Australian National University

Sustainable Animal Production in the 21st Century:
Multiple contributions to People and the Planet

Robyn Alders AO

1. Development Policy Centre & Institute for Climate, Energy and Disaster Solutions, ANU, Australia
2. Global Health Programme, Chatham House, UK
3. Kyeema Foundation, Australia
4. Dept of Pathobiology and Population, Royal Veterinary College, London, UK

2022 National Livestock Conference, Vizag, India; 11 April 2022

My dual passions, commitment to family farming and a possible conflict of interest

Village chickens and their owners

Merino sheep and Australian farmers

Acknowledgements

- **Conference Organizing Committee**, especially Prof. Dr. K. Sarjan Reddy and Sri Venkateswara Veterinary University
- **FAO**
- **Small-scale and family farmers and producers** in the Indo-Pacific
- **Kyeema Foundation** colleagues

KYEEMA FOUNDATION

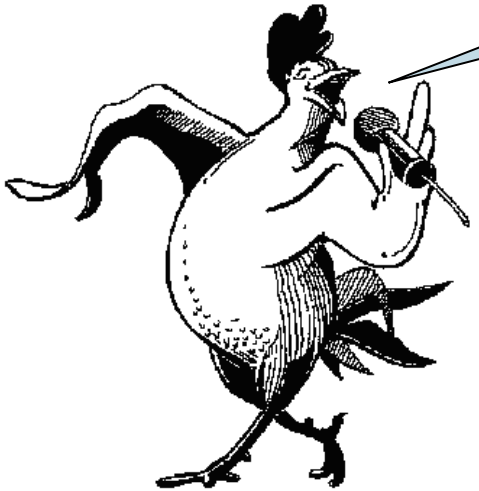
Our challenge

How do we deliver **optimal**, **ethical**, **safe** and **sustainable** animal **production** by 2050?

Presentation outline

1. **Introduction**
2. **General contributions:**
   - Animal traction
   - Natural fibres
   - Sociocultural & religious
   - Human health and wellbeing
3. **Contributions to sustainable development:**
   - Animal-source food & human nutrition
   - Ecosystems services
   - Sustainable Development Goals
4. **Sustainable & circular bioeconomies**
5. **Key recommendations**

1. Introduction



Our quest for food ….

Source: Richard Kock, 2014

Photo credits: Robyn Alders

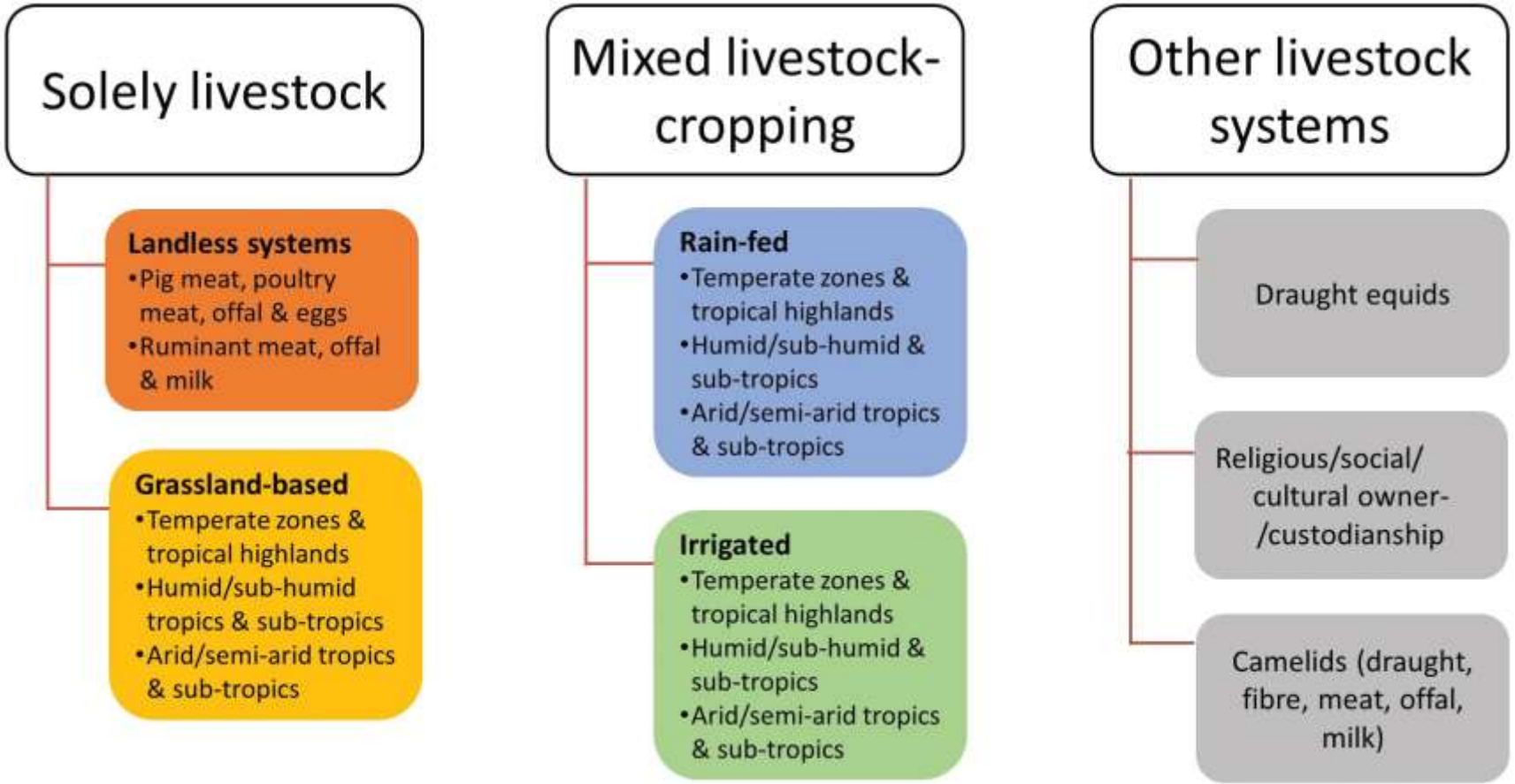
Most of the world's more than 570 million farms are small and family-run

Small farms (less than 2 ha) operate about 12% of the world's agricultural land

Family farms operate about 75% of the world's agricultural land

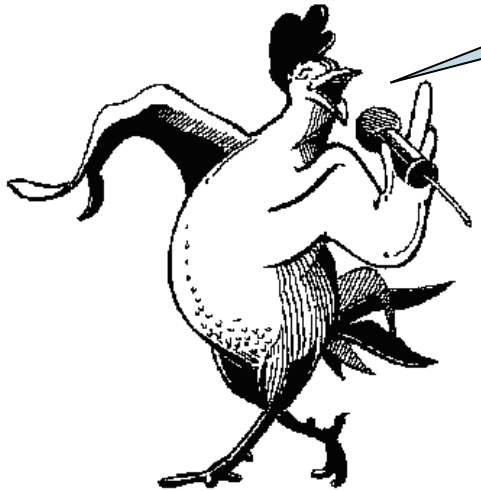
Of approx. 770 million people surviving on less than USD 1.90 per day, about half depend directly on livestock for their livelihoods, frequently on land unsuitable for cropping

Classification of livestock production systems



Source: Adapted from Steinfeld et al. (2006) by Alders et al. (2021)

2. General contributions



Animal traction

Photo credit: Fallou Gueye, FAO, 2020

Natural fibre

- Biodegradable
- Fire resistant
- Carbon sequestration
- Can be regenerative

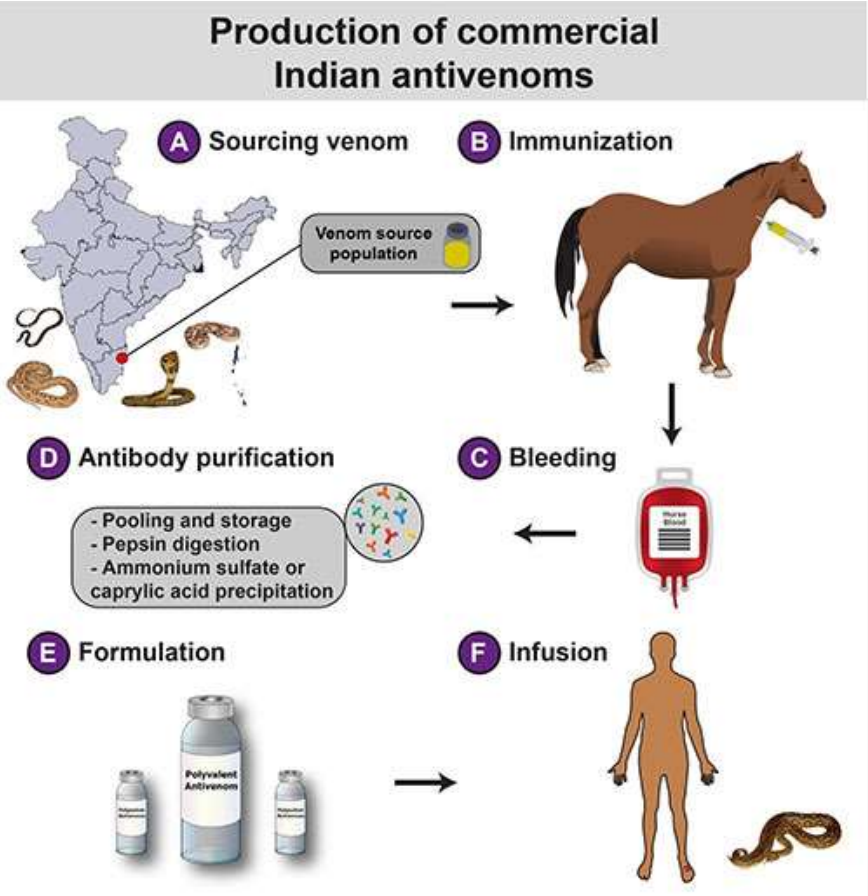
Photo credit: Robyn Alders, 2021

Sociocultural & religious

A. Chiapas Sheep breed cared for by Tzotzil shepherdesses in Mexico; prohibited to kill them
B. Mayan Tzotzil weaver transforming wool into traditional garments

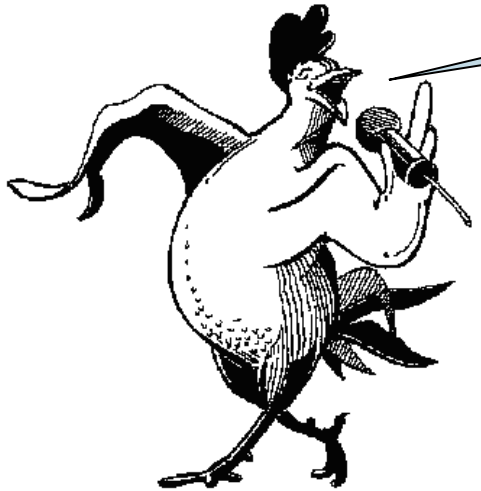
Photo credit: Raul Perezgrovas-Graza, 2019

Human health & wellbeing



- **Production of anti-sera**
  - antivenoms and antitoxins
- **Animal hormones and xenografts**
  - insulin
  - heart valves
- **Service and therapy animals**, e.g.
  - horses in the defense services
  - therapy animals for mental health support
- **Draught power**
  - multiple species across multiple countries

Source: https://www.indianpediatrics.net/mar2021/mar-219-223.htm



3. Contributions to sustainable development

The agriculture, human nutrition and health nexus

- More **food** ≠ better nutrition
- More **crops** ≠ less stunting
- **Stunting** - long-term cumulative impacts
  - **Children** – health, physical and cognitive development capacity
  - **Adults** - productivity losses
- **11% of gross national product** in Africa and Asia lost annually due to malnutrition

Photo credit: Robyn Alders, 2014

What is **mal**nutrition?

Undernutrition

- Stunting
- Wasting
- Underweight
- Micronutrient deficiencies

+

Overnutrition

- Overweight
- Obesity

=

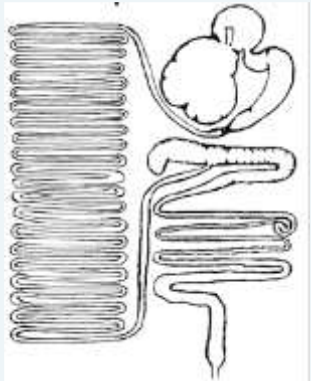
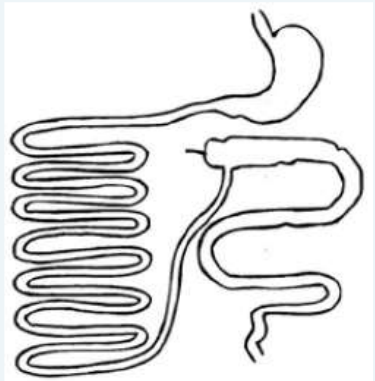
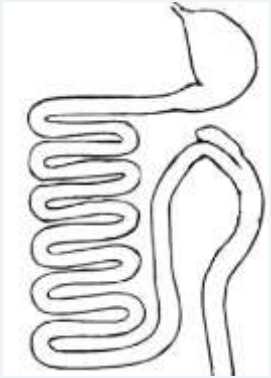
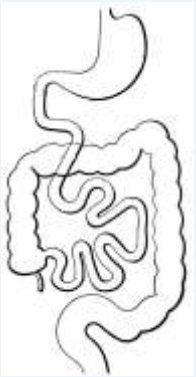
Malnutrition

Malnutrition is **bad** nutrition!

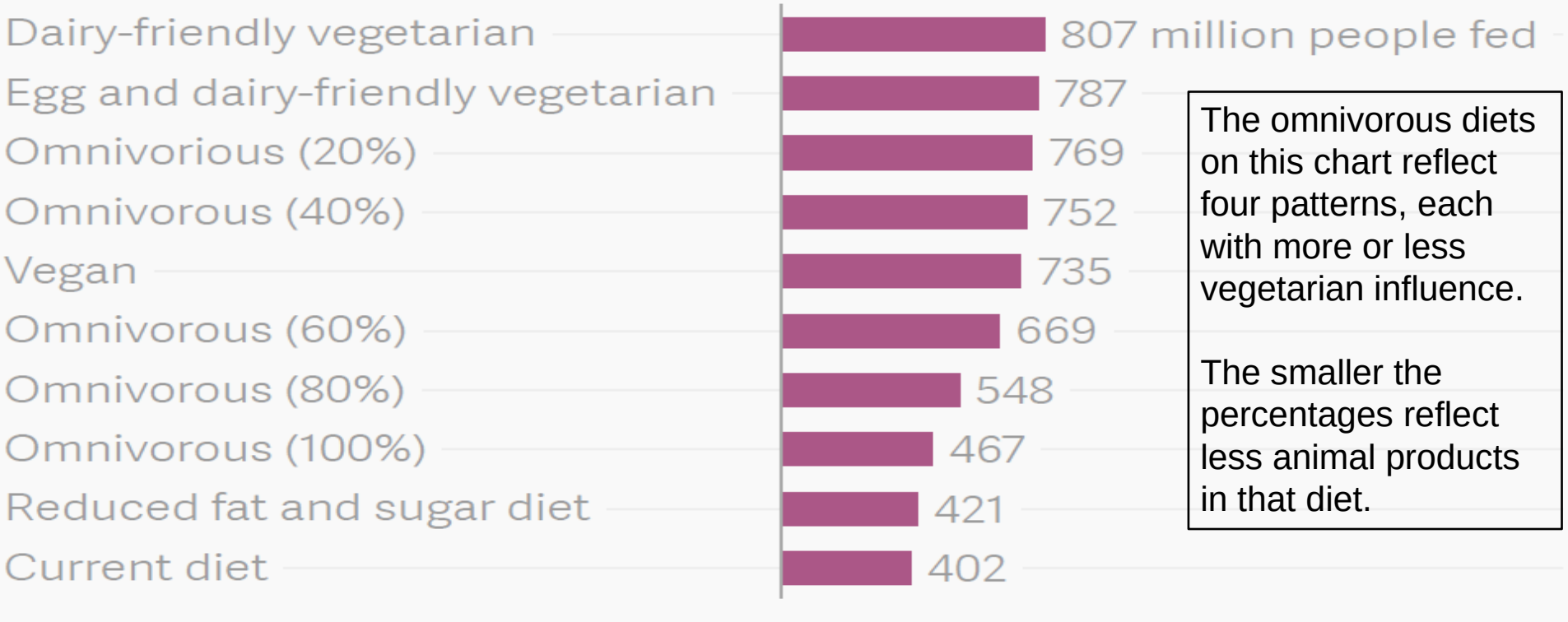
Good nutrition requires **good food**, **good care** and **good health**!

Australian National University

A quick comparison of the anatomy behind differing nutritional physiologies

Classification	Herbivore	Omnivore		Carnivore
Diet required for good health	Eats plant-source food only	Eats plant- and animal-source food		Eats primarily animal-source food
Illustrative species	Sheep *Ovis aries*	Human *Homo sapiens*	Dog *Canis familaris*	Cat *Felis catus*
Illustration of comparative length of digestive tract				

Carrying capacity of U.S. agricultural land: Ten diet scenarios



The omnivorous diets on this chart reflect four patterns, each with more or less vegetarian influence.

The smaller the percentages reflect less animal products in that diet.

Source: https://www.elementascience.org/articles/116

Arable land in US = 17.5% of land area

Micronutrient content

Recommended Nutrient Intake (RNI) for Vitamin A for a breastfeeding mother:
950 µg/d

Chicken liver, fried
9 g

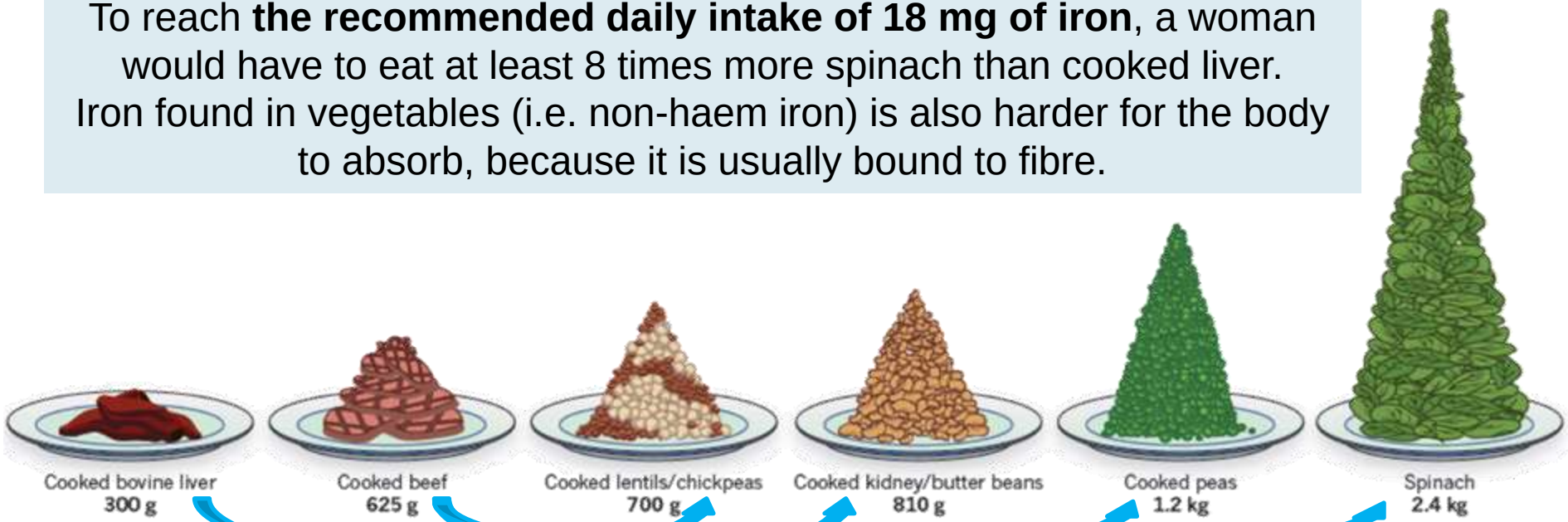
Spinach, cooked
148 g

Orange sweet potato, cooked
220 g

Fresh papaya
704 g

Nutritional contributions of animal-source foods

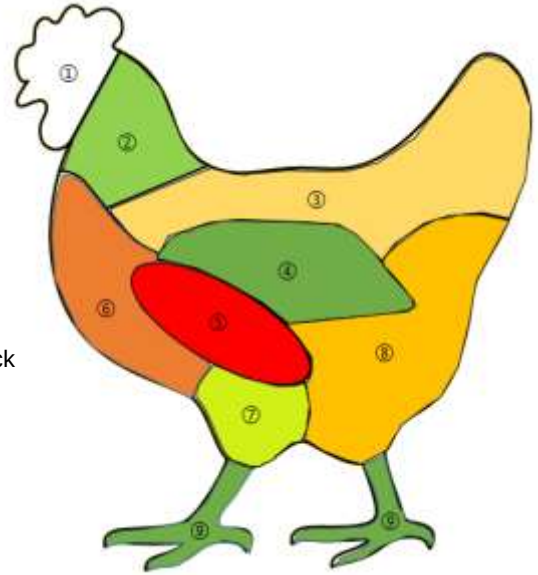
To reach **the recommended daily intake of 18 mg of iron**, a woman would have to eat at least 8 times more spinach than cooked liver. Iron found in vegetables (i.e. non-haem iron) is also harder for the body to absorb, because it is usually bound to fibre.



Credit: Gupta, 2016. Nature.

Nutrient distribution in chicken carcases (i)

① = Head
② = Neck
③ = Back
④ = Wing
⑤ = Giblets
⑥ = Breast
⑦ = Drumstick
⑧ = Thigh
⑨ = Feet

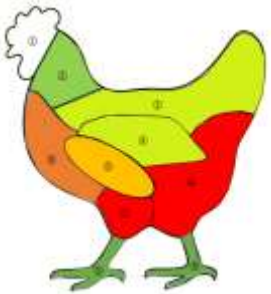


Distribution of **iron** amongst a whole chicken carcass

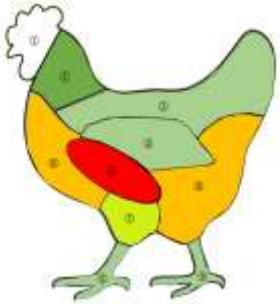
Distribution of nutrients across a chicken carcass								
	Fe (mg)	Zn (mg)	Vitamin B12 (ug)	Vitamin A (IU)	Folate (ug)	Thiamine (mg)	Protein (g)	Energy (kj)
Back	10.7	11.5	2.9	5.0	2.5	9.2	9.3	18.5
Breast	20.1	17.4	9.4	4.0	4.0	27.1	33.1	23.9
Drumstick	9.1	19.2	7.0	1.0	1.4	17.0	13.6	10.6
Thigh	12.7	19.4	11.8	2.6	2.1	21.6	18.1	21.1
Wing	5.0	10.5	2.7	0.6	2.8	10.2	11.7	11.9
Neck	6.0	4.7	0.8	1.2	0.6	2.3	2.6	4.8
Giblet	31.7	14.4	62.9	84.7	69.6	7.5	5.7	3.4
Feet	4.8	2.9	2.5	0.9	16.8	5.0	6.0	5.8

Chan, et al. 2017. What's in a Chicken? Comparing the nutrient value, potential to meet nutrient requirements and health-cost effectiveness of whole and frozen chickens. BVSc Honours Dissertation, University of Sydney.

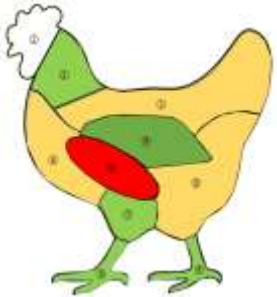
Nutrient distribution in chicken carcases (ii)



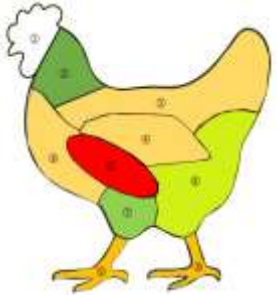
Zinc



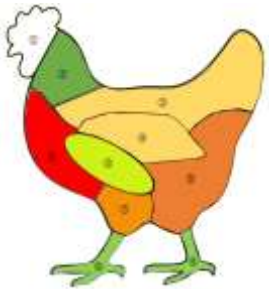
Vitamin B12



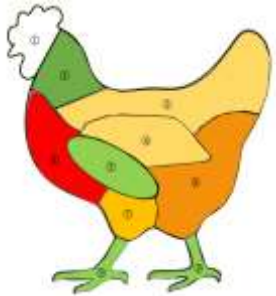
Vitamin A



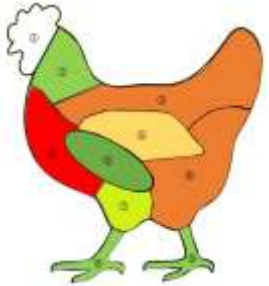
Folate



Thiamine



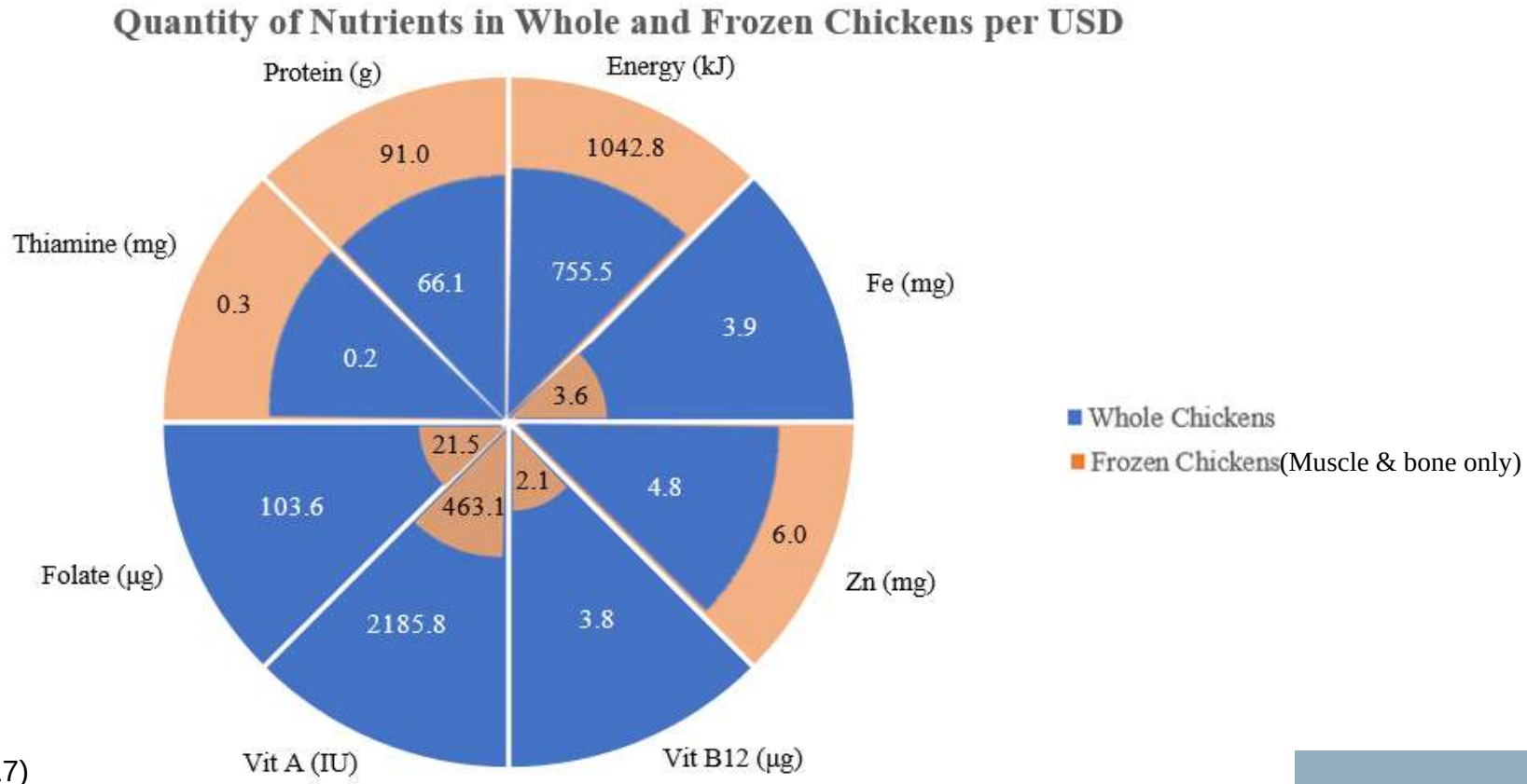
Protein



Energy

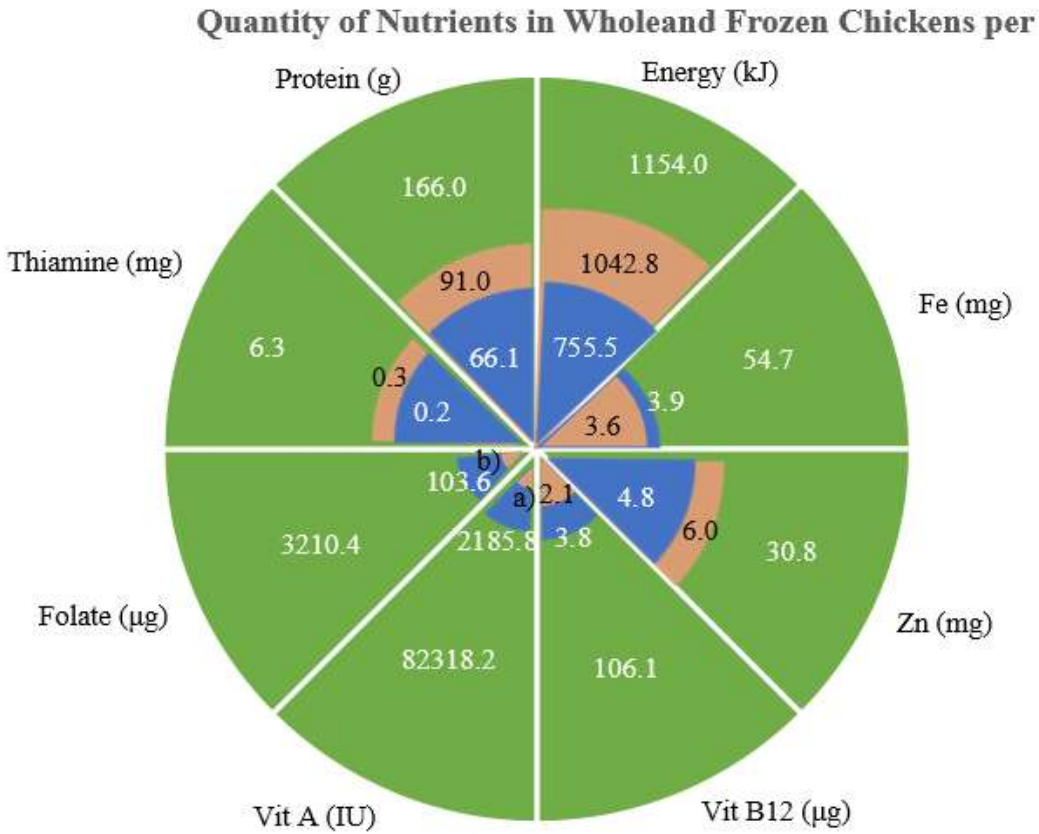
Chan et al. (2017)

Nutrient distribution in chicken carcases (iii)



Chan et al. (2017)

Nutrient distribution in chicken carcases (iv)



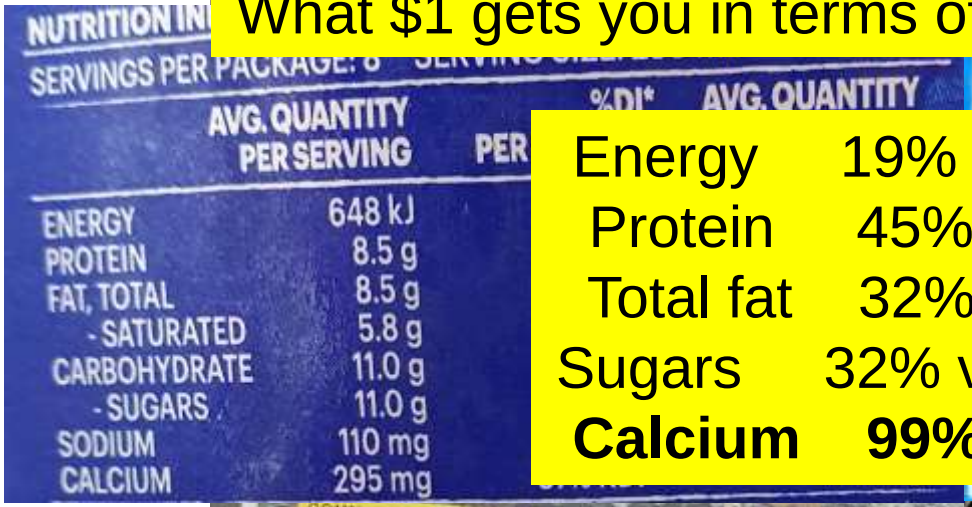
Nutrient deficiencies rarely appear alone

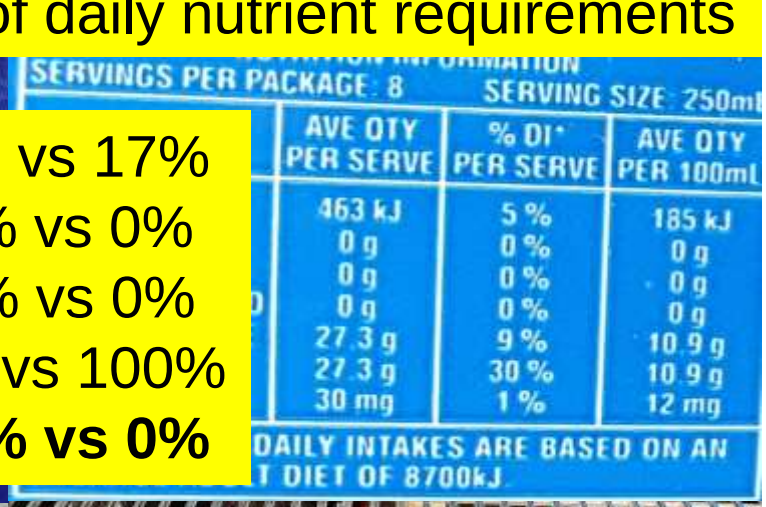
Chan et al. (2017)

How we currently value food …

What $1 gets you in terms of daily nutrient requirements

Energy	19% vs 17%
Protein	45% vs 0%
Total fat	32% vs 0%
Sugars	32% vs 100%
Calcium	**99% vs 0%**





$3.00/2L

$2.40/2L

Loss of Agrobiodiversity

- The 9 million Holstein dairy cows in the US
  - descended from 2 sires
  - female effective population size < 50

- Commercial chicken genetics lack diversity and are controlled by 4 major companies for both broilers and layers

Biodiversity and agrobiodiversity loss (II)

Biodiversity

- Biodiversity reflects overall environmental health
- Diminishing numbers of key species
- E.g, **extinction of pollinator bees would severely affect food security** and destroy the delicate balance of the Earth's ecosystem

Ecosystems services

Ecosystem services = multiple benefits to humans (e.g., food, clean water, shelter, and raw materials for our basic needs) provided by healthy ecosystems

Extensively raised livestock

- frequently integral to provision of ecosystem services
- essential to many agroecosystems
- contribute to circular food and fibre systems

Roles include:

- **transforming feed inedible by humans** into nutritious foods
- **useful products** such as pharmaceuticals and companion animal feed, fuel (through manure), and transport
- **enhancing ecosystem health** through grazing, browsing, trampling, and the production of dung and urine
- **shifting locations** allowing them to respond to fluctuations in resource availability and weather patterns

Nature-based production

Extractive

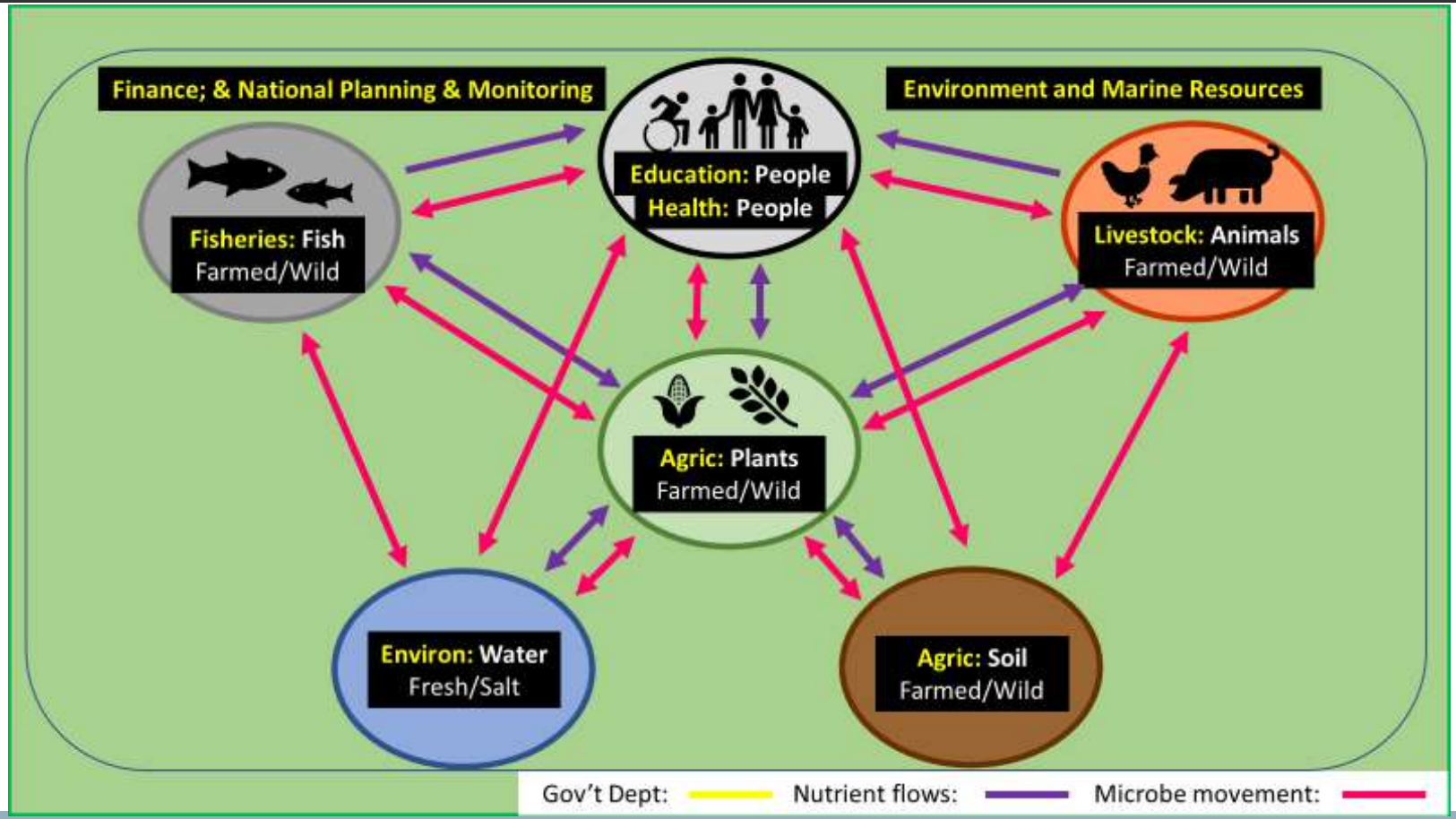
Regenerative

Australian National University

Livestock contribute to 12 of the 17 **Sustainable Development Goals**

Source: Alders et al. 2021

One Health, One Welfare & Animal Production



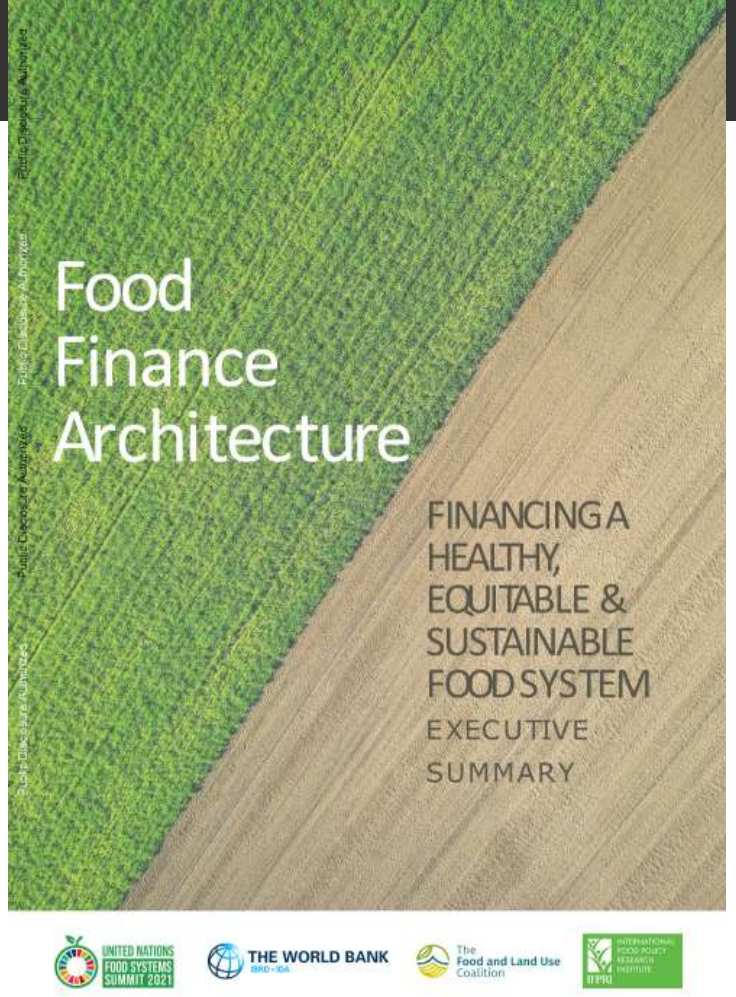
Source: Alders (2021)

World Bank et al. 2021

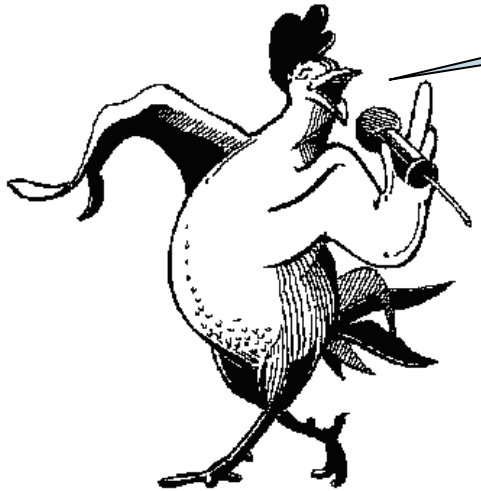
“Food systems must change rapidly and fundamentally in the coming decades to become more regenerative, resilient, and inclusive, while increasing food supply for an additional 2 billion people by 2050”

“Today’s food systems generate $12 trillion in hidden social, economic, and environmental costs”

Proposes 5 imperatives needed to optimize public spending and mobilize private capital for a global food system transformation, including **intersectoral collaboration**

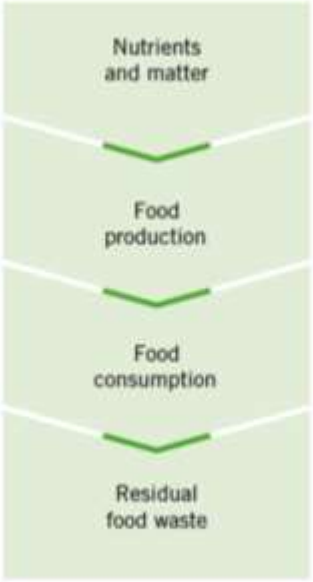


4. Sustainable & circular bioeconomies

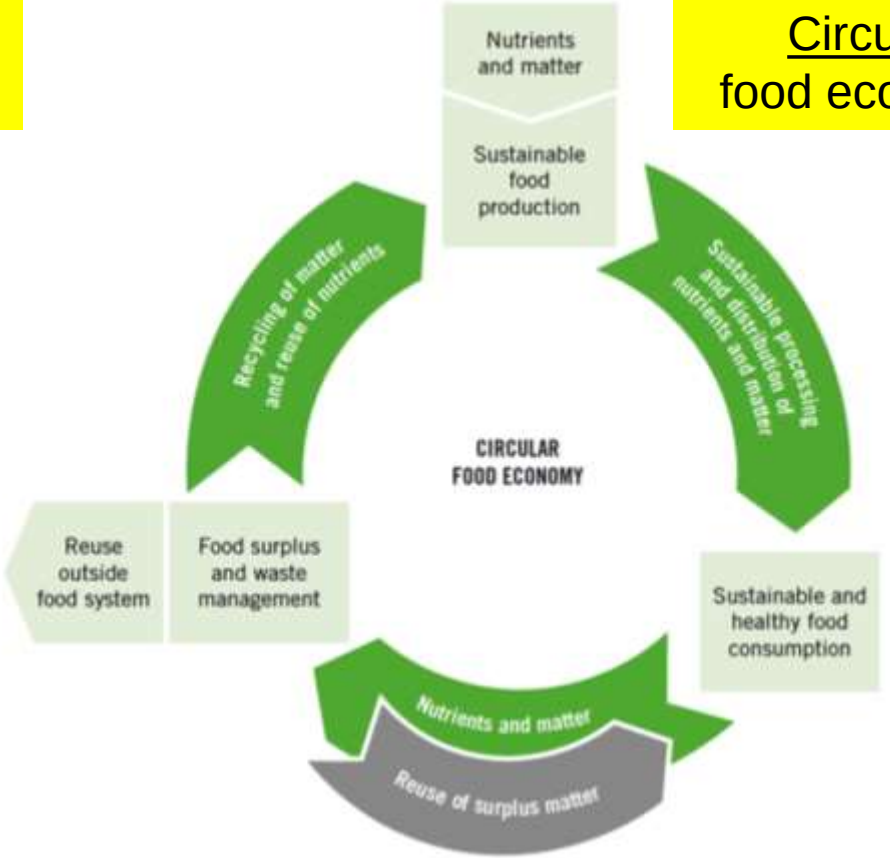


Sustainable and circular bioeconomies

Linear food economy



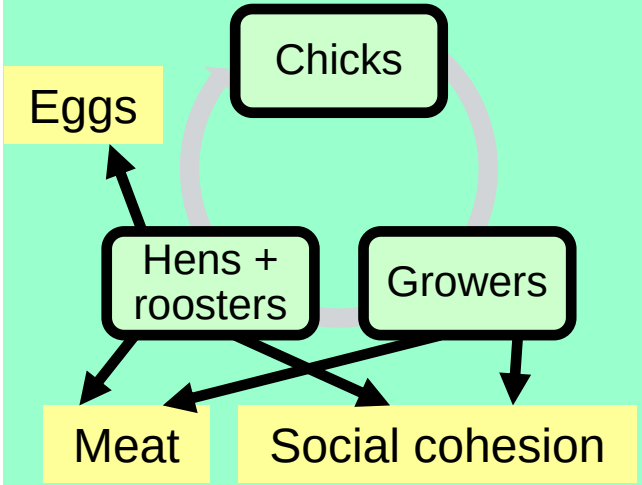
Circular food economy



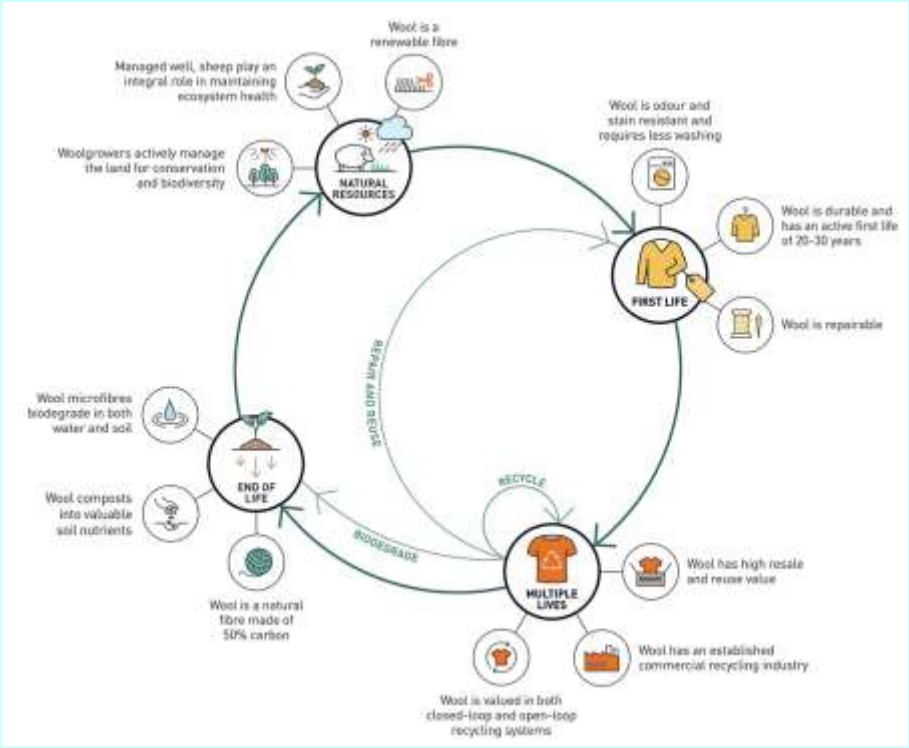
Source: Alders et al. (2020)

Circular economies: two examples

Mozambique: village chickens



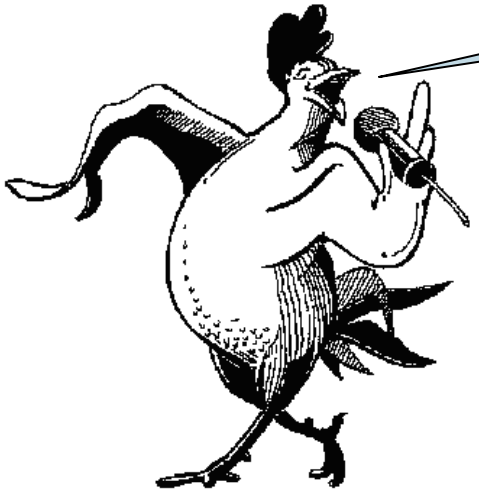
Australia: merino wool



Source: Robyn Alders, 2022

Source: Beyond the Bale, AWI

5. Recommendations



Key recommendations

As animal production specialists, we have a responsibility to encourage:

- Evidence-based debates on **sustainable human and animal nutrition and appropriate welfare**
- Use of food for people and feed for animals that are **ecologically, economically and socially sustainable**
- Land management practices involving animals that **enhance soil health and biodiversity**, employ principles of regenerative, climate-resilient livestock production
- **Value food** - according to its natural nutrient density in addition to weight and/or volume, value nutrients and enable their recycling
- **Restructure healthcare services** to place a higher value on the contributions of agriculture and livestock producers to preventive medicine

Thank you for your time

No one individual, discipline or sector can deliver ethical, economically and ecologically sustainable animal production.
Together, we have to!

- Comments and queries welcome
- robyn.alders@anu.edu.au

ONE HEALTH, ZERO HUNGER

Robyn Alders, Osman Dar, Richard Kock, and Francesco Rampa
Chatham House

FIGURE 2.1 SUSTAINABLE DEVELOPMENT GOAL 2 (ZERO HUNGER) AND THE EIGHT TARGETS FOR ASSESSING PROGRESS

Available: https://www.globalhungerindex.org/issues-in-focus/2020.html