



Fruit and Vegetable Food Systems

Overview from CSIRO - Australia

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AGRICULTURE AND FOOD
www.csiro.au



Our business units and focus areas



Agriculture and Food



Energy



Health and Biosecurity



Land and Water



Manufacturing



Mineral Resources



Oceans and Atmosphere



Astronomy and
Space Science



Australian Animal
Health Laboratory



Data61



Marine National Facility



National Computing
Infrastructure



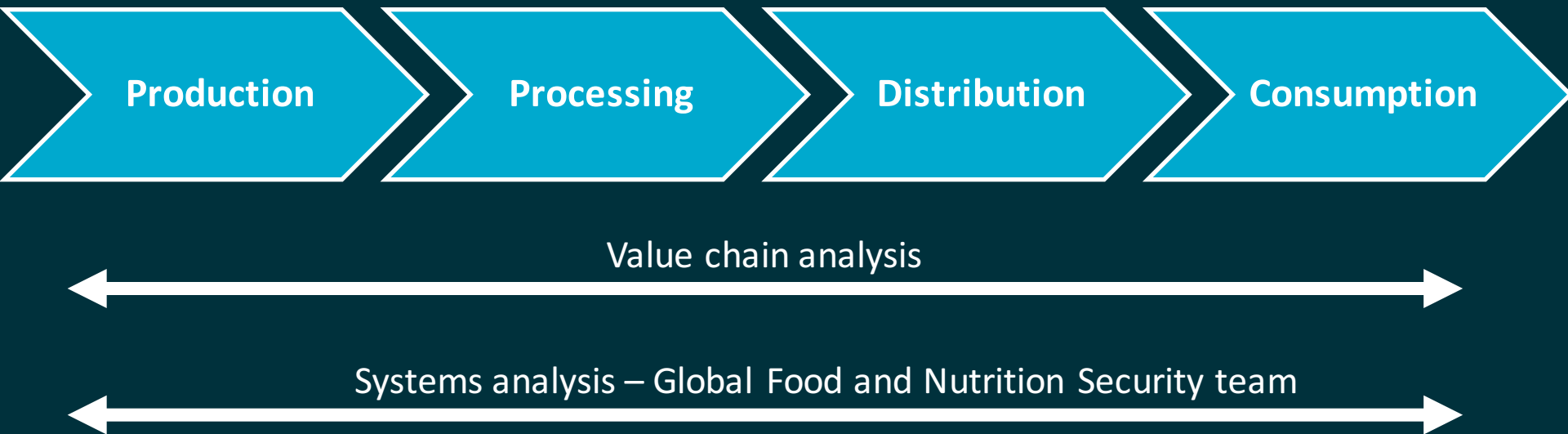
National Research
Collections of Australia

Global Food and Nutrition Security team

- Multi-disciplinary team who partners to deliver outcomes for a sustainable, food secure world



What does CSIRO contribute to the F&V space?

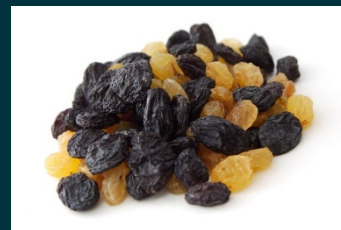


Plant breeding and farm management

- Improved selection tools – genetic markers, phenomics and selection of elite lines
 - Wine and table grapes, almonds, avocado (wheat, sugarcane, canola)
- New varieties with resistance to major pathogens, improved quality and differentiated products
 - Wine, table and dried grapes, citrus, mango, lychee, macadamia (soybean, sugarcane)
- New rootstocks with improved resistance to root pests and tolerance to salinity and drought
 - Wine, table and dried grapes, almonds
- Improved management techniques to manipulate flowering, ripening and quality attributes
 - Wine, table and dried grapes, almonds, avocado, apple
- Improved modelling of plant/crop and gene-to-phenome



Phenomobile™ Lite



Processing

Food innovation centre

Processing technologies for increased shelf life, reduced seasonality, retained/enhanced nutritional quality:

- Extrusion
- High pressure processing (HPP)
- Modified atmosphere packaging
- Separation and stabilisation

Advanced capability in sensory and consumer science



Food innovation centre

HORTICULTURE

Food waste: Excess crops become base for healthy snacks

Program on food loss:

Aim → to divert and transform edible food loss, using novel processing methods to add value and enhance sustainability

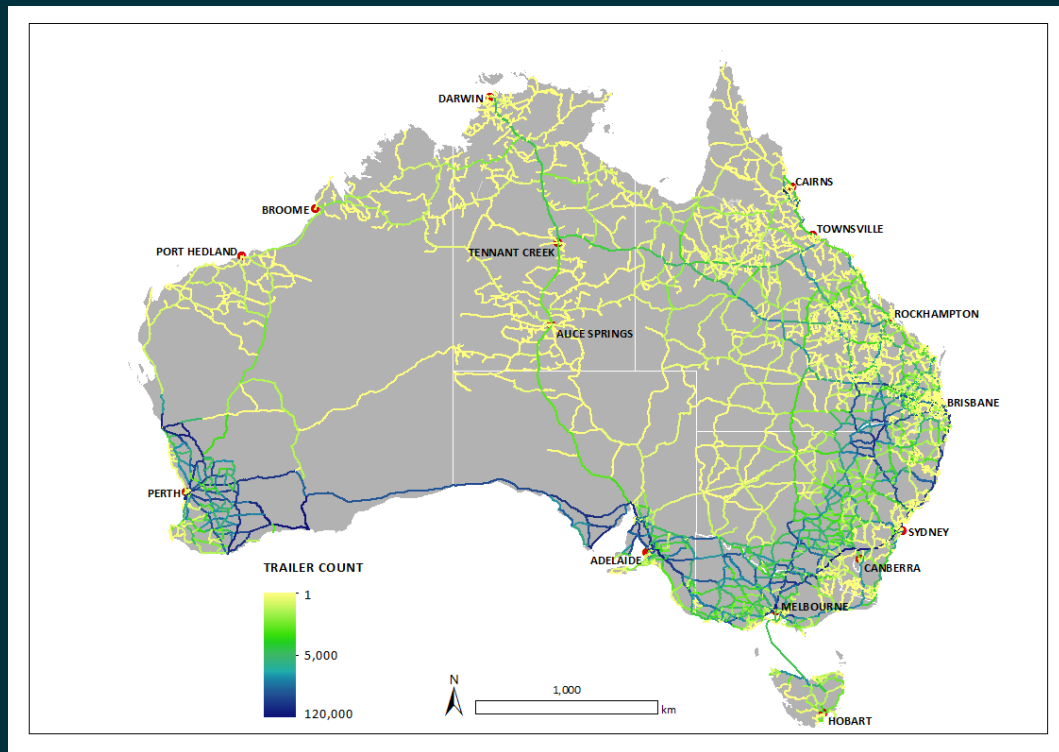
- Extrusion → snacks or powder from broccoli, carrot, apple and other F&V (utilising imperfect produce that would otherwise be wasted)
 - Snacks can be eaten as is
 - Powders can be added to smoothies, dips, sauces, spreads, pasta, noodles or bakery items
- Vision that growers/groups of growers could generate a secondary income from imperfect produce/waste material



<https://blog.csiro.au/broccoli-better-latte-than-never/>

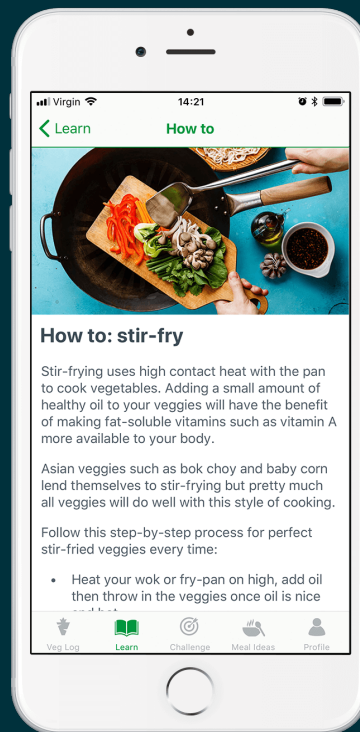
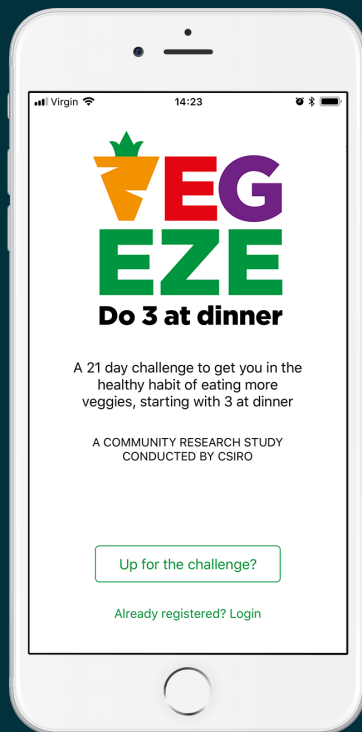
TraNSIT tool

- CSIRO's TraNSIT tool analyses transport and logistics options for agriculture to identify potential cost savings.
- Used by industry to inform logistics/decision making
- Used in decision making around infrastructure investment



Increasing demand – VegEze App

- <5% of Australians eat recommended # vegetable serves
- CSIRO developed an app that challenges people to eat 3 serves of veg at dinner over 21 days
- The 'challenge' period helps to establish new habits
- The app gives info on portion sizes and prompts with easy ways of increasing intake
- Impact: Average serves of vegetables increased by 0.6 serves at 21 days, and 0.7 serves at 90 days



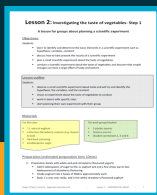
Consumption

Increasing demand: Vegetable education resource for primary schools



A 5-week Classroom Based Program:

- Aimed at changing children's knowledge, attitudes & receptivity to consuming vegetables
- Aligned to the curriculum
- Suitable for teachers' needs to facilitate adoption



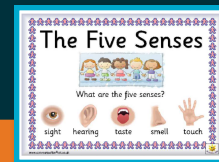
Written resources

- 5 x 1hr lessons
- Aimed at each of three age stages (ages **5-8**, **8-10**, and **10-12 years**) of Australian primary schools.



Theoretical Framework of Exposure & Sensory Education

- Vegetable tasting
- Development of the senses
- Hands-on learning



Cross-Curricular

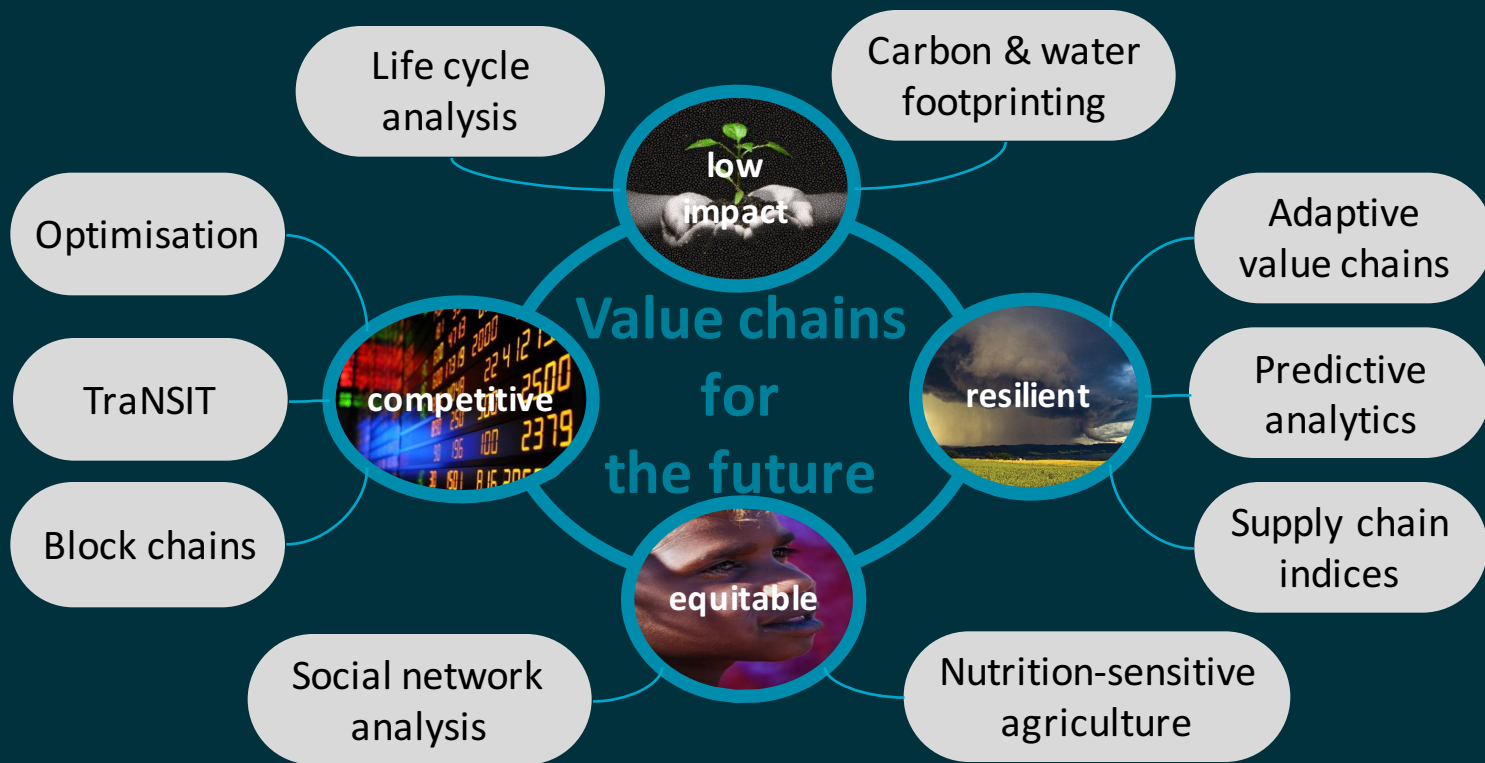
- Science
- Physical Health & Education (but no explicit health messages)



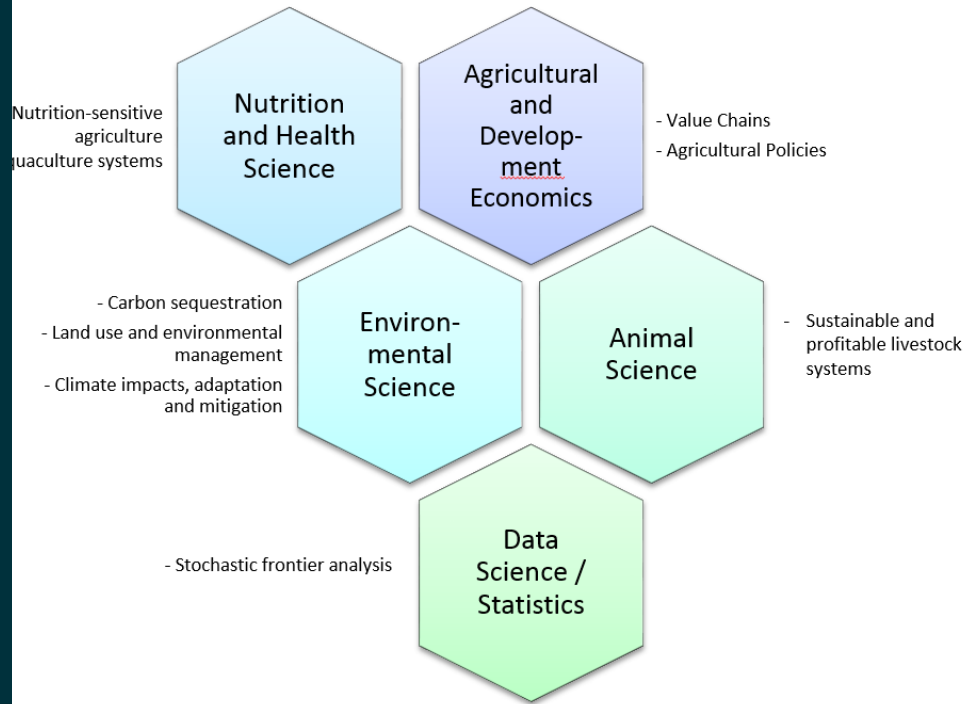
Food
Nutrition
Education



CSIRO value chain capability



Systems analysis from local to global scales– Global F&N Security team

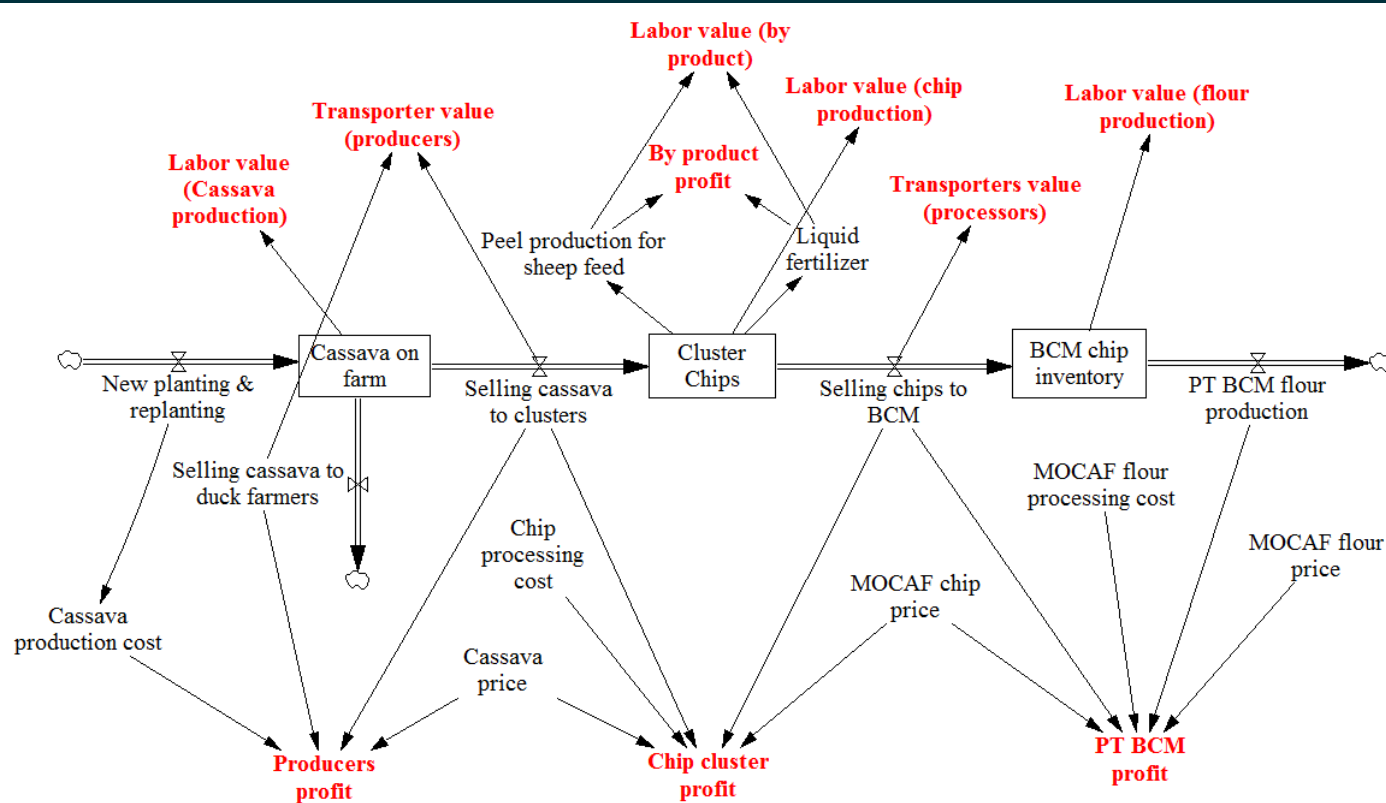


Methods and data:

- Scenarios and projections
- Agricultural systems analysis and modelling
 - Dynamic simulation modelling for land use, food production and economics
 - Crop modelling
 - Statistical modelling
- Spatial analysis
- Environmental impact assessment
- National agricultural censuses and surveys
- Food composition data bases

Example 1 - systems modelling

- Modelling approaches to map value addition throughout the chain (methods applied to Cassava in this case, but applicable to any value chain)

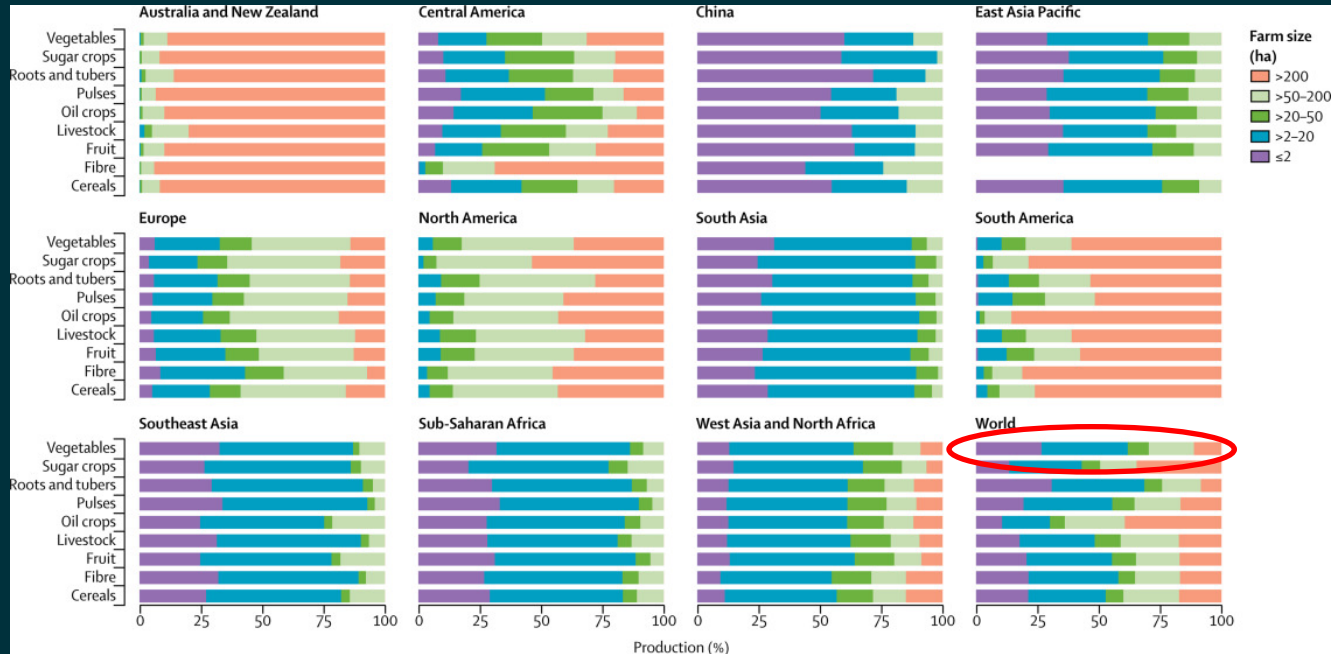


Value chain performance (\$AUD)	Profit/ton cassava produced
Cassava Producers profit	23
CPP + Chip cluster profit	37
CPP+CCP+ By-products profit	44
CPP+CCP+BPP+ Labor profit	84
CPP+CCP+BPP+LB+ Transporters profit	89

Confidential, Kanar Dizyee (unpublished)

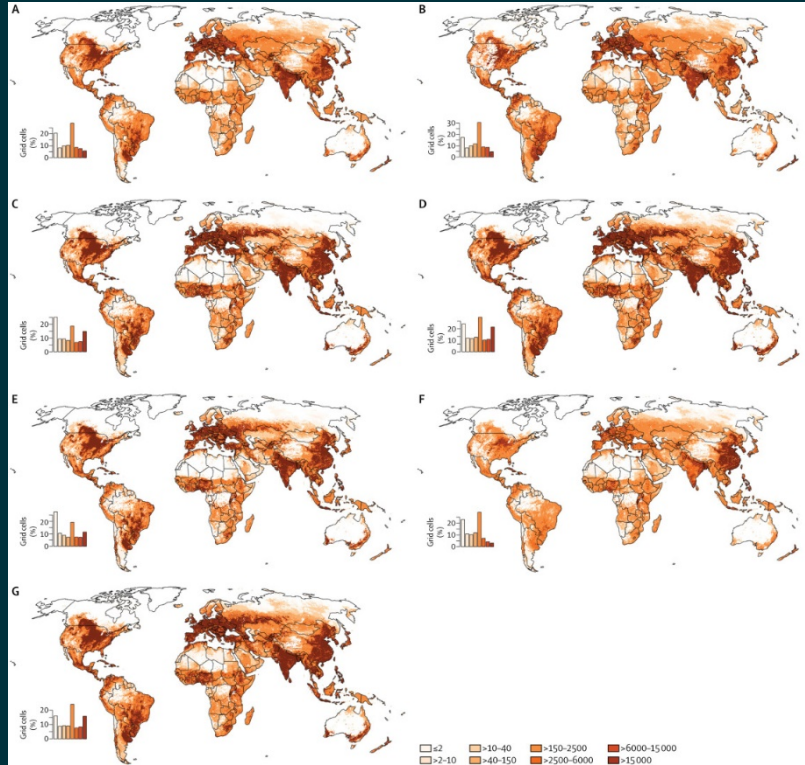
Example 2 – mapping global nutrient production

- Small and medium farms produce between 50-75% of the world's food



Herrero et al. 2017 The Lancet PH

Example 2 – mapping global nutrient production



Collaboration with the IHME

ARTICLE

OPEN

doi:10.1038/nature25760

Mapping child growth failure in Africa between 2000 and 2015

Aaron Osgood-Zimmerman^{1*}, Anoushka I. Millar^{1*}, Rebecca W. Stubbs¹, Chloe Shields¹, Brandon V. Pickering¹, Lucas Earl¹, Nicholas Graetz¹, Damaris K. Kinyoki¹, Sarah E. Ray¹, Samir Bhatt¹, Annie J. Browne¹, Roy Burstein¹, Ewan Cameron¹, Daniel C. Casey¹, Aniruddha Deshpande¹, Nancy Fullman¹, Peter W. Gething¹, Harry S. Gibson¹, Nathaniel J. Henry¹, Mario Herrero¹, L. Kendall Krause¹, Ian D. Letourneau¹, Aubrey J. Levine¹, Patrick Y. Liu¹, Joshua Longbottom¹, Benjamin K. Mayala¹, Jonathan F. Mosser¹, Abdulsalan M. Noor^{1,2}, David M. Pigott¹, Ellen G. Pwoso¹, Pujia Rao¹, Rahul Rawat¹, Robert C. Reiner Jr¹, David L. Smith¹, Daniel J. Weiss¹, Kirsten E. Wiens¹, Ali H. Mokdad¹, Stephen S. Lim¹, Christopher J. L. Murray¹, Nicholas J. Kassebaum^{1,3,4,5} & Simon I. Hay^{1,2,6}

Insufficient growth during childhood is associated with poor health outcomes and an increased risk of death. Between 2000 and 2015, nearly all African countries demonstrated improvements for children under 5 years old for stunting, wasting, and underweight, the core components of child growth failure. Here we show that striking subnational heterogeneity in levels and trends of child growth remains. If current rates of progress are sustained, many areas of Africa will meet the World Health Organization Global Targets 2025 to improve maternal, infant and young child nutrition, but high levels of growth failure will persist across the Sahel. At these rates, much, if not all of the continent will fail to meet the Sustainable Development Goal target—to end malnutrition by 2030. Geospatial estimates of child growth failure provide a baseline for measuring progress as well as a precision public health platform to target interventions to those populations with the greatest need, in order to reduce health disparities and accelerate progress.

(A) calcium, (B) folate, (C) iron, (D) protein, (E) vitamin A, (F) vitamin B12 (G) zinc

Herrero et al. 2017 The Lancet PH

Osgood Zimmerman et al 2018 Nature



Example 3 - Policy coherence for nutrition?

1. Mapping of key policies which shape the food system
2. Assessment of their coherence with positive nutrition outcomes

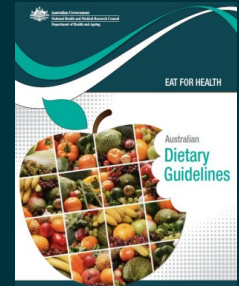
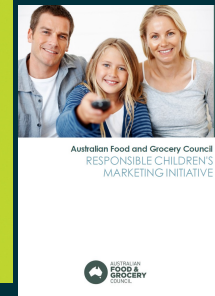
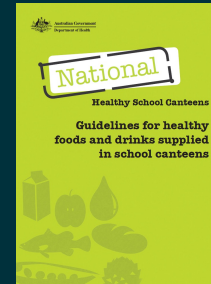
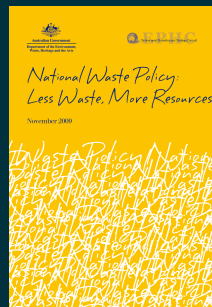
Production

Processing

Distribution

Retail

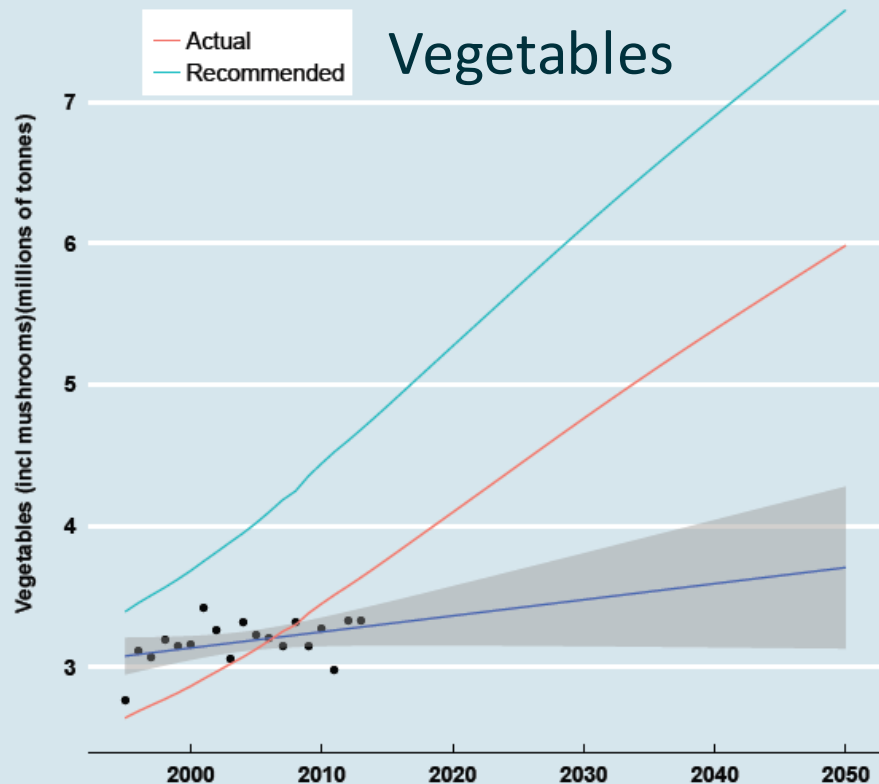
Consumption



The issues – Availability:Need gap

Production and Demand at Farm Gate

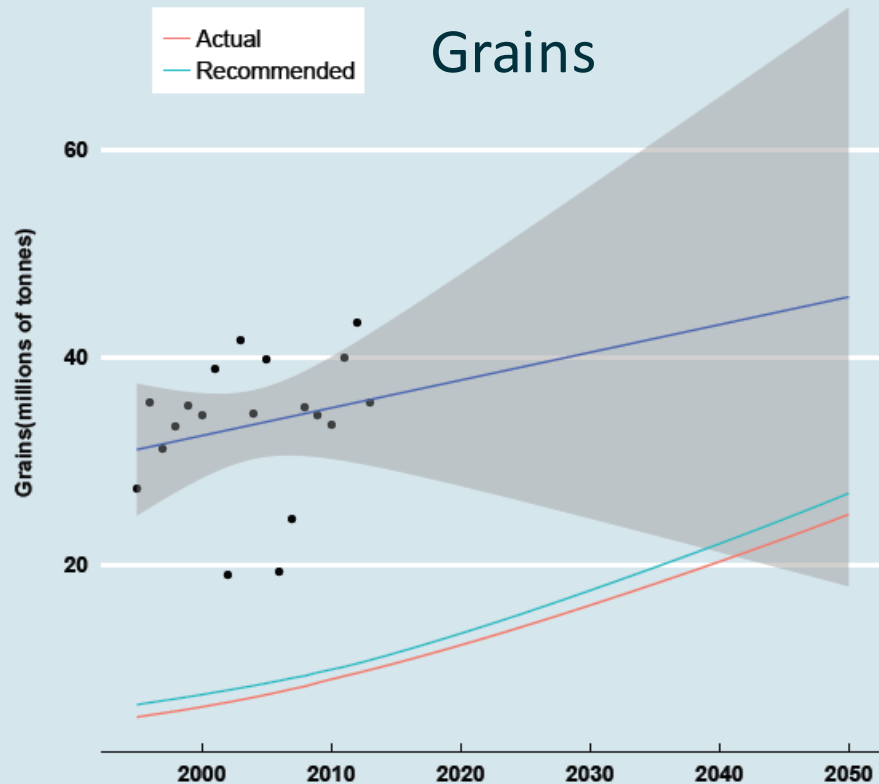
Vegetables



(Ridoutt et al, 2017)

Production and Demand at Farm Gate

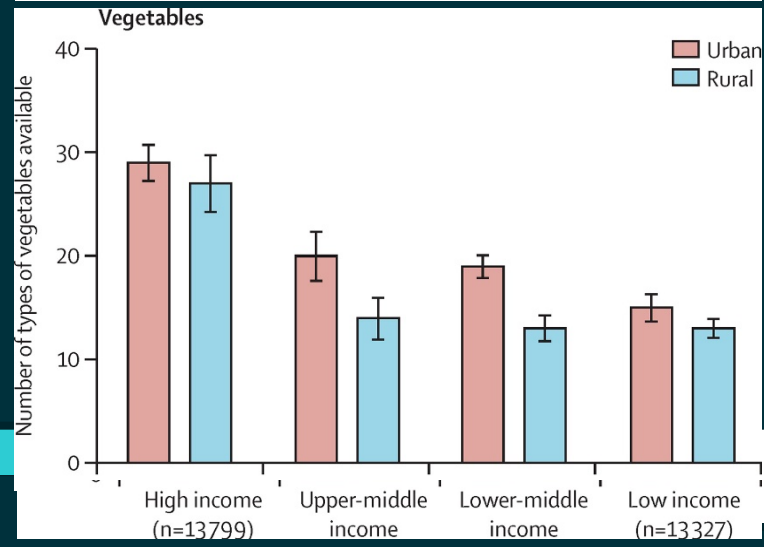
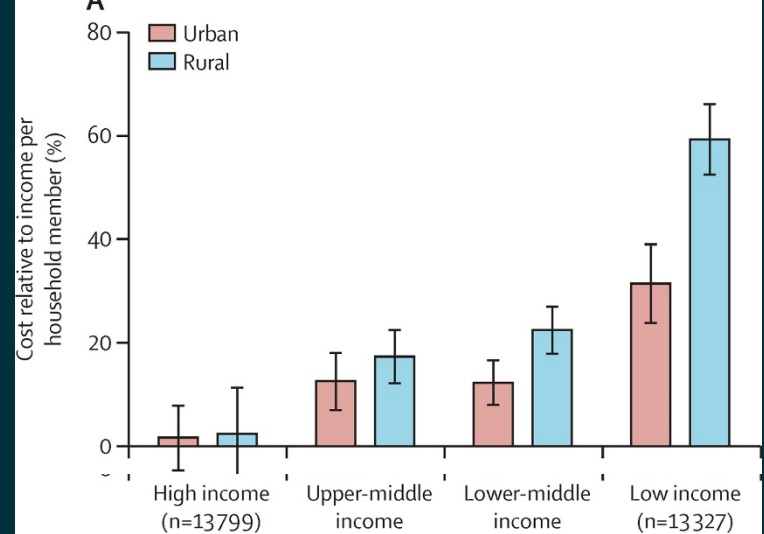
Grains



The issues: affordability and availability

- “The consumption of fruit and vegetables is low worldwide, particularly in LICs, and this is associated with low affordability” (Miller, 2016)
- Mean daily F&V consumption was:
 - 2.14 servings in LICs
 - 3.17 servings in LMICs
 - 4.31 servings in UMICs
 - 5.42 servings in HICs

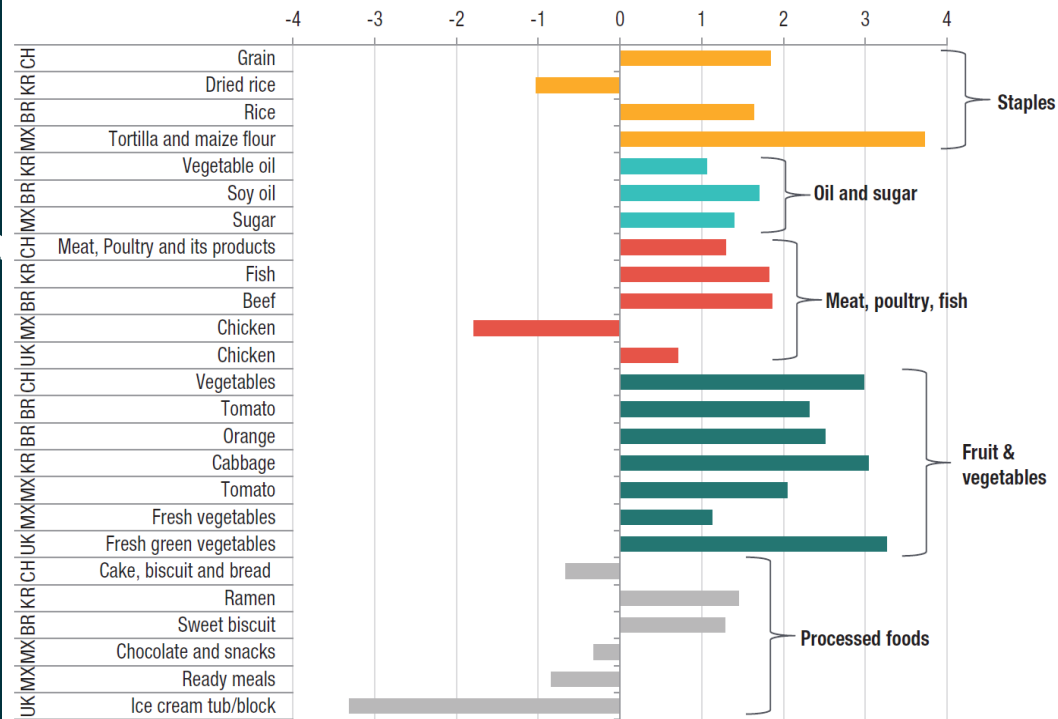
Miller et al, 2016



The issues: Cost of F&V relative to unhealthy food

- Price of fruit and vegetables ↑ 55-91% from 1990-2012 whilst many processed foods are getting cheaper
- Consistent with findings in Australia (Harrison, 2010)
- In remote Indigenous communities in Australia, from 1986-2012, affordability of F&V ↑ by 30%, and consumption doubled (Lee, 2016)
- BUT...affordability of discretionary foods also increased and the net result was a decline in overall dietary quality

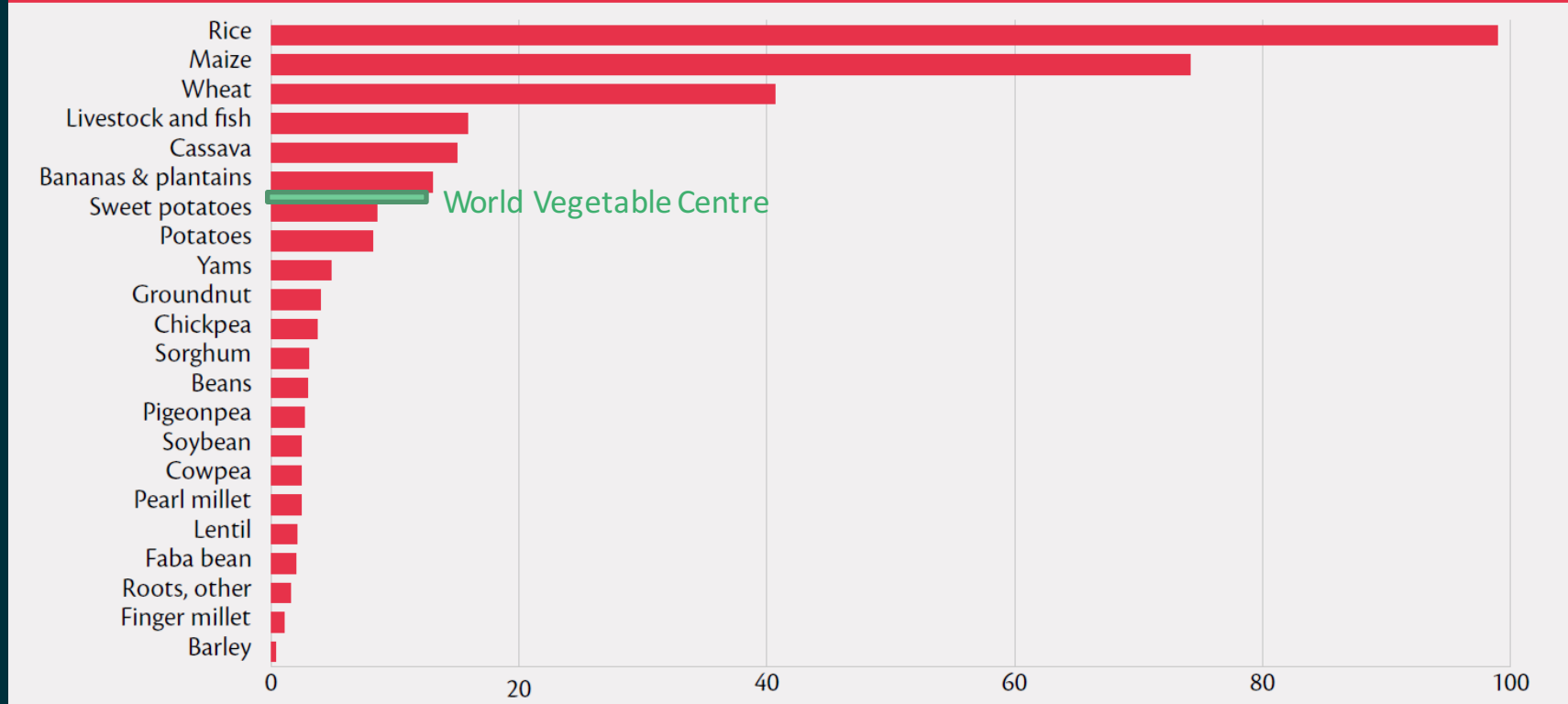
Figure A: Estimated average annual price changes from 1990



(Wiggins and Keats, ODI, 2015)

The issues: Global funding environment

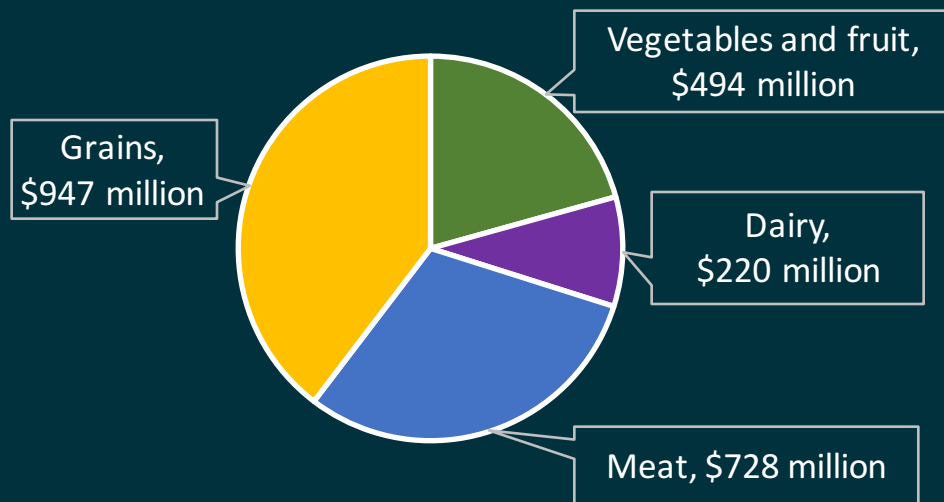
FIGURE 6.6: CGIAR research funding allocated to specific crops in 2012 (in US\$ million)



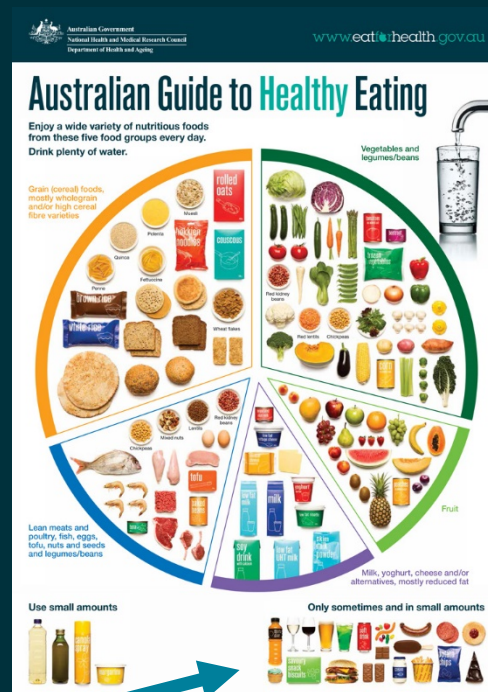
(Global Panel report on Food Systems and Diets, 2016)

The issues: Australian funding environment

Investment in agricultural R&D by food groups 2010-2015



Discretionary food
\$109 million - sugar
\$141 million - wine



Data gap: Nutrient composition of indigenous varieties

	Vitamin A content (RE/100 g)	Portion needed to meet RNI for adult woman (g)
3 banana varieties found in Solomon Islands		
Aibwo/Suria	871	57
Fagufagu	698	72
Saena	16	3125
Cavendish	6	8333

RNI, recommended nutrient intake WHO/FAO 2004
RE, retinol equivalents



Aibwo banana



References

- Englberger, L., Lyons, G., Foley, W., ...Taylor, M. (2010). Carotenoid and riboflavin content of banana cultivars from Makira, Solomon Islands. *Journal of Food Composition and Analysis*, 23(6), 624-632. doi:<http://dx.doi.org/10.1016/j.jfca.2010.03.002>
- Global Panel on Agriculture and Food Systems for Nutrition. (2016). *Food systems and diets: Facing the challenges of the 21st century*. London, UK.
- Harrison, M., Lee, A., Findlay, M., ...Martin, C. (2010). The increasing cost of healthy food. *Aust N Z J Public Health*, 34(2), 179-186. doi:10.1111/j.1753-6405.2010.00504.x
- Herrero, M., Thornton, P. K., Power, B., ...Havlík, P. (2017). Farming and the geography of nutrient production for human use: a transdisciplinary analysis. *The Lancet Planetary Health*, 1(1), 33-42. doi:[http://dx.doi.org/10.1016/S2542-5196\(17\)30007-4](http://dx.doi.org/10.1016/S2542-5196(17)30007-4)
- Lee, A., Rainow, S., Tregenza, J., ...Schomburgk, D. (2016). Nutrition in remote Aboriginal communities: lessons from Mai Wiru and the Anangu Pitjantjatjara Yankunytjatjara Lands. *Aust N Z J Public Health*, 40 Suppl 1, S81-88. doi:10.1111/1753-6405.12419
- Livingstone, K., Olstad, D., Leech, R., ...McNaughton, S. (2017). Socioeconomic Inequities in Diet Quality and Nutrient Intakes among Australian Adults: Findings from a Nationally Representative Cross-Sectional Study. *Nutrients*, 9(10), 1092.
- Miller, V., Yusuf, S., Chow, C. K., ...Mente, A. (2016). Availability, affordability, and consumption of fruits and vegetables in 18 countries across income levels: findings from the Prospective Urban Rural Epidemiology (PURE) study. *The Lancet Global Health*, 4(10), e695-e703. doi:10.1016/S2214-109X(16)30186-3
- Osgood-Zimmerman, A., Milllear, A. I., Stubbs, ...Hay, S. I. (2018). Mapping child growth failure in Africa between 2000 and 2015. *Nature*, 555, 41. doi:10.1038/nature25760
- Ridoutt, B., Baird, D., Bastiaans, K., ...Keating, B. (2017). Australia's nutritional food balance: situation, outlook and policy implications. *Food Security*, 9(2), 211-226. doi:10.1007/s12571-017-0650-x
- Wiggins, S., & Keats, S. (2015). *The rising cost of a healthy diet: Changing relative prices of foods in high-income and emerging economies*. London: Overseas Development Institute.

Thank you

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