THE UNIVERSITY of EDINBURGH
Global Academy of
Agriculture and Food Systems

The role of legumes in achieving sustainable agriculture

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Extraordinary futures await

The challenge: Sustainable Food Production

How to Sustainably Feed 10 Billion People by 2050, in 21 Charts (2018) World Resources Institute.

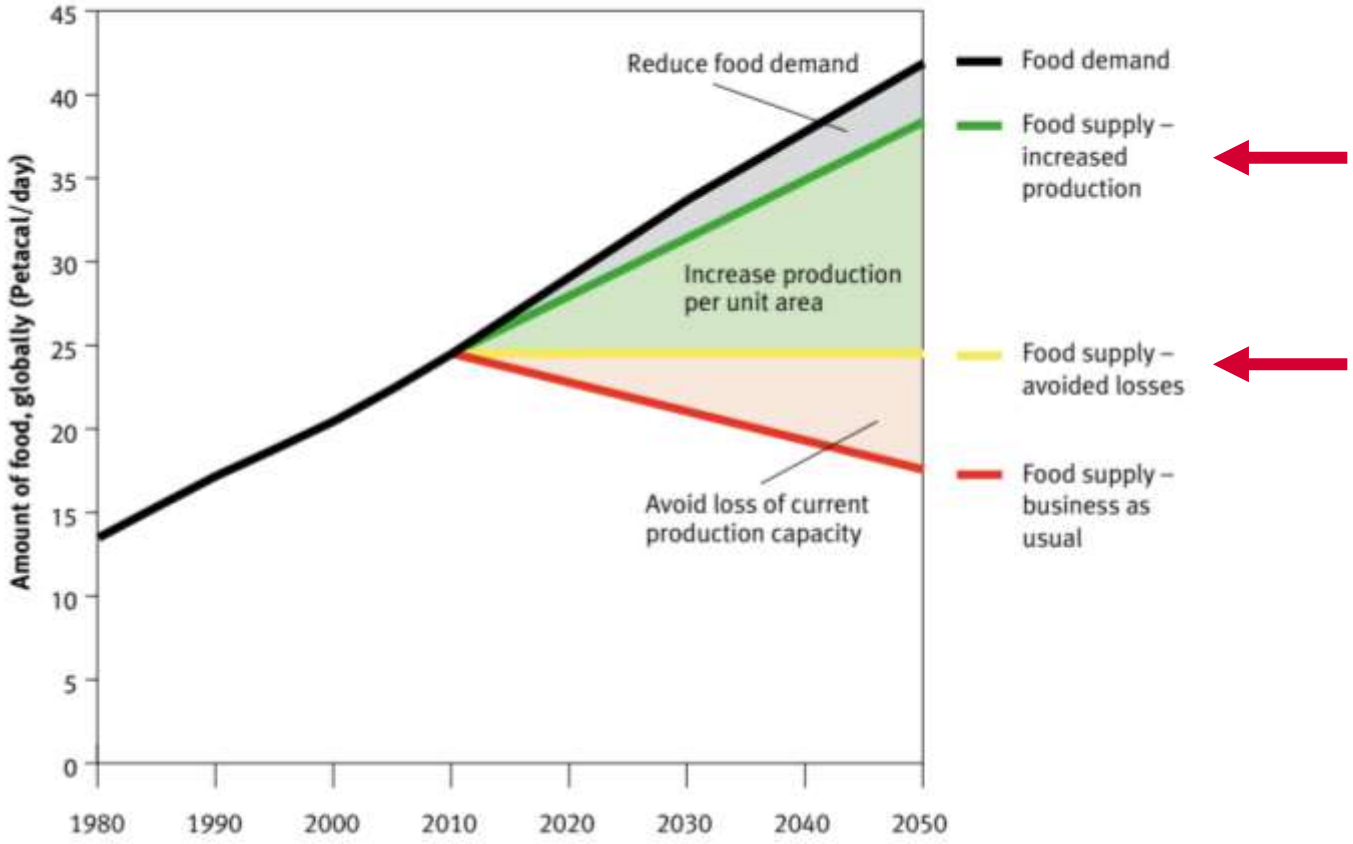
Increase global food production significantly

Prevent further spread of agriculture into natural or semi natural habitat

Decrease negative environmental issues associated with agriculture

Routes to achieve future food security

Figure 2: Balancing food supply and demand.



Source: **Achieving food security in the face of climate change.** Final report from the Commission on Sustainable Agriculture and Climate Change (2012)

A brief introduction to legumes

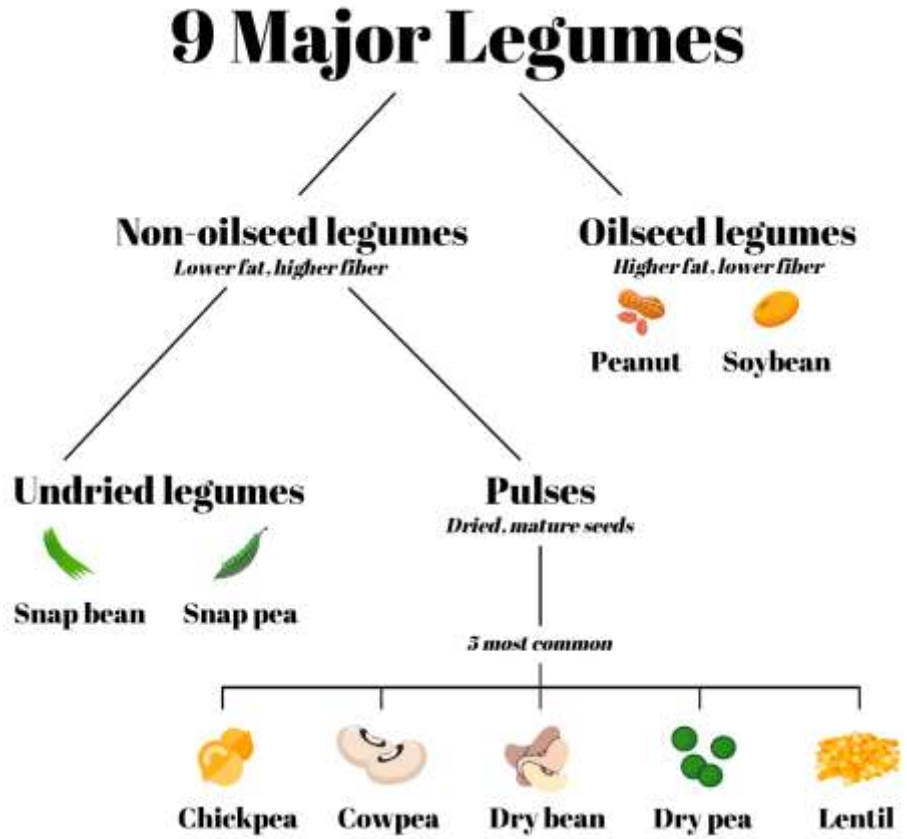


Figure: **Defining Nutritional and Functional Niches of Legumes: A Call for Clarity to Distinguish a Future Role for Pulses in the Dietary Guidelines for Americans** (2021) https://doi.org/10.3390/nu13041100

- Archaeological signs of widespread legume cultivation across Asia, Africa, the Americas and Europe. some dating as far back at 7,000 years BC.
- Leguminosae family: ~ 800 genera, ~20,000 species. Capable of fixing N
- Grain legumes: used for human food and animal feed (soy/pea).
- Forage legumes: Animal feed e.g. alfalfa and clover

Legumes as a Cornerstone of the Transition Toward More Sustainable Agri-Food Systems and Diets in Europe. (2021) https://doi.org/10.3389/fsufs.2021.694121

Legume nutrition

- Nutrient dense food for achieving food security. Contain macro (protein, carbohydrates, fat) and micro nutrients (Fe, Zn, K, thiamine, folate, Vit E, Vit A etc) and fibre.
- A recent review stated there is no strong evidence to suggest that “anti-nutrients” present in legumes cause deleterious effects to human health when consumed in their whole form, after proper preparation.
- The benefits of eating legumes far outweigh any potential impacts of certain compounds. In some cases, so – called ‘anti-nutrients- may be therapeutic.

Defining Nutritional and Functional Niches of Legumes: A Call for Clarity to Distinguish a Future Role for Pulses in the Dietary Guidelines for Americans (2021) https://doi.org/10.3390/nu13041100
Is There Such a Thing as “Anti-Nutrients”? A Narrative Review of Perceived Problematic Plant Compounds (2020) https://doi.org/10.3390/nu12102929

Image by Leopictures from Pixabay

Increased Production: Intercropping with Legumes

Cereal–legume cropping systems for enhanced productivity, food security, and resilience (2022) https://doi.org/10.1079/9781800621602.0003, (33–47)

Increased Production: Intercropping with Legumes

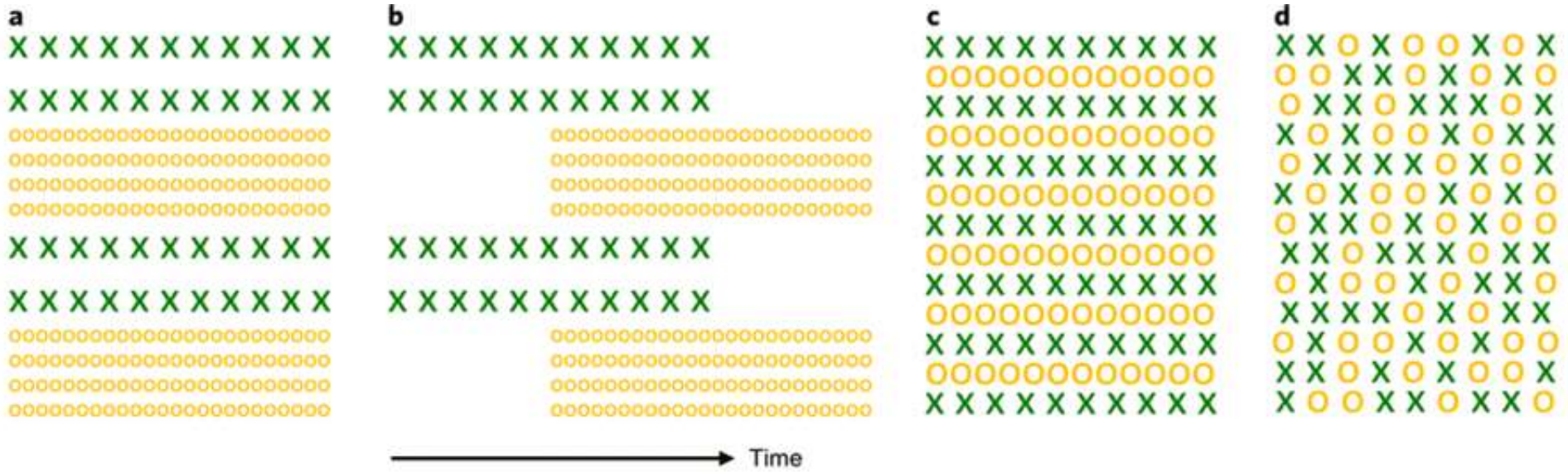


Figure 1: Illustration of intercropping systems and strategies. Panels (a – d) show different planting designs for intercropping (a = strip, b = relay, c = row and d = mixed). Figure from Li et al. (2020)

Cereal–legume cropping systems for enhanced productivity, food security, and resilience (2022)
https://doi.org/10.1079/9781800621602.0003, (33–47)

Increased Production: Intercropping with Legumes

Benefits:

1) Complementary N acquisition strategies – reducing N inputs
2) Improved soil N content after legume crop
3) Transfer of N from legume to companion

Intercropping of grain legumes and cereals improves the use of soil N resources and reduces the requirement for synthetic fertilizer N: A global-scale analysis (2020) https://doi.org/10.1007/s13593-020-0607-x

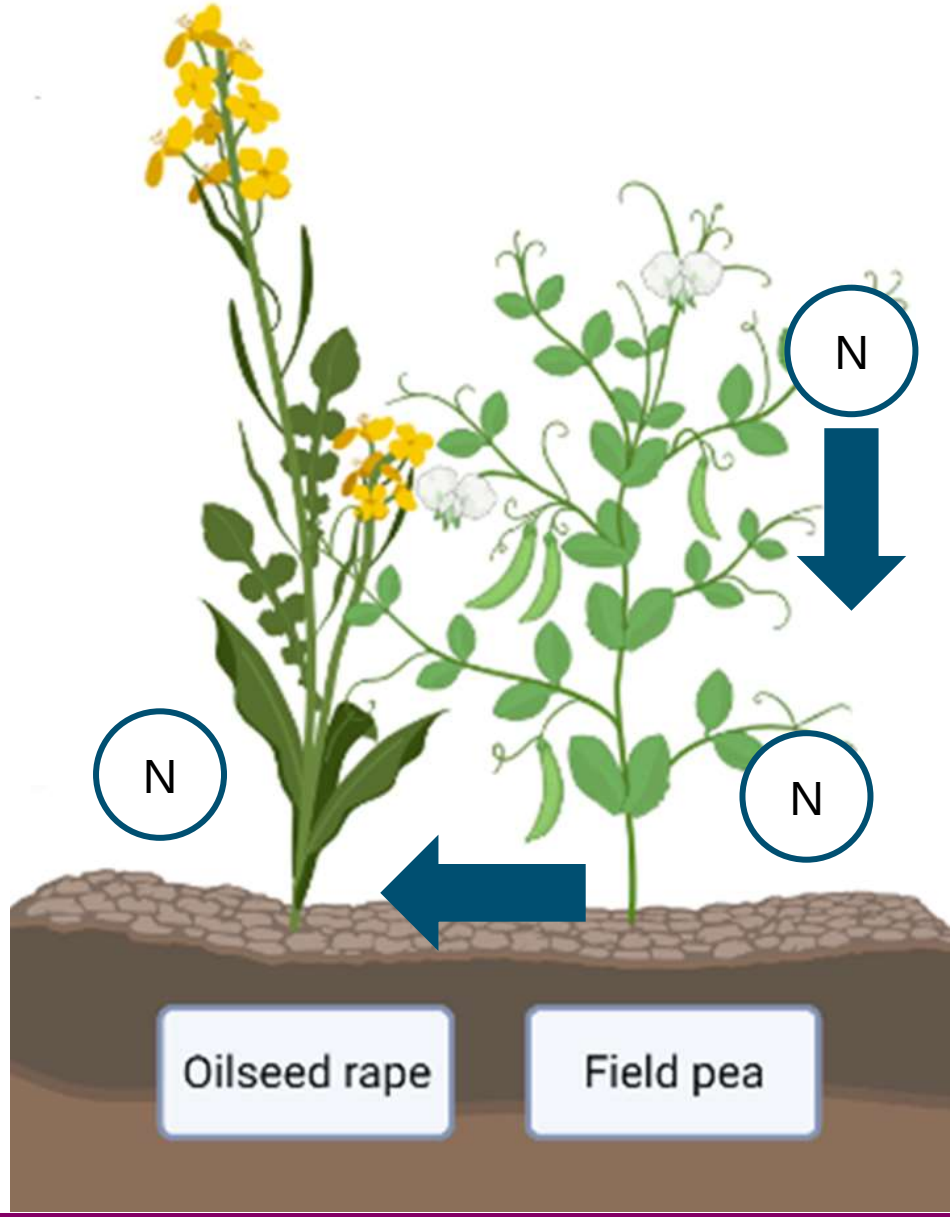


Figure made in Biorender.com (S Kalakonda)

Increased Production: Intercropping with Legumes

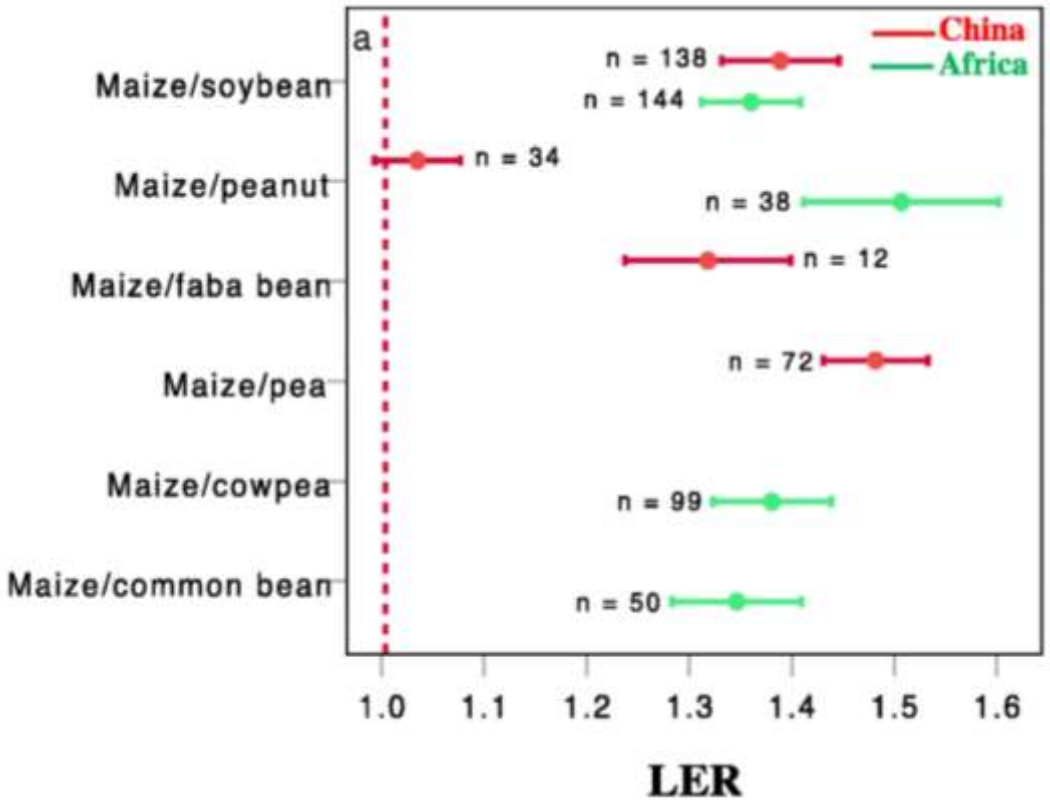


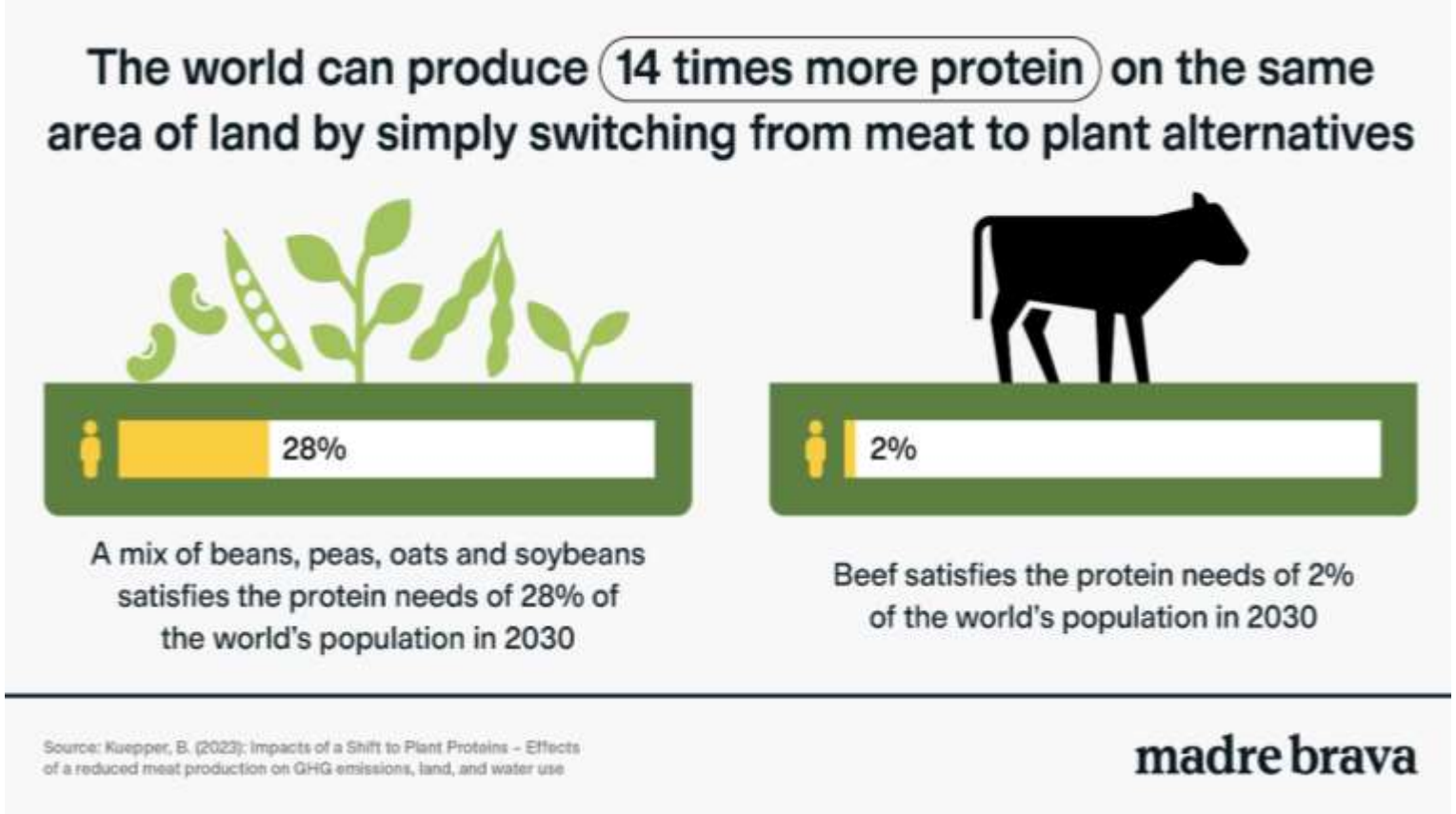
Figure: Land equivalence ratio for maize and various grain-legumes based on primary data from Africa and China based intercropping studies.

- The horizontal lines and symbols represent the confidence interval and mean.

Source: Mudare et al., 2022. (DOI below)

Yield and fertilizer benefits of maize/grain legume intercropping in China and Africa: A meta-analysis (2022). https://doi.org/10.1007/s13593-022-00816-1

Reduce Losses/Inefficiencies: Legumes for plant-based protein



- Animal based proteins e.g. beef, are relatively inefficient protein sources
- Huge amount of crops fed to livestock (e.g. soyabean) which could be fed directly to humans (including legumes).

Madre Brava (2023) — Replacing 30% of meat with plants proteins could offset almost all global aviation emissions, free up an India-sized carbon sink and save 7.5 million swimming pools worth of water a year

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Thank you

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