Carbon footprint of meat consumption in the Irish diet

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Circular Agronomics

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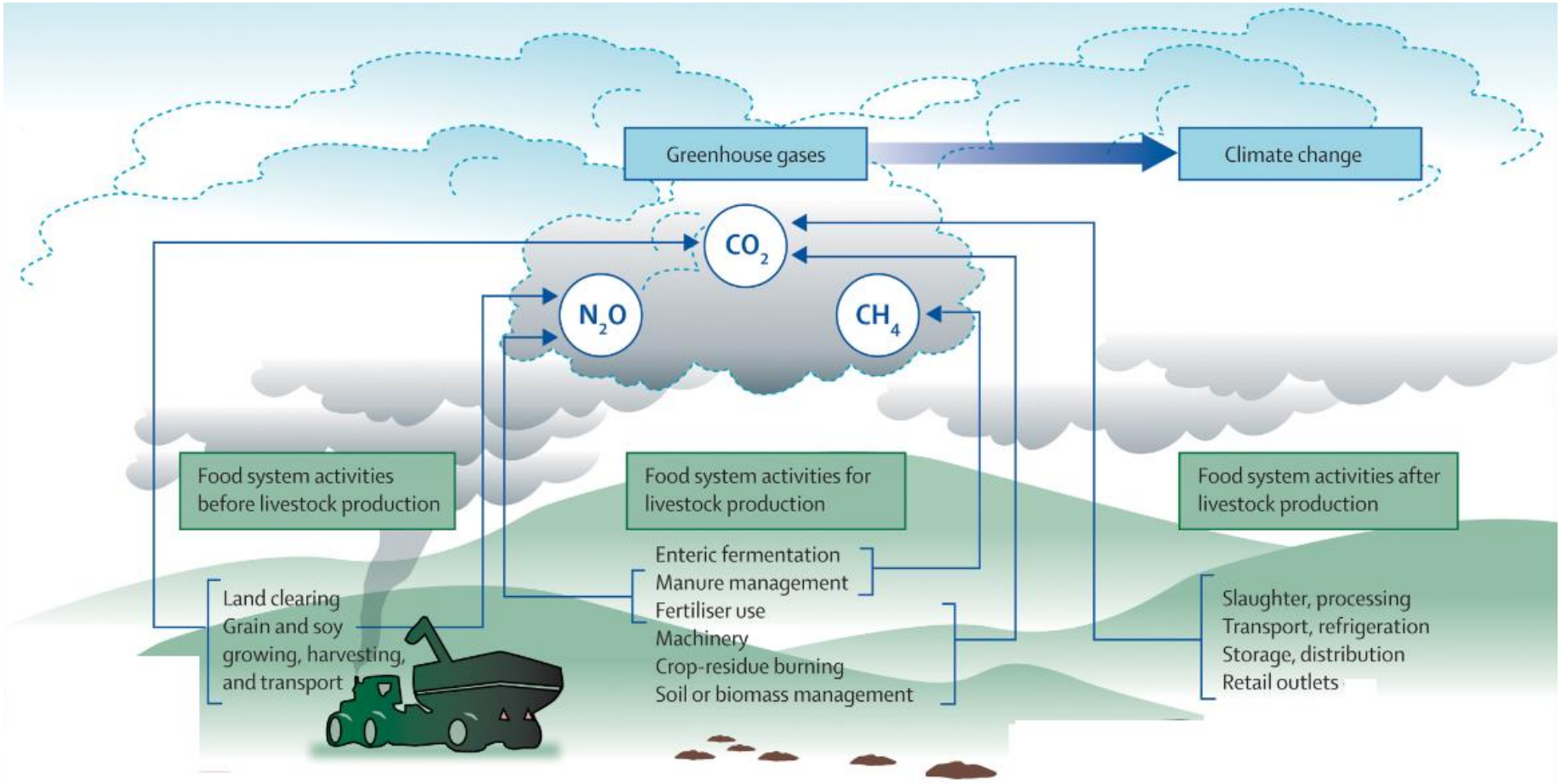
Greenhouse gas emissions, agriculture and food



88% of emissions

12% of emissions

Sustainable Diets

"*diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations.*

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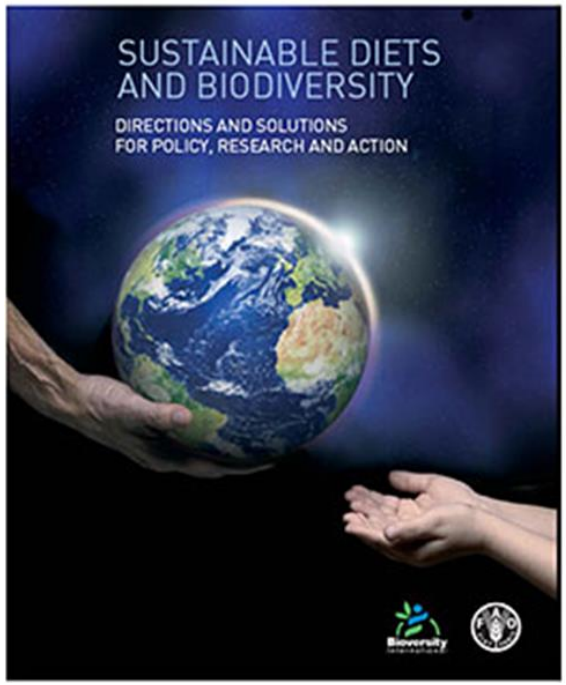
Sustainable diets are protective and respectful of biodiversity and ecosystems, ***culturally*** *acceptable, accessible, economically fair and affordable;* ***nutritionally*** *adequate, safe and* ***healthy****; while optimizing natural and human resources".*

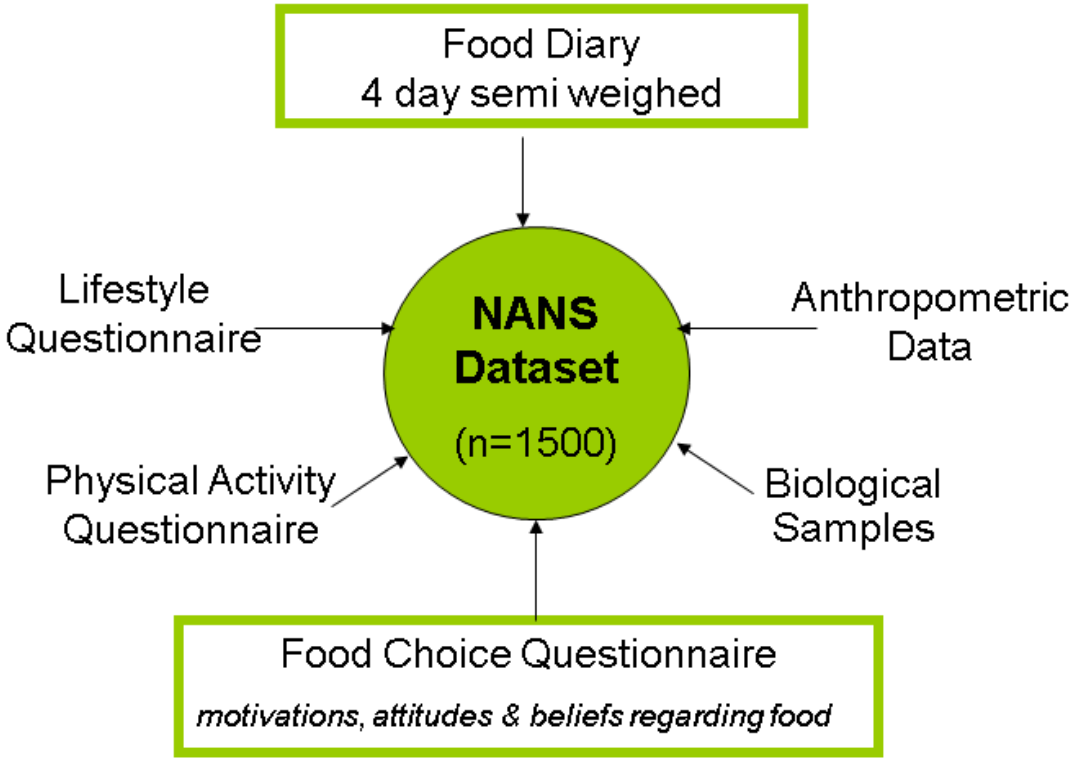


Sustainability and nutritional guidelines

- Germany and Sweden are the only two European countries that feature messages about sustainability in their food guidelines
- The Netherlands and the United Kingdom have also begun working to incorporate environmental considerations into their food guidelines, according to the report
- Recent Lancet Eat report, recommends a global diet with minimal animal derived foods and increased plant derived foods

IS THE IRISH DIET SUSTAINABLE?

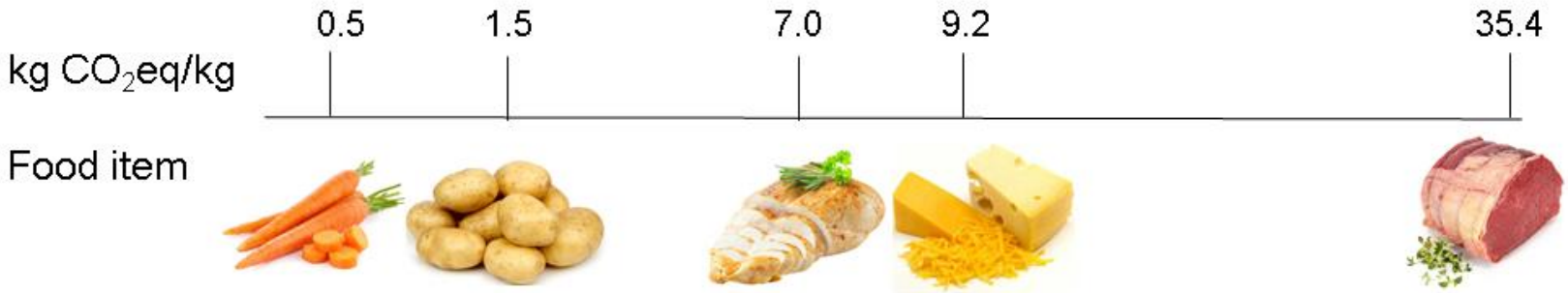
Methods 1: Food consumption data collection National Adult Nutrition Survey (www.iuna.net)



- Demographic, socio-economic, education profiles
- Representative of the Irish population
- Energy misreporters excluded

Methods 2: GHG emissions calculations

- Life cycle analysis (LCA)
  - Considered production - consumer waste
- #Emissions factor assigned to each of the 67 food groups



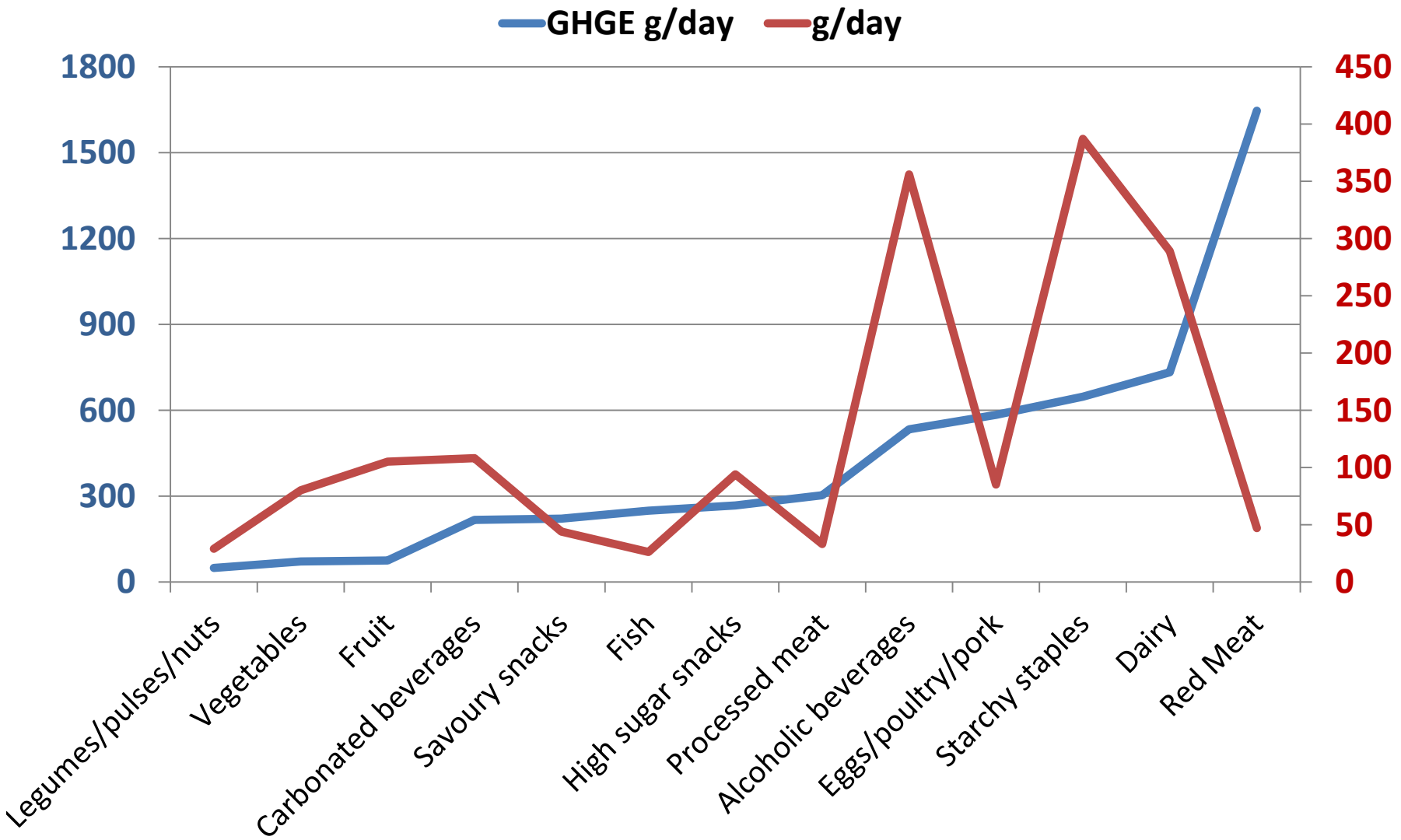
- Food groups of similarity were categorised together to form 16 summary food groups for ease of analysis.
- Cluster analysis was subsequently used to identify patterns in GHGE production and dietary patterns

GHGE conversion factors for food were drawn from: Green et al. (2015); Heller and Keoleian (2015); Finnegan et al., (2015)

Mean daily food intake, energy intake & GHGEs

	n	Food intake (kg/d)	Energy intake (MJ/d)	GHGE (kg CO_2eq/d)
Male	470	3.34	11	7.85
Female	490	2.67	8	5.27
Total	960	3.01	9	6.53

Daily food group consumption & emissions



Cluster analysis: GHGE dietary patterns

- Cluster analysis identified similarities of dietary emissions, based on their inter-correlations.
- Cluster analysis classified food groups into different classes, or more precisely, the partitioning of a data set into subsets (*i.e.* the clusters)
- The data in each subset (ideally) share common traits
- Thus, the final clusters consist of cases with common behaviour regarding the variables used in the analysis.

Unsustainable 25%

- Distinguishing food groups:
  - Processed meat
  - Savoury snacks
  - Alcohol

Nutritionally Sustainable 26%

- Distinguishing food groups:
  - Fruit & veg
  - Fish
  - Low red meat
  - Dairy

Culturally Sustainable 48%

- Distinguishing food groups:
  - Red meat
  - Dairy
  - Starchy staples

Mean GHGEs from food groups across clusters

Male (n = 470)	Unsustainable		Nutritionally Sustainable		Culturally Sustainable	
Food Groups	x̄	%	x̄	%	x̄	%
Red meat	2131	21	1603	19	2263	28
Dairy	607	7	925	12	877	12
Starchy staples	657	8	817	11	764	11
Eggs, poultry, pork	707	8	735	10	680	10
Alcoholic drinks	1749	18	328	4	605	8
Processed meat	685	8	248	3	327	5
High sugar snacks	168	2	385	5	306	5
Fish	96	1	486	7	212	3
Savoury snacks	606	7	188	3	142	2
Carbonated beverages	489	6	180	2	165	2
Vegetables	36	0.4	111	2	56	0.8
Fruit	28	0.3	155	2	54	0.8
Legumes, pulses, nuts	40	0.5	82	1	40	0.6
Daily total (kg CO_2eq)	**9.0**		**7.7**		**7.4**	

Implications

- Mean daily GHG emissions somewhat similar to other studies:
  - **UK**: 7.3 kg CO_2eq/day (Berners-Lee et al., '12); 8.8 kg CO_2eq/day (Hoolohan et al., '13)
  - **France**: 4.2 kg CO_2eq/day (Vieux et al., 2012)
  - **Netherlands**: 4.3 4.2 kg CO_2eq/day (Temme et al., 2015)
  - **EU**: 7.1 kg CO_2eq/day (Tukker et al., 2011)

- Foods from animal sources were the greatest contributors of daily dietary emissions.
- However, those who eat the most red meat (cultural) did not have significantly different dietary emissions than those who ate the least (nutritional).

- Western style unsustainable diets typified are particularly bad for the climate as well as lower achievement of dietary guidelines.

- A holistic assessment of diet is required for any attempts to reduce dietary GHGE rather than focusing on one food group alone.

- Recommendations to reduce dietary related emissions must consider consumer behaviour, prevailing dietary patters as well as focussing on reducing emissions associated with food production.

STRATEGIES TO BE MORE SUSTAINABLE

Sustainable Strategies

- Adopt the EAT global diet
- Sustainable food production
- Eating to meet requirements
- Reduce Food Waste

EAT Global diet

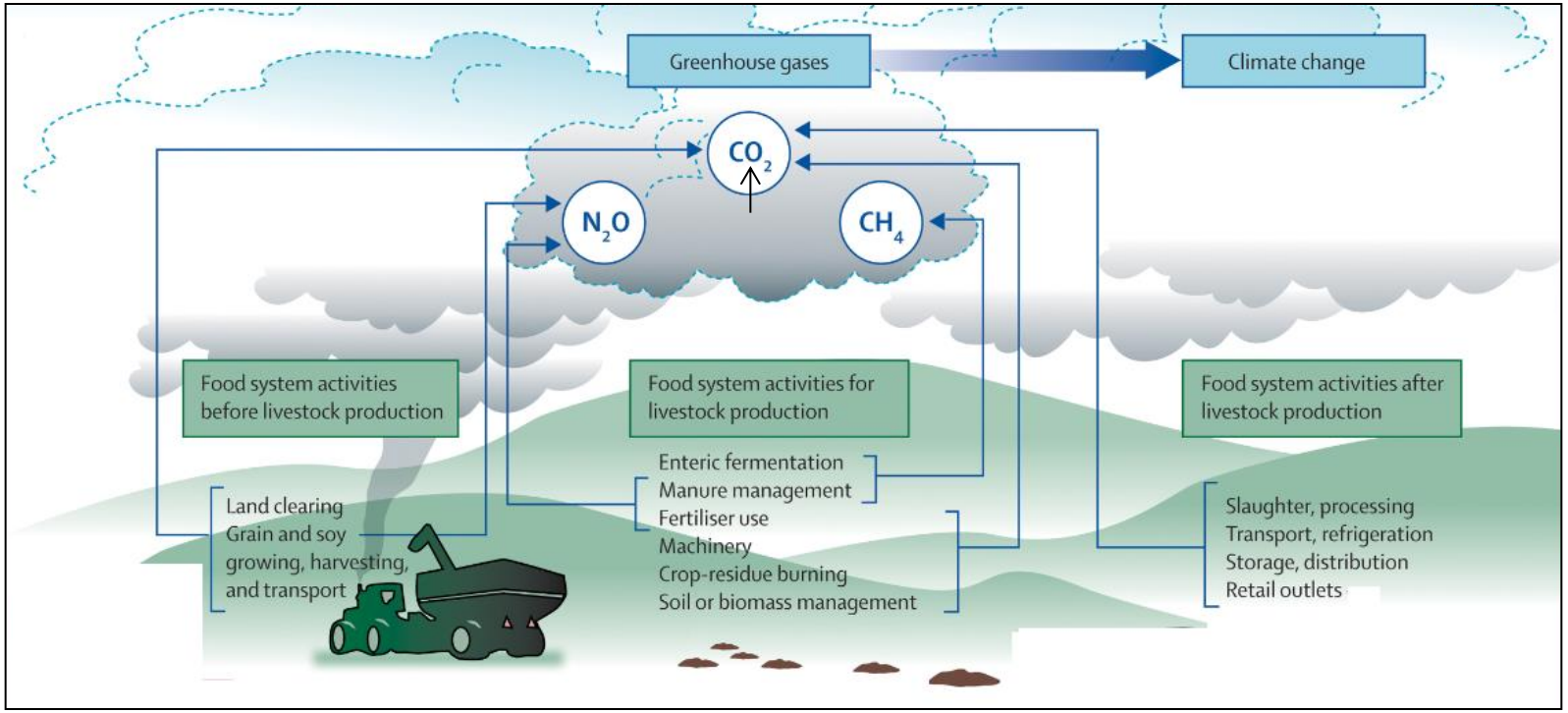
- Significant reliance on behaviour change
- Changes of land use
- Additional fertilizer inputs
- Matching calorie vs. protein intake?
  - To achieve parity for protein from red meat will require >3 times the amount of lentils or soya beans would need to be consumed, resulting in higher calorie intake.

Macronutrient content per 100g of beef, lentils and soya beans

	Beef, sirlion, lean		Lentils boiled		Soya beans boiled	
Nutrient	per100g	% of RDA	per100g	% of RDA	per100g	% of RDA
Protein (g)	31.5	73.3	7.6	30.4	14.0	39.7
Fat (g)	5.1		0.4		7.3	
Carbohydrate (g)	0.0		17.5		5.1	
Energy (kcal)	172		100		141	

- 100g Beef 32g protein, 172 calories, 3500 gCO2eq
- 400g Lentils 32g protein, 400 calories, 600gCO2eq
- 200g Soya 28g protein, 282 calories, 240gCO2eq

Sustainably Produced Food



88% of emissions	12% of emissions

Per kg of beef:	31kg CO2	4kg CO2

Eating to meet requirements

- Excess Energy In = Excess Carbon Out
- Excess Energy In = Excess Body Weight
- Eating beyond out estimated energy requirements can be considered a form of food waste that contributes not only to climate changed but also to public health issues such as obesity
- Those consuming beyond their ER generate
  - 25% more emissions = 1.5kg CO2 per day
  - 500kcals per day = 14kg weight gain per year (McCarthy, 2018)

Reduce Food Waste

FAO
Global Food Data
2015

every year around the globe

1.3 BILLION TONNES OF

FOOD

is

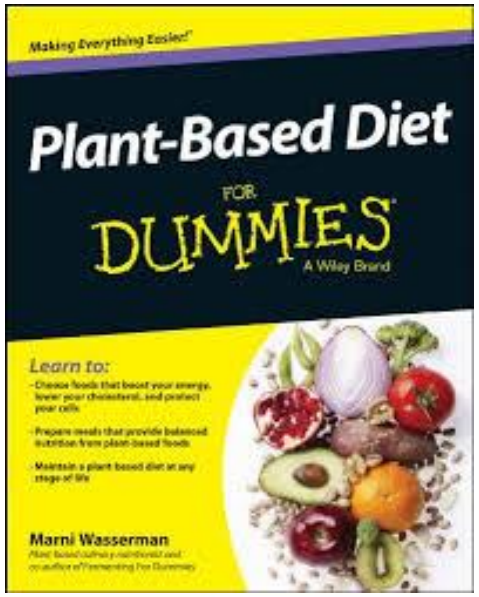
lost or **wasted**

that is

1/3 OF ALL FOOD PRODUCED FOR HUMAN CONSUMPTION

Developing REALISTIC AND ATTAINABLE strategies for increased sustainability

- Adopt plant-based diet
  - Will result in a lower diet related CO2 footprint



- Send men to MARS
  - Will decrease CO2 by more than 50%
  - Will immediately cease population growth
  - Learn to live sustainably

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Further reading and references

- JJ Hyland, MB McCarthy, M Henchion, SN McCarthy (2017). Dietary emissions patterns and their effect on the overall climatic impact of food consumption. *International Journal of Food Science & Technology* 52 (12), 2505-2512
- JJ Hyland, M Henchion, M McCarthy, SN McCarthy (2017) The role of meat in strategies to achieve a sustainable diet lower in greenhouse gas emissions: A review. *Meat science* 132, 189-195
- JJ Hyland, M Henchion, M McCarthy, SN McCarthy (2017) The climatic impact of food consumption in a representative sample of Irish adults and implications for food and nutrition policy*. Public Health Nutrition* 20 (4), 726-738

- Summary documents from the above research can be downloaded at the following: https://www.teagasc.ie/media/website/publications/2016/TResearch-Autumn-'16-Digital.pdf
- https://www.teagasc.ie/media/website/publications/2018/TResearch_Winter_2018_p38-39-EnergyInCarbonOut.pdf

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FOOD DEVELOPMENT SERVICES

Sensory Food Network Ireland
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Sensory Food Network Ireland and food@LIT are delighted to host two half-day sensory workshops

Monday 11th March, Limerick Institute of Technology

Workshop 1: Introduction to Sensory Evaluation

Workshop 2: Sensory Evaluation in Food Quality Control & Benchmarking