cb8054en/cb8054en.pdf

" … nutritional LCA (nLCA), a phrase used to describe an LCA study where the provision of nutrient(s) is considered as either the main function or one of the main functions of a food item." (p.5, McLaren et al., 2021).

# The importance of the functional unit

News > Science

## Lettuce is 'three times worse than bacon' for emissions and vegetarian diets could be bad for environment

Common vegetables 'require more resources per calorie' than many people realise, according to a team of scientists at the prestigious Carnegie Mellon University

Adam Withnall • Tuesday 15 December 2015 10:27 • Comments

From: www.independent.co.uk (2015)

## DEBUNKED: Lettuce is not 'three times worse' than bacon


Skye Gould/Tech Insider

Image credit: https://www.businessinsider.com/meat-produce-calories-difference-graphic-2015-12;

# Choice of functional unit can influence results considerably

**Table 11:** Examples of greenhouse gas emissions (kg $CO_2$e) of food items across a selection of functional units

| Food item | Type of food | kg $CO_2$ e/ 100 g product | kg $CO_2$ eq/ serving size | kg $CO_2$ e/ 100 g dry weight | kg $CO_2$ e/ 100 kcal | kg $CO_2$ e/ 100 g protein | kg $CO_2$ e/ 100 mg calcium |
|---|---|---|---|---|---|---|---|
| Ham shoulder medium fat boiled | Red meat | 1.08 | 0.16 | 3.95 | 0.81 | 6.60 | 9.04 |
| Beef rump steak prepared | Red meat | 3.13 | 2.35 | 9.01 | 2.15 | 10.70 | 21.46 |
| Potatoes w/o skins boiled average | Starchy vegetables | 0.09 | 0.05 | 0.42 | 0.11 | 4.86 | 1.24 |
| Eggs (chicken) boiled average | Eggs | 0.43 | 0.22 | 1.82 | 0.34 | 3.51 | 0.53 |
| Chicken with skin prepared | Poultry | 1.36 | 1.02 | 3.17 | 0.59 | 5.25 | 4.53 |
| Milk whole | Dairy | 0.21 | 0.52 | 1.68 | 0.34 | 6.32 | 0.28 |
| Milk skimmed | Dairy | 0.20 | 0.49 | 2.03 | 0.56 | 5.32 | 0.44 |
| Cheese Gouda 48+ average | Dairy | 1.31 | 0.26 | 2.16 | 0.36 | 5.74 | 0.04 |
| Shrimps Dutch peeled boiled | Fish | 1.54 | 0.15 | 6.39 | 1.64 | 7.78 | 1.22 |
| Herring salted | Fish | 0.28 | 0.21 | 0.84 | 0.16 | 1.59 | 0.32 |
| Kale curly boiled | Vegetables | 0.16 | 0.08 | 1.14 | 0.35 | 4.00 | 0.19 |
| Mushrooms boiled | Vegetables | 0.52 | 0.26 | 5.21 | 2.48 | 13.71 | 49.60 |
| Pineapple | Fruit | 0.10 | 0.10 | 0.70 | 0.18 | 20.11 | 1.47 |
| Banana | Fruit | 0.08 | 0.08 | 0.31 | 0.08 | 6.88 | 1.33 |
| Beans French boiled | Legumes | 0.11 | 0.05 | 1.34 | 0.42 | 5.89 | 0.79 |
| Peas frozen boiled | Legumes | 0.11 | 0.06 | 0.44 | 0.12 | 1.90 | 0.38 |
| Bread wholemeal average | Cereals | 0.10 | 0.04 | 0.17 | 0.04 | 0.93 | 0.13 |

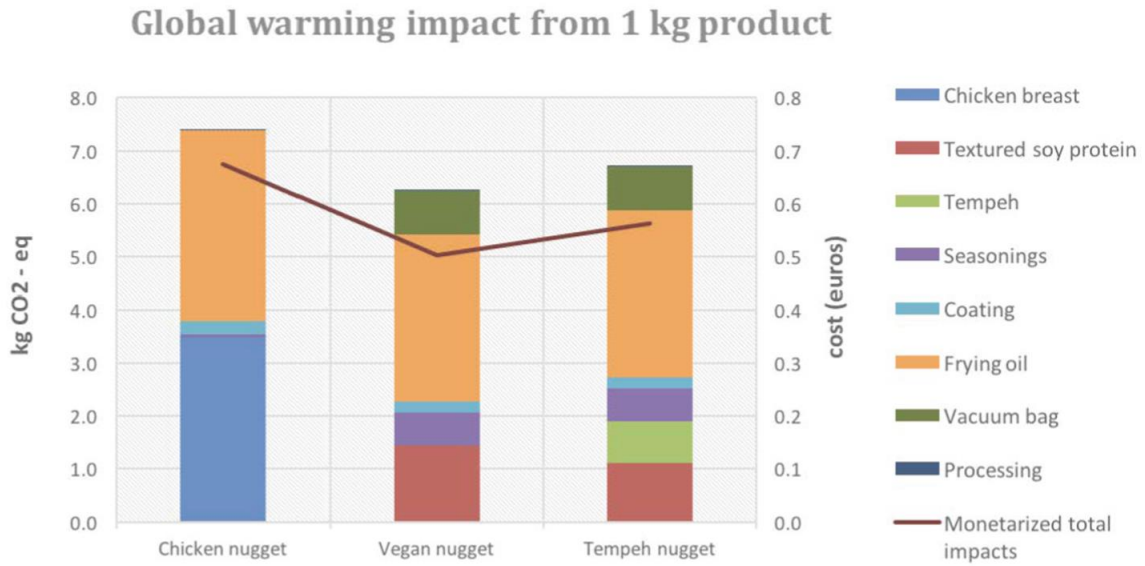
Note: colour indicates ranking within the **column** from high (red) to low (green)

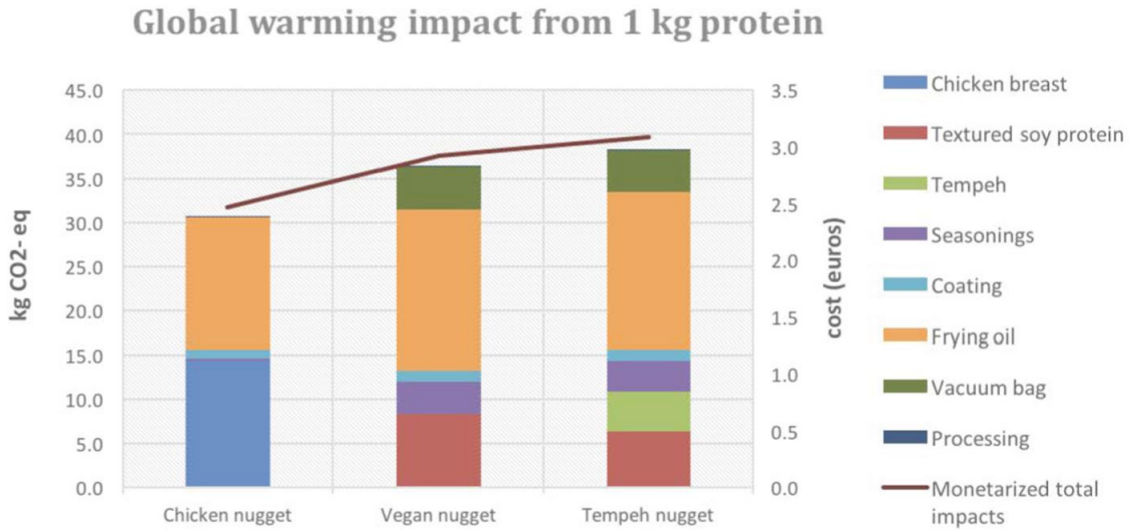
[other foods items lower down the table are not showing here]

McLaren S, et al. FAO 2021, p.57

# Chicken vs. vegetarian nuggets

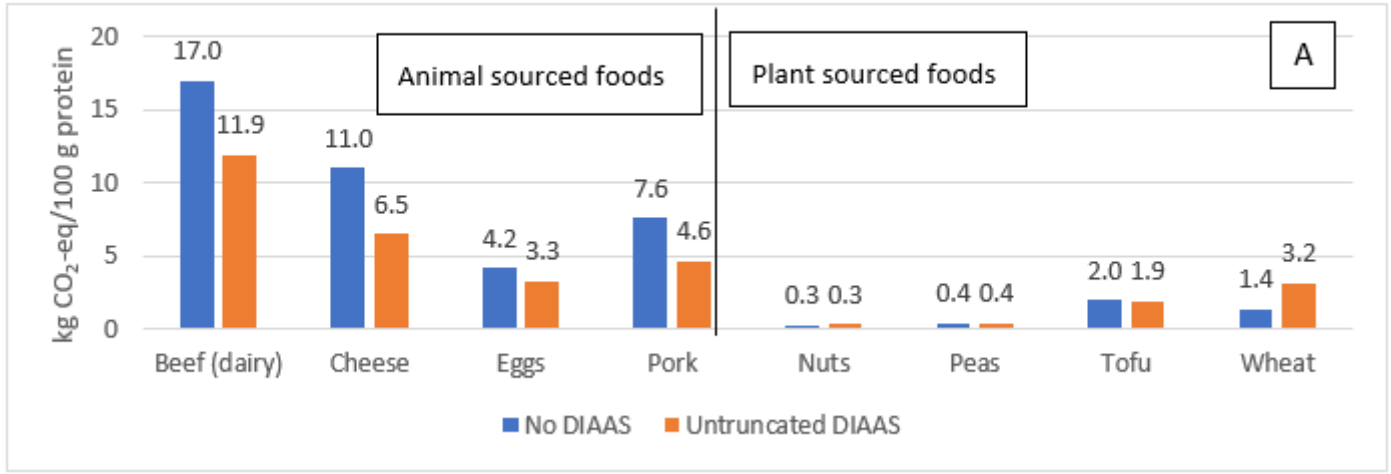
Sun et al. (2023)
https://doi.org/10.1016/j.ijgfs.2023.100748



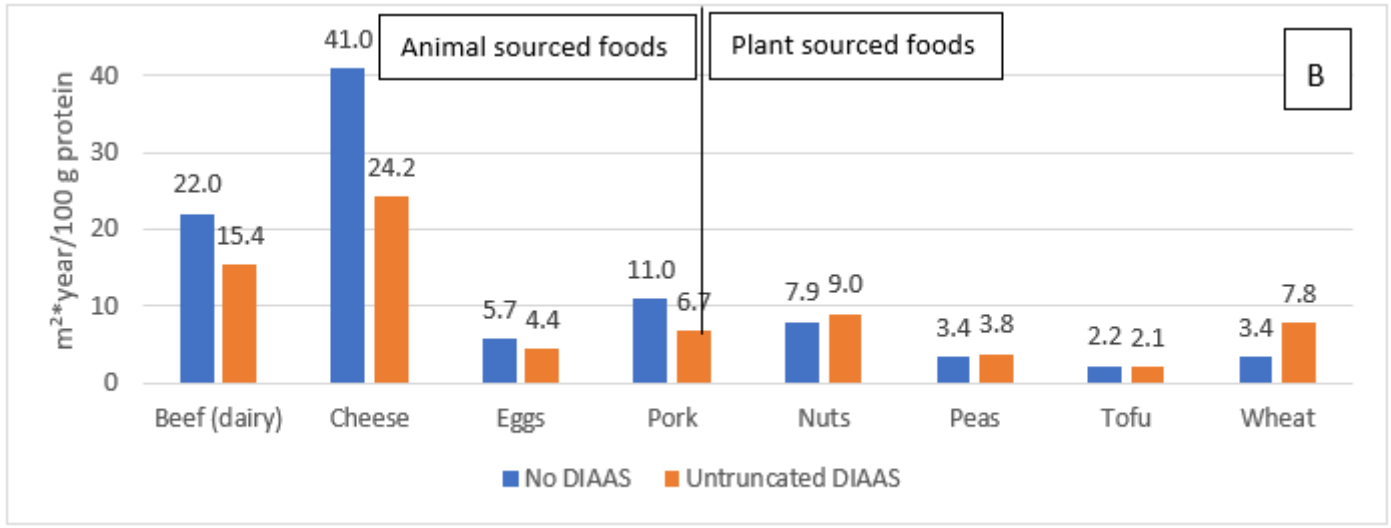



# Protein quality matters

**Figures:**

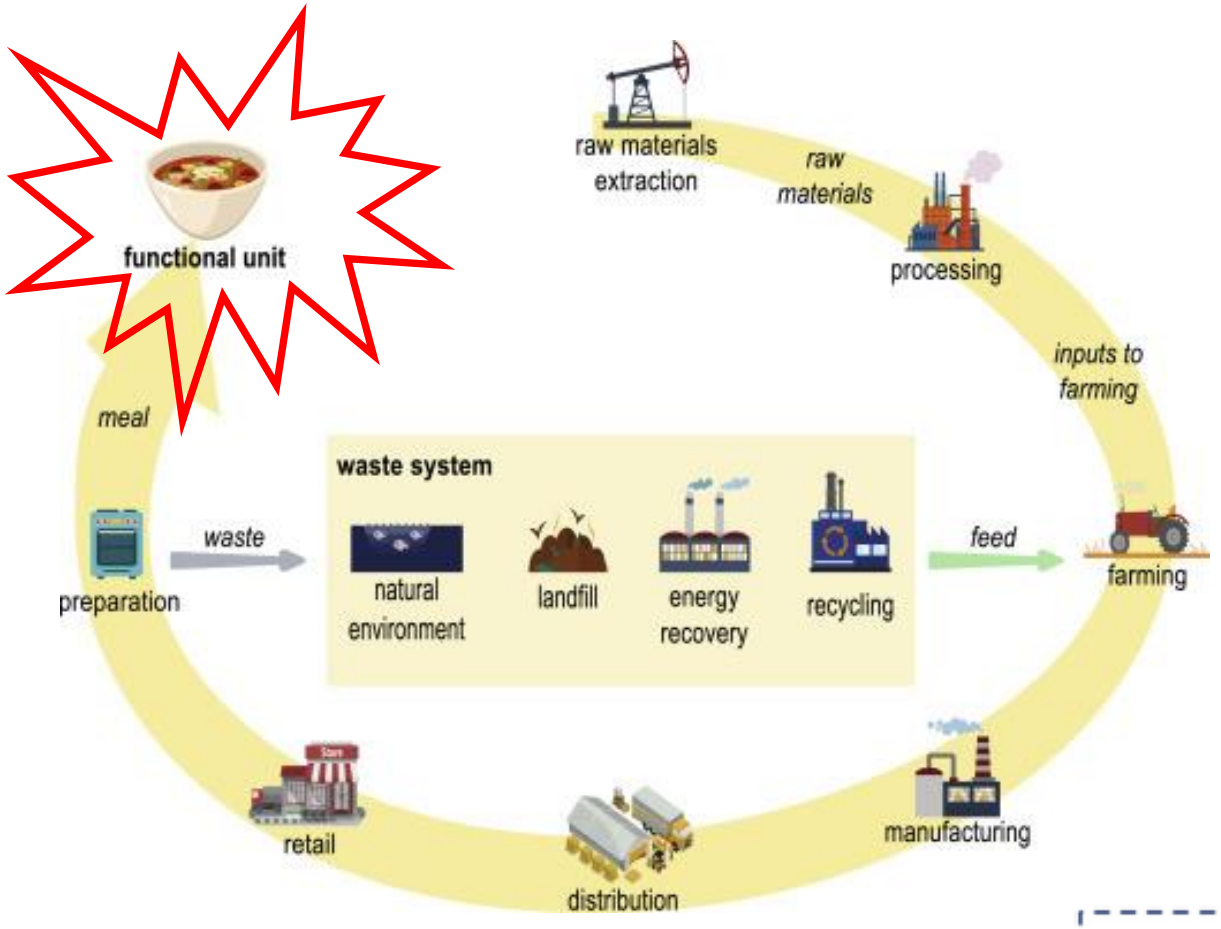



← Greenhouse gas emissions




← Land use

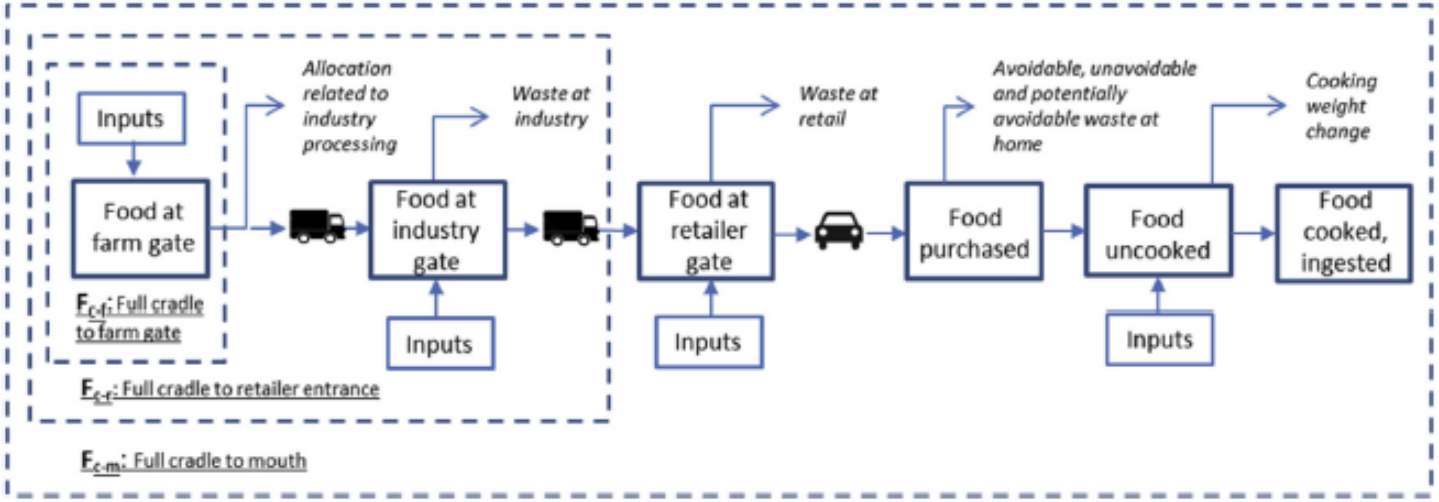
G McAuliffe et al. International Journal of Life Cycle Assessment, *In Press*




# Life Cycle Assessment (LCA) of foods and diets – system boundaries – consider impact of:

- Packaging and storage
- Cooking method (fuel)
- Effect of food preparation on nutritional qualities
- Food waste

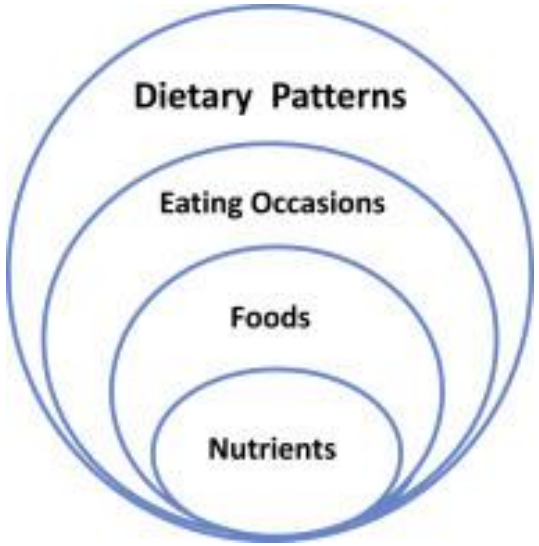
**System boundaries in food LCA studies**



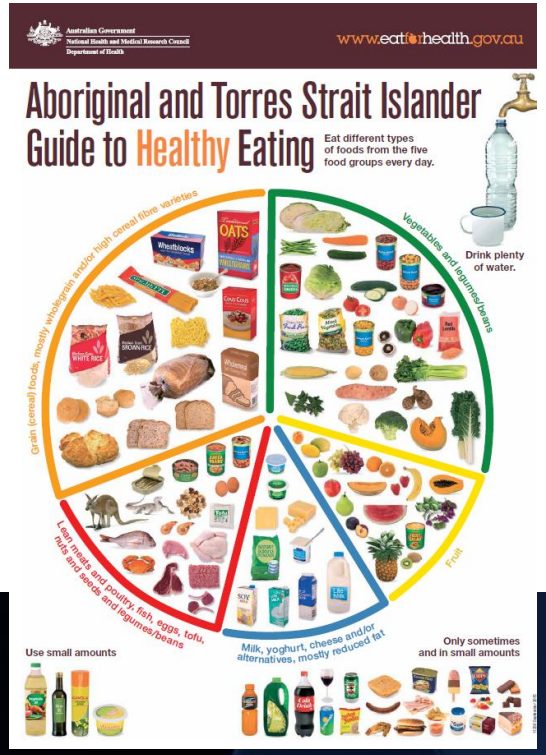
# Focus of nutrition research and dietary advice has shifted from nutrients to whole diets (dietary patterns)

National dietary guidelines around the world are mostly food based (not nutrient based)

Foods are more than the sum of the nutrients recognised in adequate intake requirements




From: S. McNaughton. Present knowledge in nutrition – Chapter 13 – Dietary Patterns (2020)




# Trends towards accountability & value creation

**ESG Reporting:**
**Environmental**: water and energy efficiency, greenhouse gas emissions and climate change strategy, waste and pollution management, biodiversity
**Social**: human rights, child labour, gender equity, diversity, health and safety
**Governance**: board diversity, compliance, shareholder democracy, business ethic,  corporate behaviour

## Sustainability reporting in food industry: an innovative tool for enhancing financial performance

Amina Buallay
*Ahlia University, Manama, Bahrain and Brunel University London, Uxbridge, UK*

Sustainability reporting in food industry

1939

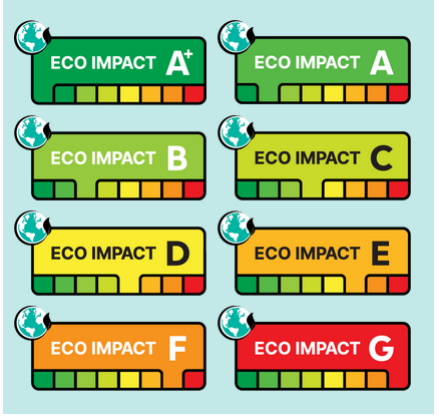
Received 17 January 2021
Revised 19 May 2021
25 July 2021
11 September 2021
Accepted 10 October 2021

**Abstract**

**Purpose** – This study investigates the relationship between the level of sustainability reporting and Food Industry Performance (operational, financial and market).
**Design/methodology/approach** – Using data culled from 1426 observations from 31 different countries for ten years (2008–2017), an independent variable derived from environmental, social, and corporate governance

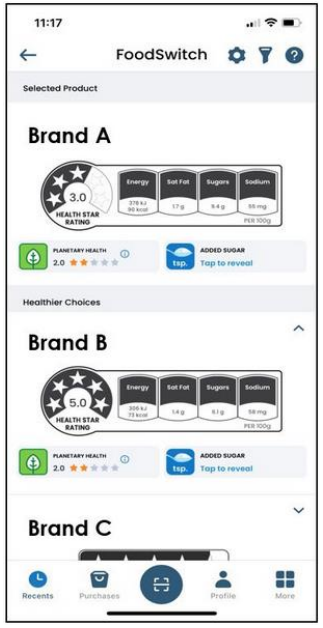
## Product labelling







## Consumer choice

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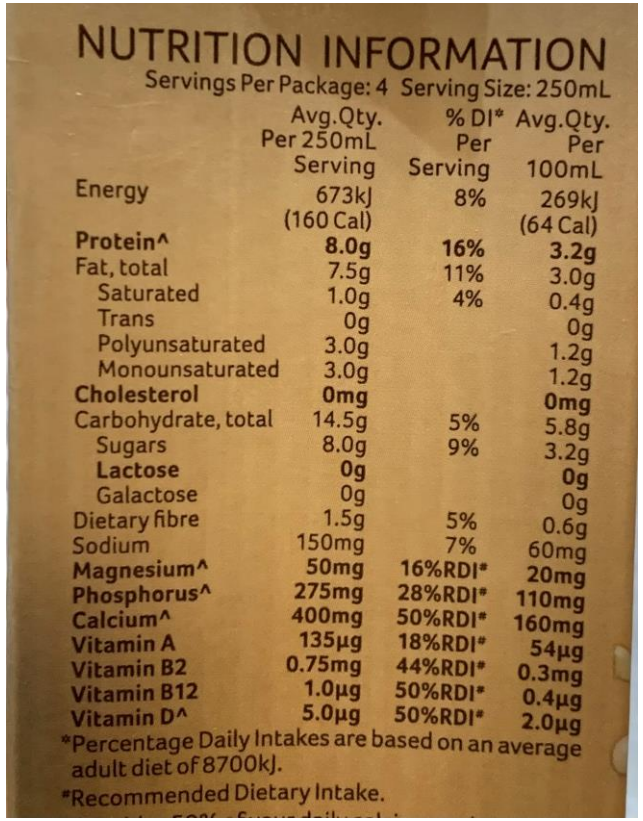
WHO/FAO: Need to consider culture, gender equity and affordability

# Identified priorities

- Considerations of bioavailability of nutrients, nutrient interactions, anti-nutritional compounds
- How to deal with food fortification in nLCA.
- Use of nLCA studies at the meal and dietary scales
  - Representation of multi-functionality of food items in nLCA
  - Development of nutrition impact category
- Environmental and nutritional data for developing countries



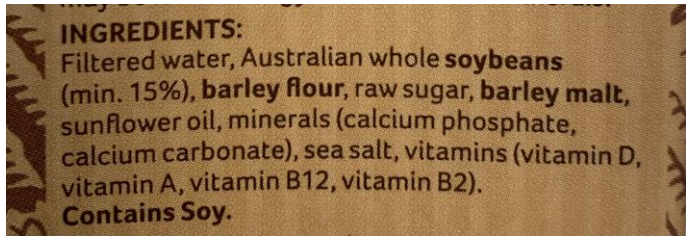
NUTRITION INFORMATION

Servings Per Package: 4 Serving Size: 250mL

| | Avg.Qty. Per 250mL Serving | % DI* Per Serving | Avg.Qty. Per 100mL |
|---|---|---|---|
| Energy | 673kJ (160 Cal) | 8% | 269kJ (64 Cal) |
| **Protein^** | **8.0g** | **16%** | **3.2g** |
| Fat, total | 7.5g | 11% | 3.0g |
| Saturated | 1.0g | 4% | 0.4g |
| Trans | 0g | | 0g |
| Polyunsaturated | 3.0g | | 1.2g |
| Monounsaturated | 3.0g | | 1.2g |
| **Cholesterol** | **0mg** | | **0mg** |
| Carbohydrate, total | 14.5g | 5% | 5.8g |
| Sugars | 8.0g | 9% | 3.2g |
| **Lactose** | **0g** | | **0g** |
| Galactose | 0g | | 0g |
| Dietary fibre | 1.5g | 5% | 0.6g |
| Sodium | 150mg | 7% | 60mg |
| **Magnesium^** | **50mg** | **16%RDI*** | **20mg** |
| **Phosphorus^** | **275mg** | **28%RDI*** | **110mg** |
| **Calcium^** | **400mg** | **50%RDI*** | **160mg** |
| **Vitamin A** | **135µg** | **18%RDI*** | **54µg** |
| **Vitamin B2** | **0.75mg** | **44%RDI*** | **0.3mg** |
| **Vitamin B12** | **1.0µg** | **50%RDI*** | **0.4µg** |
| **Vitamin D^** | **5.0µg** | **50%RDI*** | **2.0µg** |

*Percentage Daily Intakes are based on an average adult diet of 8700kJ.

^Recommended Dietary Intake.



**INGREDIENTS:**
Filtered water, Australian whole **soybeans** (min. 15%), **barley flour**, raw sugar, **barley malt**, sunflower oil, minerals (calcium phosphate, calcium carbonate), sea salt, vitamins (vitamin D, vitamin A, vitamin B12, vitamin B2).
**Contains Soy.**

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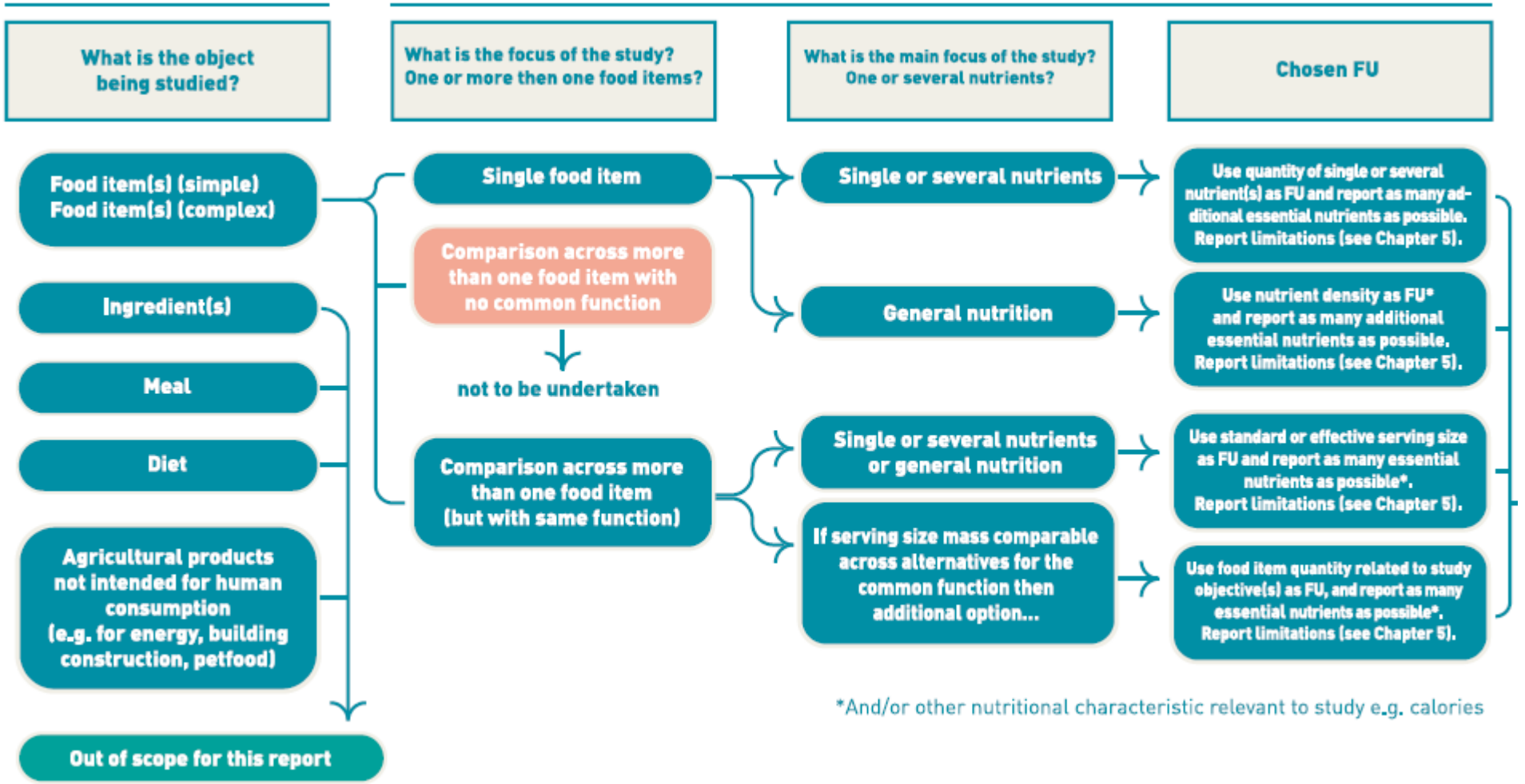


McLaren S, et al. FAO 2021