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Valorisation of agri/food wastes as animal feed

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The Big Issues with Livestock

- Global demand for animal products is increasing
- People want nutritious, healthy, safe, affordable products
- Competition for land to grow animal feed or human food
- Pressure on the environment (Greenhouse gases, N, P)
- We need more efficient use of resources

Aim: To Increase Production Efficiency whilst Reducing Environmental Impact

Resource Use

- World Agricultural Land Utilisation
  36% crops, 37% grass & forage, 35% rough grazing
- One third of grain harvest is fed to animals, mainly pigs and poultry
- Pigs & poultry compete with humans for wheat, maize and soya
- Ruminants can use by-products that are inedible for humans
  Sugar beet pulp, distillers grains, straw, wheatfeed, soyameal

	Efficiency (%)			
	Total		Human Edible	
	Energy	Protein	Energy	Protein
Pigs & Poultry	15-28	20-30	26-43	30-40
Beef & Lamb	2-10	3-10	21-43	30-60
Milk	24	20	237	164

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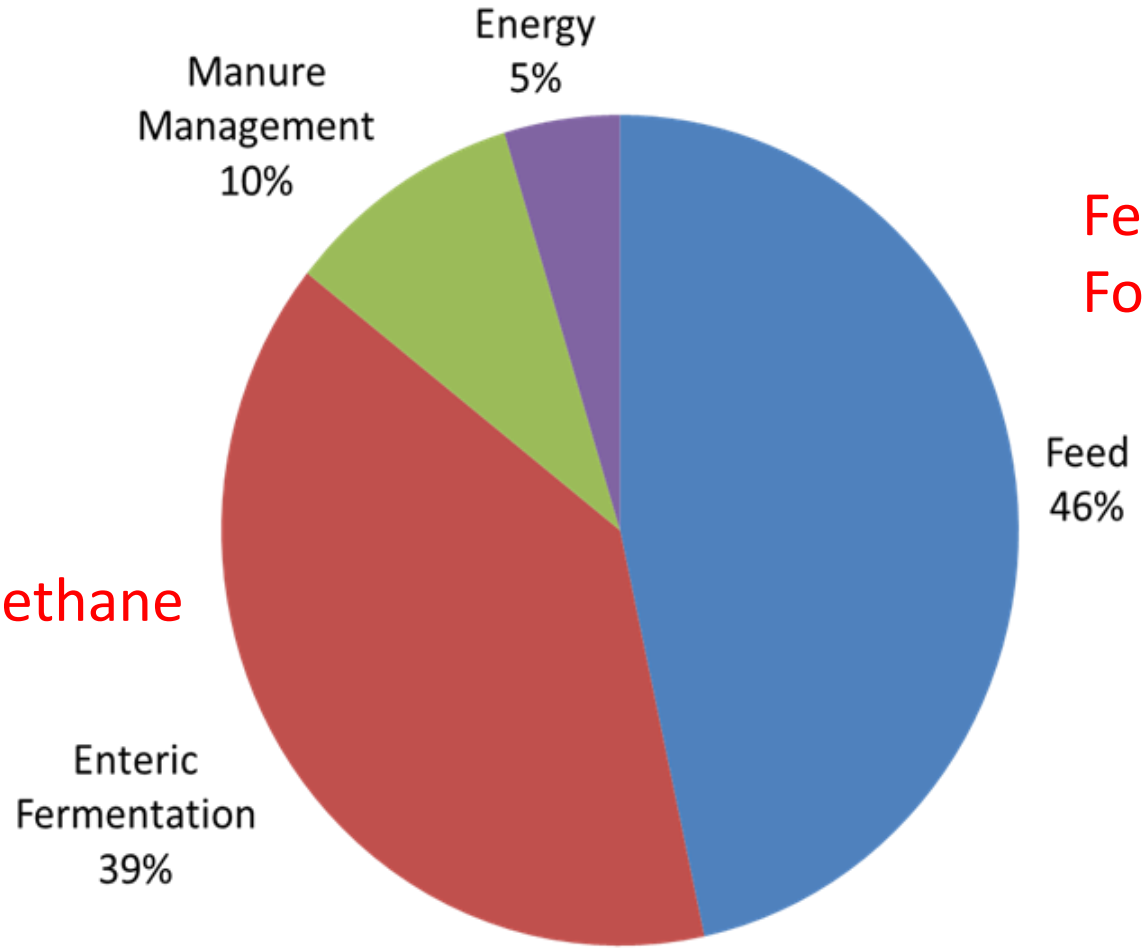
Dairy GHG emissions



Feed Carbon Footprint

Rumen Methane

Terminology is important

- Food (human) v Feed (Animal)
- Product v waste
  - Barley → Animal feed (product)
  - Barley → Beer + spent grains (waste)
- Disposal of waste needs a licence
- By-product
  - Barley → Beer + brewers grains (by-product)
- Co-product
  - Barley → Beer + brewers grains (co-product)
- Co-products are all produced with due diligence and quality control

Example co-products - 1

- Bakery
  - Bread, biscuits, cake, breakfast cereals – surplus, trimmings, outside QC or shelf life
- Oil
  - Soya meal, rape meal, soya hulls, palm kernel
- Sugar
  - Sugar beet pulp, molasses
- Drinks (e.g. cider, apple, orange)
  - Apple pomace, citrus pulp
- Potato (e.g. chips, crisps, shapes)
  - Peel, trimmings, product <QC, starch

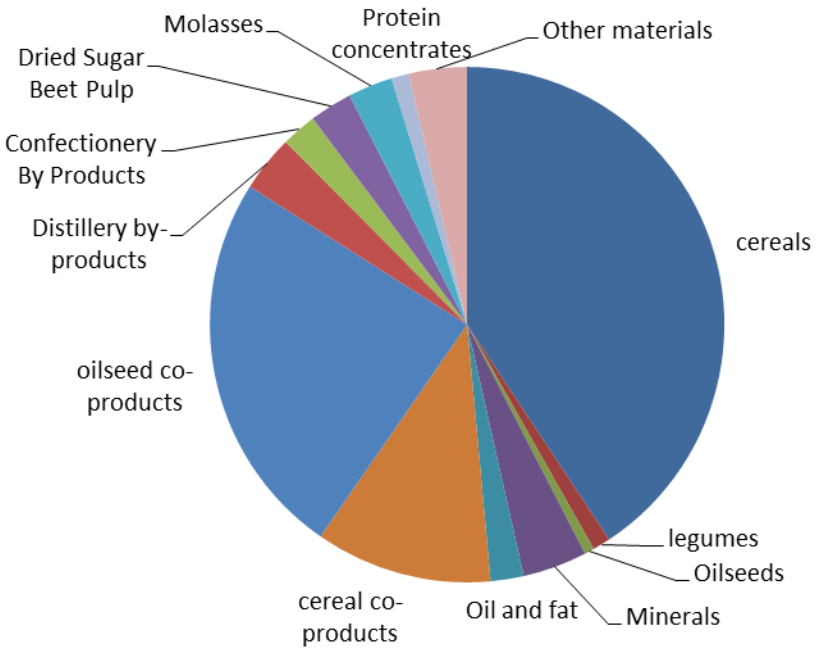
Example co-products - 2

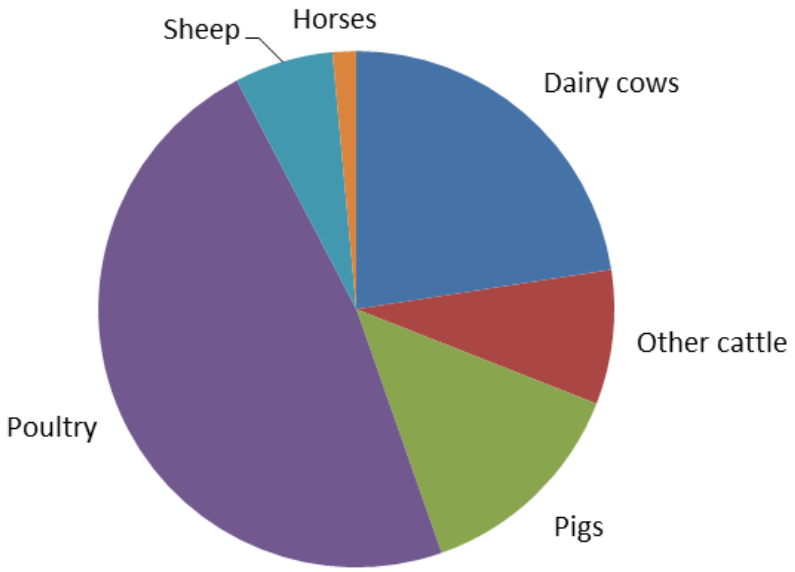
- Brewing
  - Brewers grains, yeast
- Distilling
  - Distillers grains, pot ale syrup, Distillers dried grains with solubles (DDGS), yeast
- Wheat fractionation (for starch)
  - Wheatfeed, gluten, syrup, starch, ‘grains’
- Dairy
  - Whey (powder, liquid, concentrate, permeate, delactosed), skim-milk, yoghurt, ice cream

Example ‘products’

- Cereals
  - Feed wheat, barley, oats
  - Grown for food, surplus, or does not meet QC
- Fruit & vegetables
  - Supermarket rejects – surplus, wrong size, wrong shape
- Catering/kitchen waste - banned

Raw materials in manufactured feeds





Defra stats 2010-2017

- 50% products, 50% co-products
- Cereals and soya meal main ingredients
- Poultry, pigs, dairy cows main species

Feed evaluation

- Moisture content (liquid, dried, moist)
- Protein content & quality
  - Amino acid balance, digestibility, rumen degradability
- Energy content
  - Digestible or metabolisable energy
- Fibre content
  - NDF, lignin, digestibility
- Starch & oil content
- Anti-nutritional factors

Increasing value

- Heat treatment
  - Lower moisture for transport, handling & storage
  - Improve digestibility
  - Denature anti-nutritional factors
  - Reduce rumen degradability
  - Too much heat denatures protein
- Enzymes
  - Aid starch digestion
  - Break down fibre
  - Release P from phytate
- Blending
  - Mixture can be better than separate ingredients

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ENBBIO DDGS Consortium

LINK
COLLABORATIVE RESEARCH

- DDGS from Bioethanol
- Metabolism and digestion
- Rumen degradability
- Methane emissions
- Dairy & Beef Performance

Example studies - Ruminants

- Enzyme treatment of Traffordgold
  - In vitro gas production
  - In vivo digestibility &metabolisable energy in sheep
- Chemical treatment of rapeseed meal
  - Rumen degradation characteristics
  - Dairy cow performance trial

Example studies – Non-ruminants

- Enzyme treatments
  - Phytase in pig and poultry diets
  - Xylanase in pig and poultry diets
- Starch structure of wheat
  - Hard v soft, genetic modification, +/- enzymes
- Extrusion of diets
  - Temperature, pressure, moisture effects
- Rapeseed oil extraction
  - Ileal digestibility of amino acids

Conclusions

- Co-products are widely used as animal feed ingredients
- Co-products are NOT waste materials
- Nutritive value needs to be evaluated to optimise use in diets
- Processing and treatment of co-products can increase their value
- Using co-products reduces competition for land to grow food and is more sustainable