

Life cycle assessment of the global food consumption

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Goal and scope

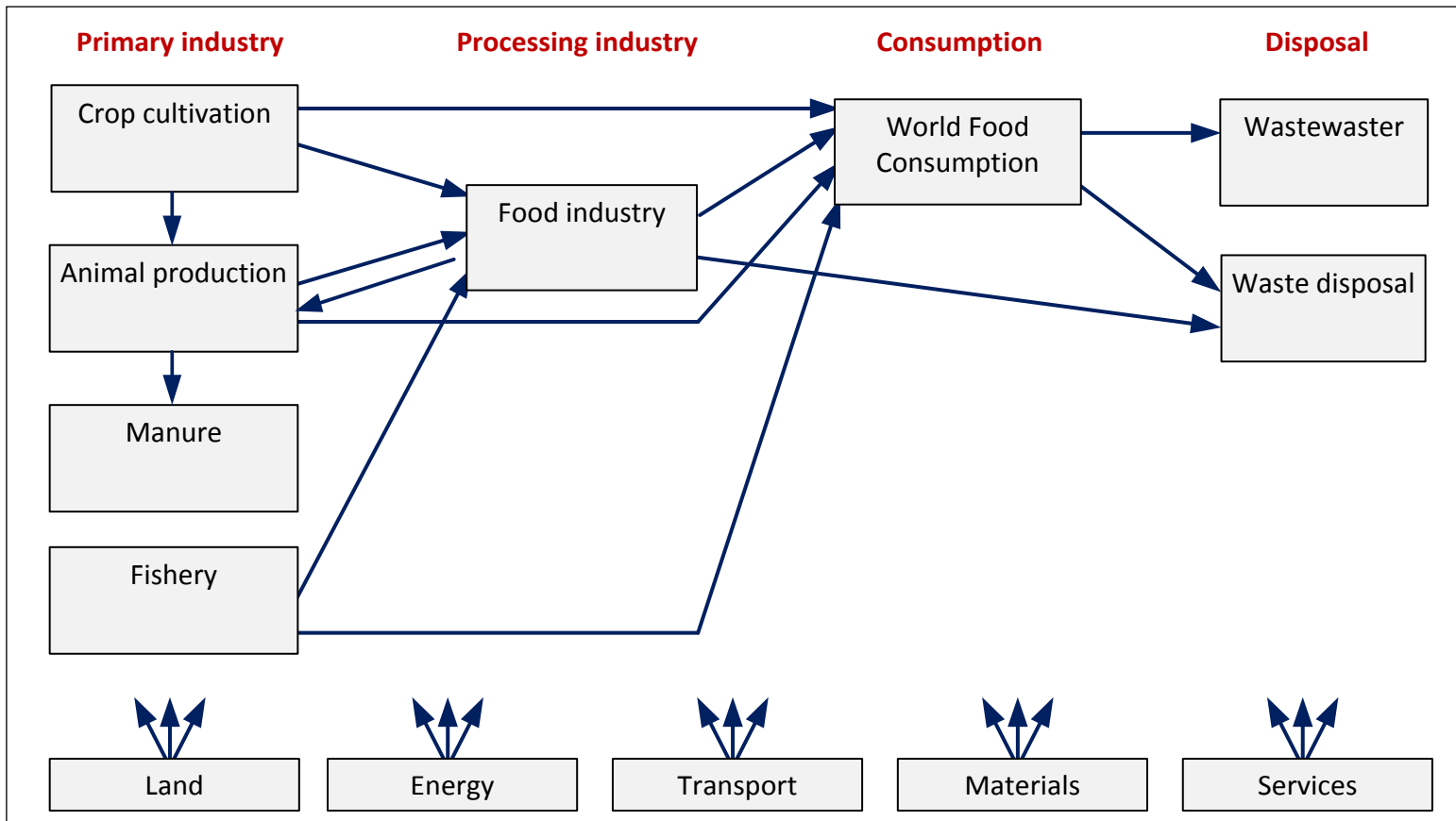
- **Purpose:** Detailed and complete info on global food consumption:
 - Mass flow analysis
 - GHG emissions
 - Contribution analysis
- **Application areas**
 - Basis for 'basket of products' indicator
 - Identification of improvements
 - Good starting point for **global LCAfood database**
- **Functional unit:** the world's consumption of food in 2007
- **Interpretation:** Decision context
 - The size of functional unit does not reflect decision context.
 - Results are representative for "small" changes, in food consumption.
- **Data:** Based on global hybrid IO database for 2007.
- **Land use change:** Indirect land use changes (iLUC) included.

Database

-  exiobase_{v2} (preliminary version)
- Multi-regional hybrid IO database
- Year 2007
- 43 countries + 5 rest-of-world regions
- 160 products/industries
- Based on integration of:
 - Monetary input-output tables
 - Mass flow analysis
 - Energy accounts
 - Process LCA (hybridisation and detailing)
- Model for indirect land use changes (iLUC) integrated

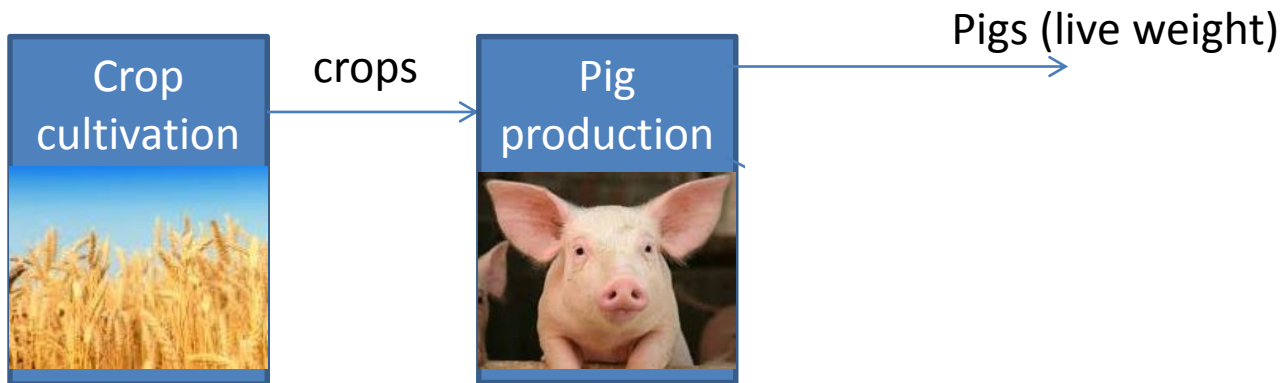
System boundaries

- No cut-off
- Each activity: mass balance
- System boundary



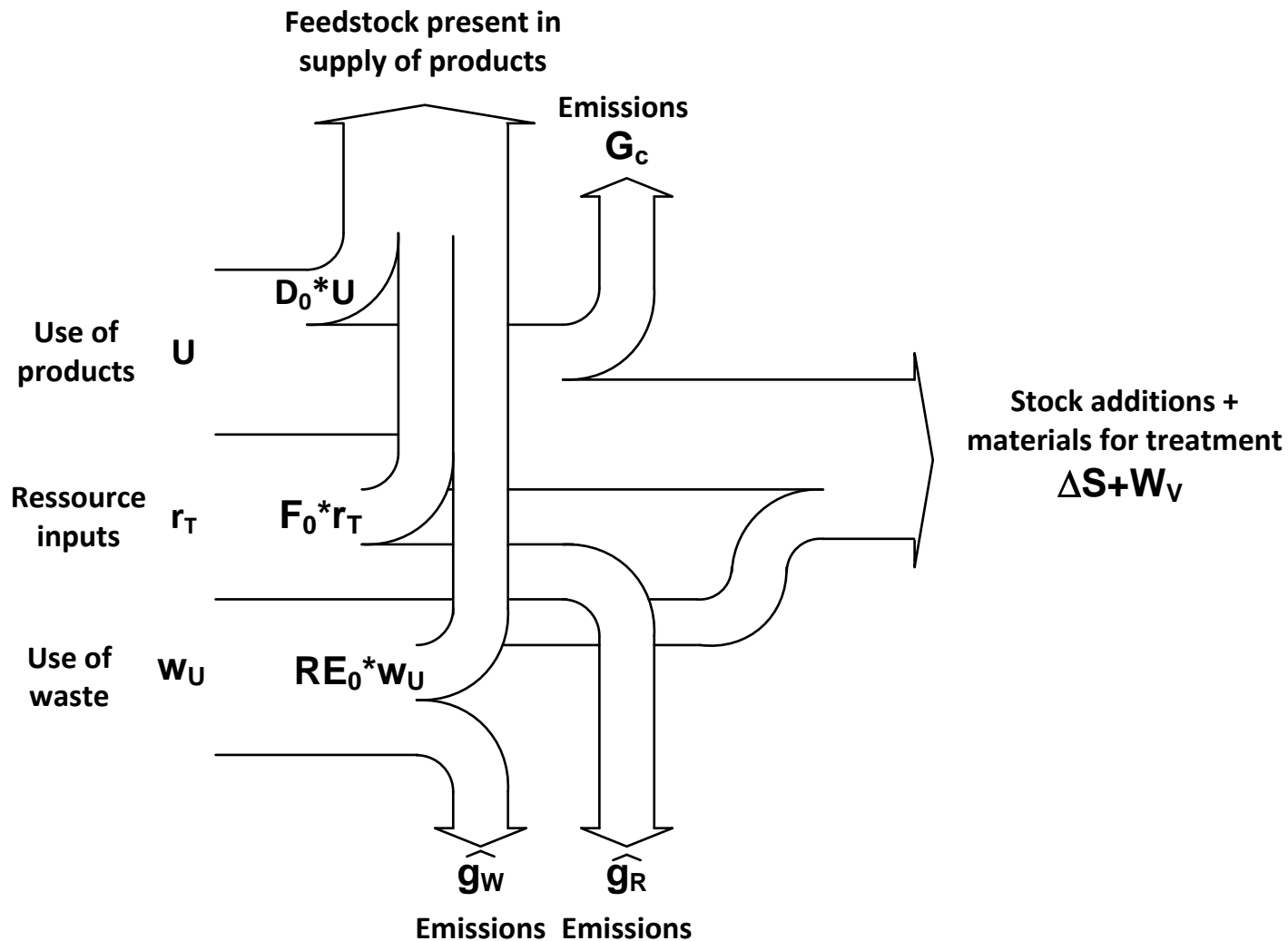
Co-product modelling

- Mainly relevant for waste treatment AND meat/milk systems
- Substitution
 - ISO 14044
 - Allocation operates with impossible activities
 - Allocation alters mass balances => not an option



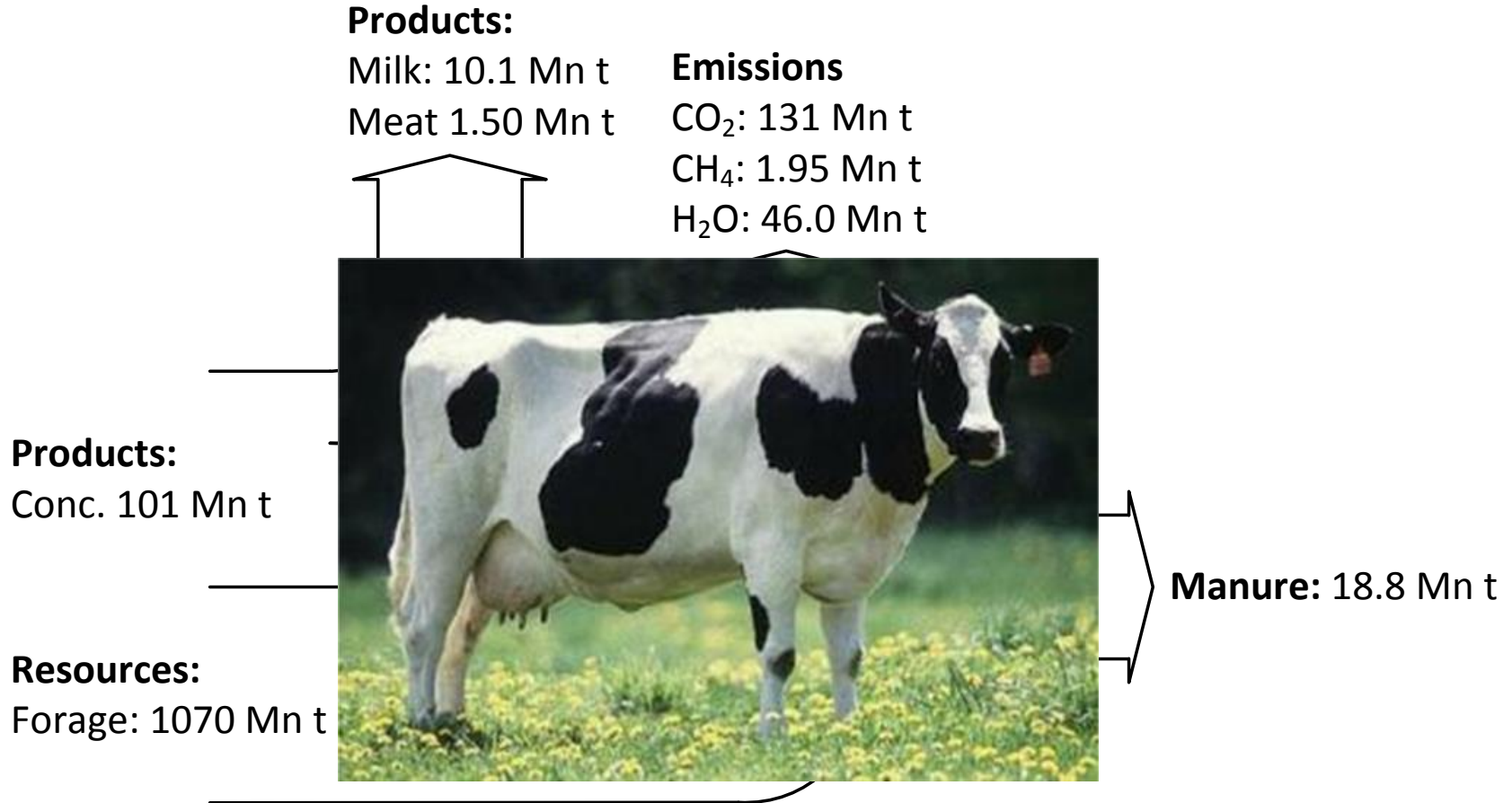
Mass balance method

- For each industry and each material input to this industry

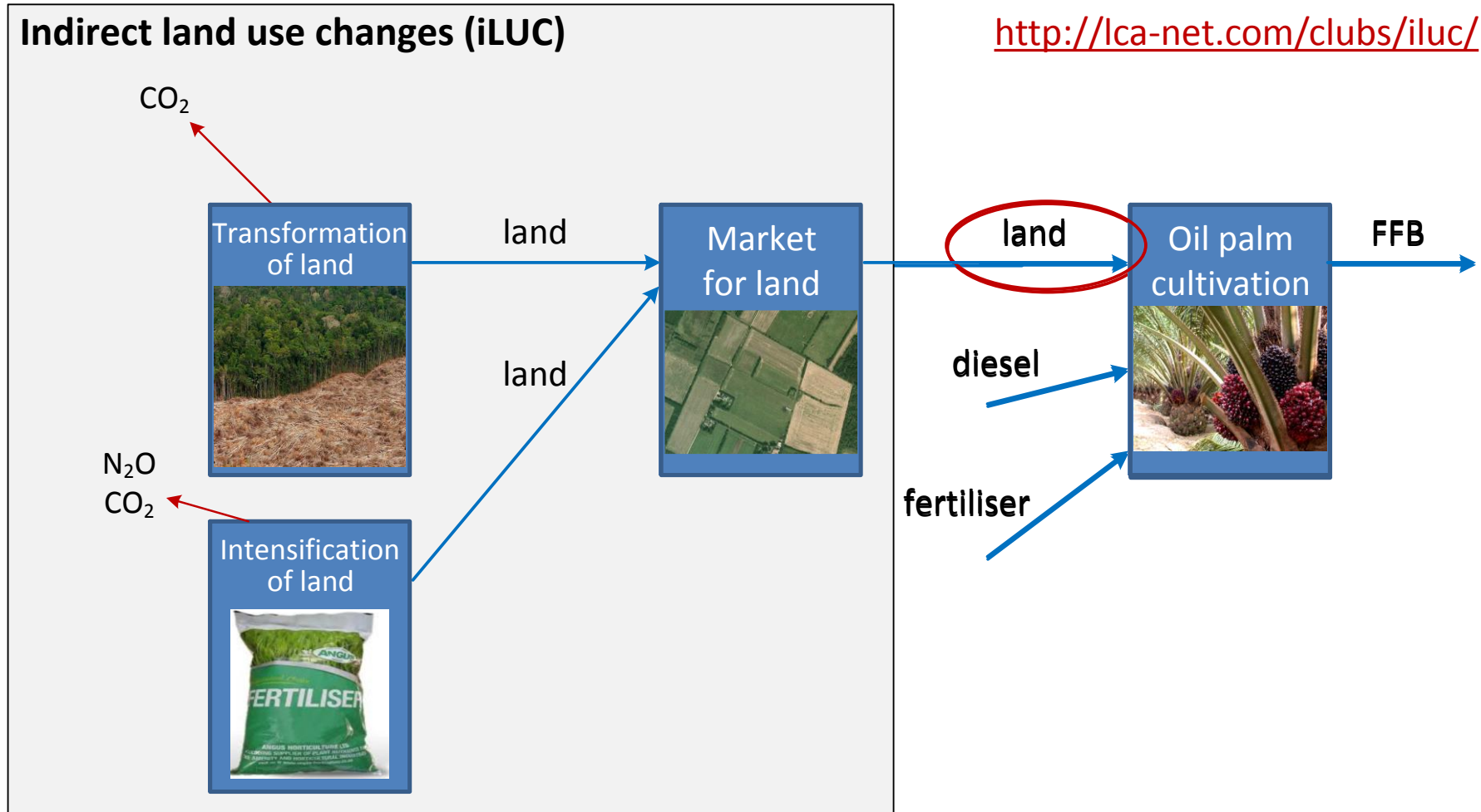


Mass balance method - example

- Global milk system (million t dry matter)



Model for indirect land use changes (iLUC)



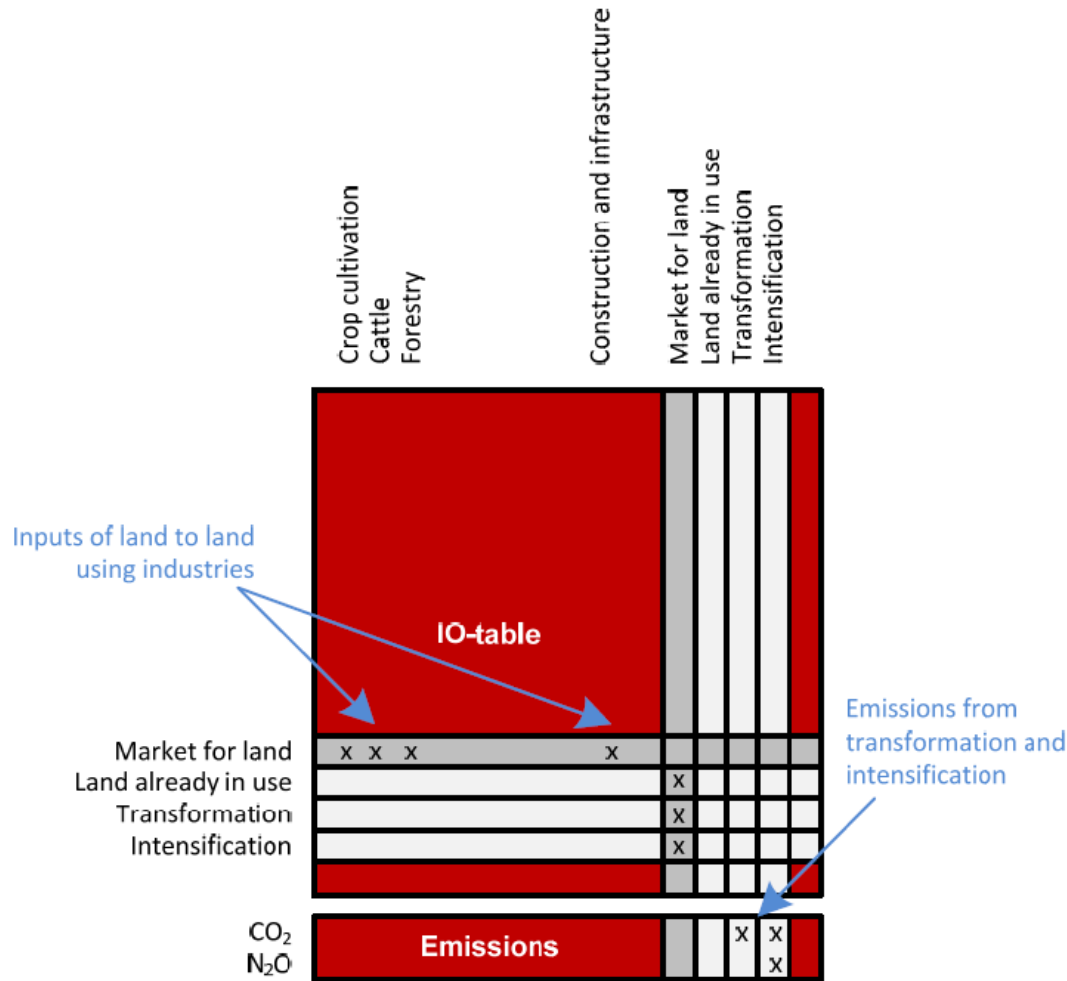
Schmidt JH, Weidema BP, Brandão M (2014, in review) Modelling Indirect Land-Use Changes in Life Cycle Assessment. Submitted to Journal of Cleaner Production.

Schmidt JH, Muñoz I (2014) The carbon footprint of Danish production and consumption – Literature review and model calculations.

Danish Energy Agency, Copenhagen. Accessed April 2014: http://www.ens.dk/sites/ens.dk/files/klima-co2/klimaplan-2012/VidenOmKlima/_dk_carbon_footprint_20140305final.pdf

Model for indirect land use changes (iLUC)

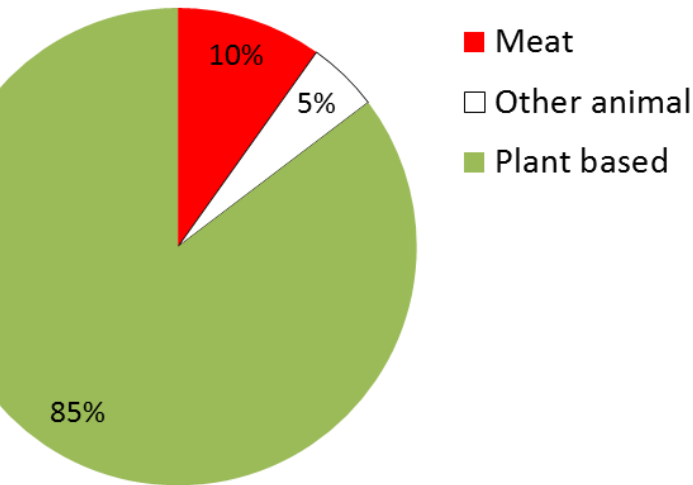
- Embedding in IO-model



Schmidt JH, Muñoz I (2014) The carbon footprint of Danish production and consumption – Literature review and model calculations. Danish Energy Agency, Copenhagen. Accessed April 2014: http://www.ens.dk/sites/ens.dk/files/klima-co2/klimaplan-2012/VidenOmKlima/_dk_carbon_footprint_20140305final.pdf

Reference flow

World's food consumption 2007

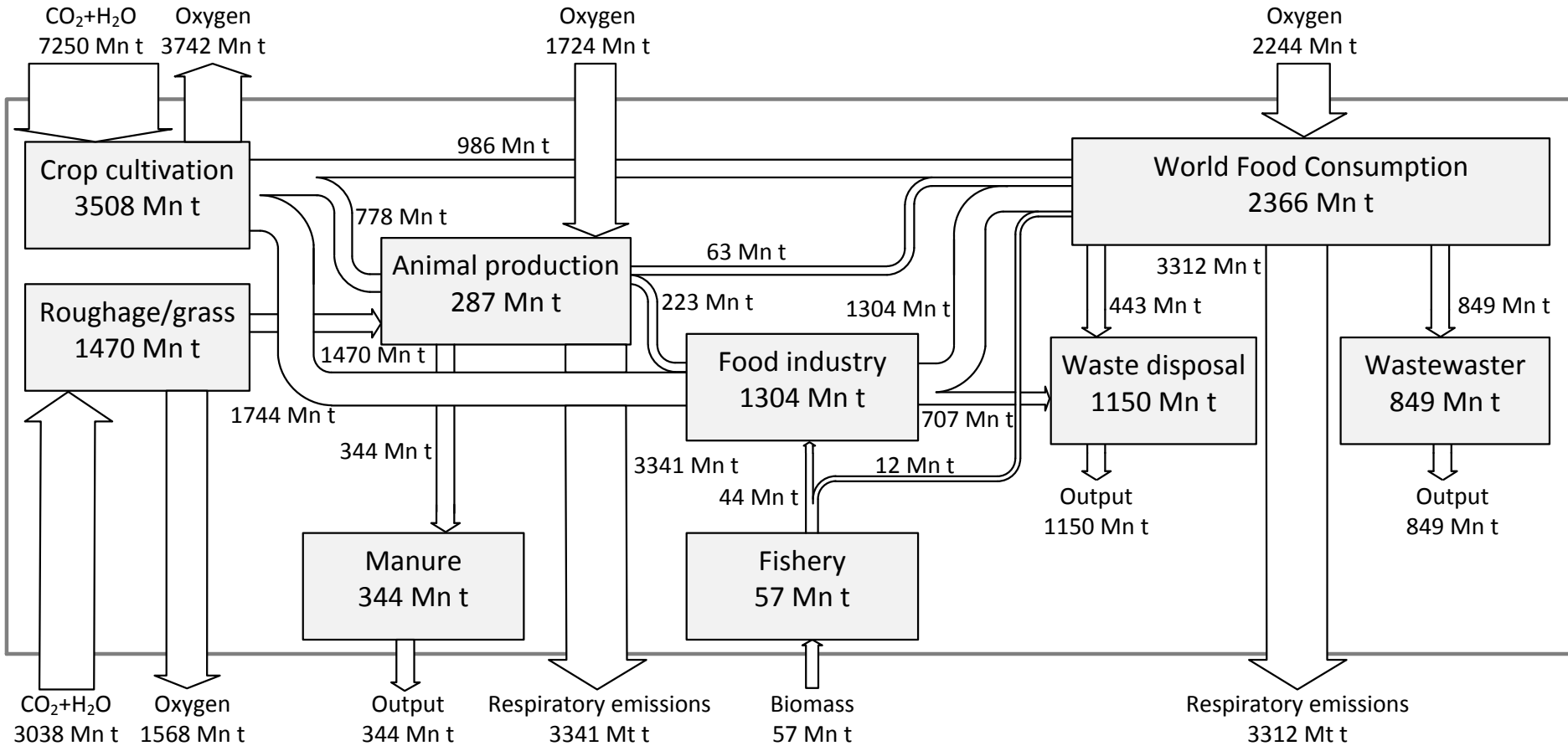


Unit: million tonne dry matter

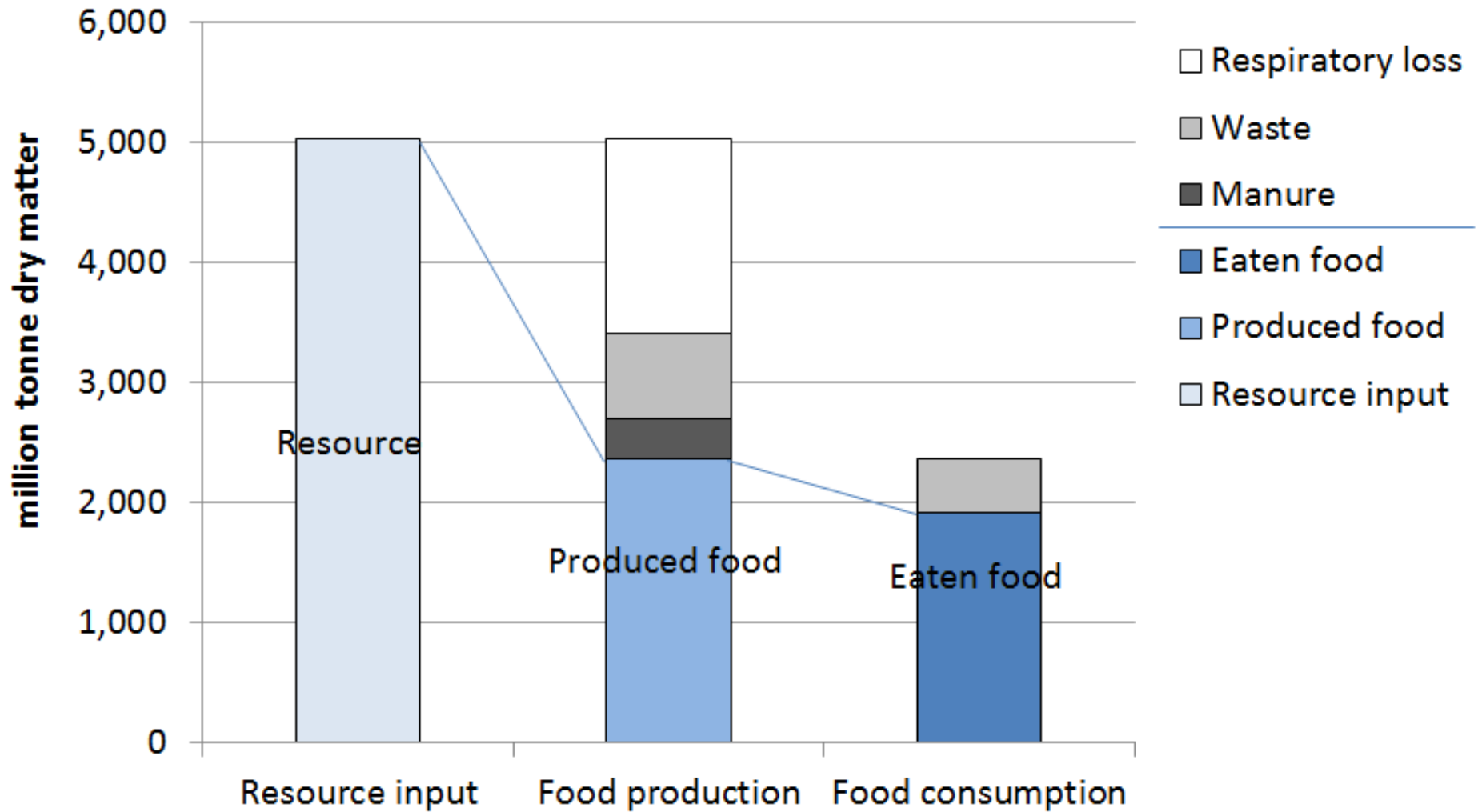
Food item	Total	Kg dry matter per capita	Moisture content
Crops			
Paddy rice	85	13	15%
Wheat	104	16	14%
Cereal grains, other	80	12	15%
Vegetables, fruit	474	71	82%
Oil crops	60	9	9%
Sugar cane/beet	115	17	75%
Crops, other	69	10	79%
Animals			
Cattle, beef	0.5	0	53%
Cattle, raw milk	7	1	88%
Pigs	11	2	55%
Poultry	22	3	70%
Meat animals, other	3	0	57%
Animal products, other (e.g. egg)	20	3	26%
Fish	12	2	80%
Processed food			
Meat, cattle	31	5	61%
Meat, pigs	71	11	41%
Meat, Poultry	38	6	75%
Meat, other	10	1	35%
Vegetable oils	71	11	0%
Dairy products	87	13	46%
Rice, processed	123	18	15%
Sugar	234	35	1%
Food, other	536	80	33%
Beverages	68	10	90%
Fish products	35	5	80%
Total			
Total	2,366	355	43%

Results: Mass flow analysis

Unit: million tonne dry matter

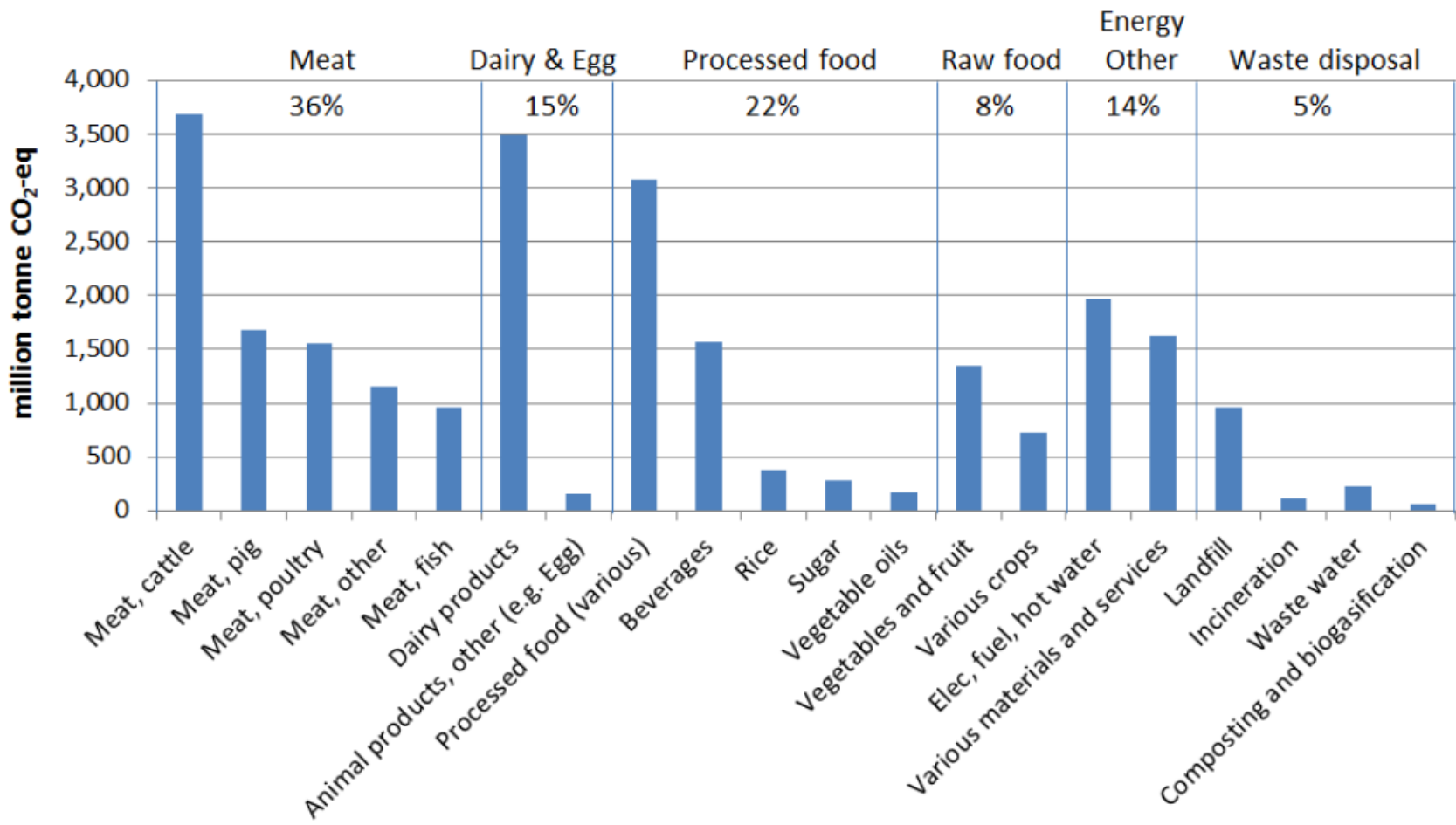


Results: Food waste



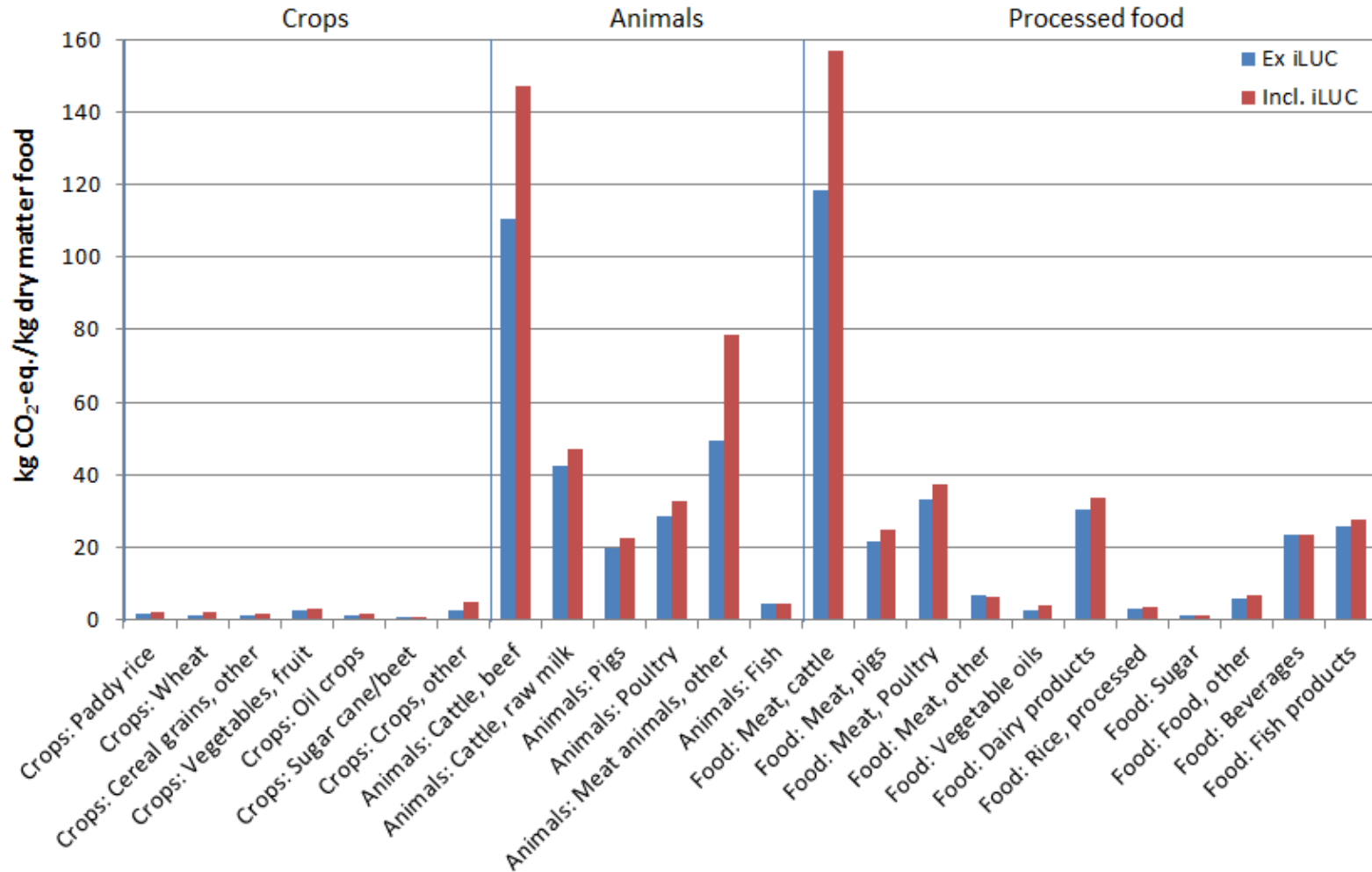
Results (excluding iLUC)

- **GHG emissions:** 25,370 million tonne CO₂-eq.
- **Land use:** 4900 million ha.
- **Contribution analysis:** direct inputs to the food consuming activities.



Results: GHG emissions (including iLUC)

- Total: 25,370 => 29,450 million tonne CO₂-eq.
- GHG-emissions per kg dry matter product (cradle-to-gate).



Conclusion: Global food consumption

Mass flow analysis

- Of total extracted plant material at ~5000 Mn t
 - Only 48% becomes food
 - Only 39% is being eaten
- 45% of extracted plant material was used as animal feed
- High losses as animal respiratory emissions

GHG emissions

- Food consumption accounts for 3.8 t CO₂-eq. per capita (excl. iLUC)
- iLUC adds 16%

Integrated LCA/MFA/IO models

- Useful for national/regional analysis of consumption groups AND detailed LCA
- Good starting point for consistent, complete and detailed **LCAfood database**