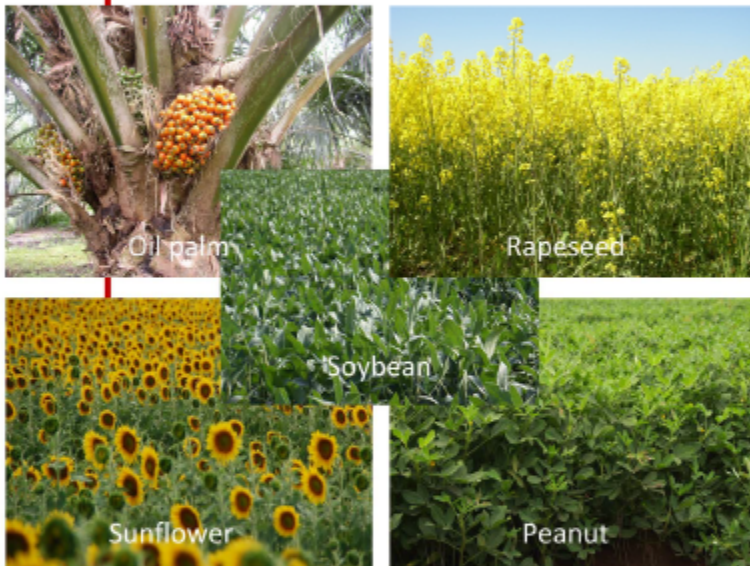


Study on the "Relative Sustainability of Vegetable Oils"

- LCA of five different vegetable oils



RSPO
Roundtable on Sustainable Palm Oil

Five Edible Oils - a comparison

Jannick H Schmidt

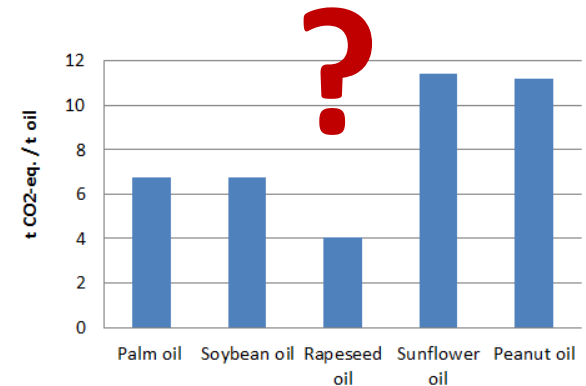
Medan 12th November 2013

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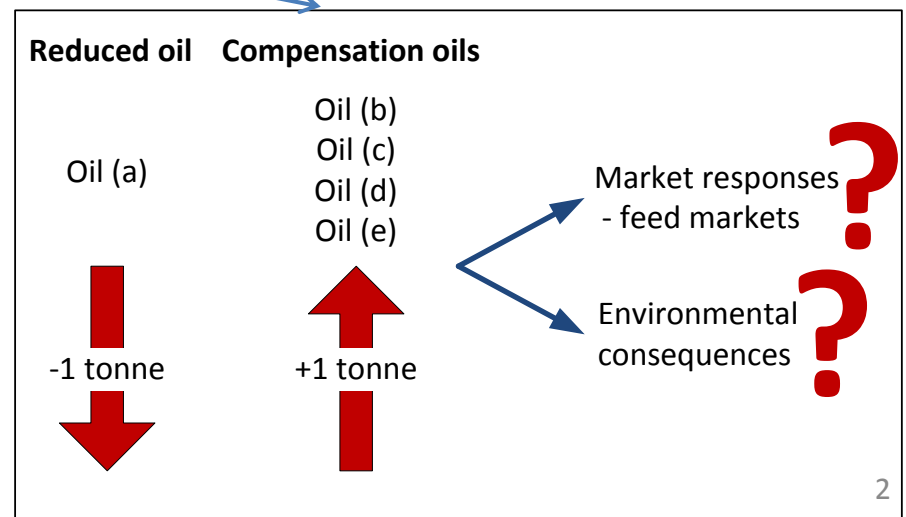


Background

- Life cycle assessment (LCA)
- Commissioned by RSPO
- ISO 14040 and 14044
- Purpose
 1. environmental information on five oils,
 2. taking out different vegetable oils: market responses and environmental consequences



- Oils:
 - Palm oil
 - Soybean oil
 - Rapeseed oil
 - Sunflower oil
 - Peanut oil



Methods and data

■ Functional units

1. Comparing oils: 1 t refined oil (NBD oil*)
2. Reducing & compensating oil: 1 t reduced & 1 t increased refined oil (NBD oil*)

■ Impacts

- **GHG-emissions** (GWP₁₀₀, measured in t CO₂-eq.)
- **Biodiversity** (land occupation, measured in ha yr)
- **Water** (blue water weighted by Water Stress Index, measured in m³ blue water eq.)

■ Market responses and comparability => next slides

■ Indirect land use changes (iLUC) => next slides

Market responses and comparability (1 of 3)

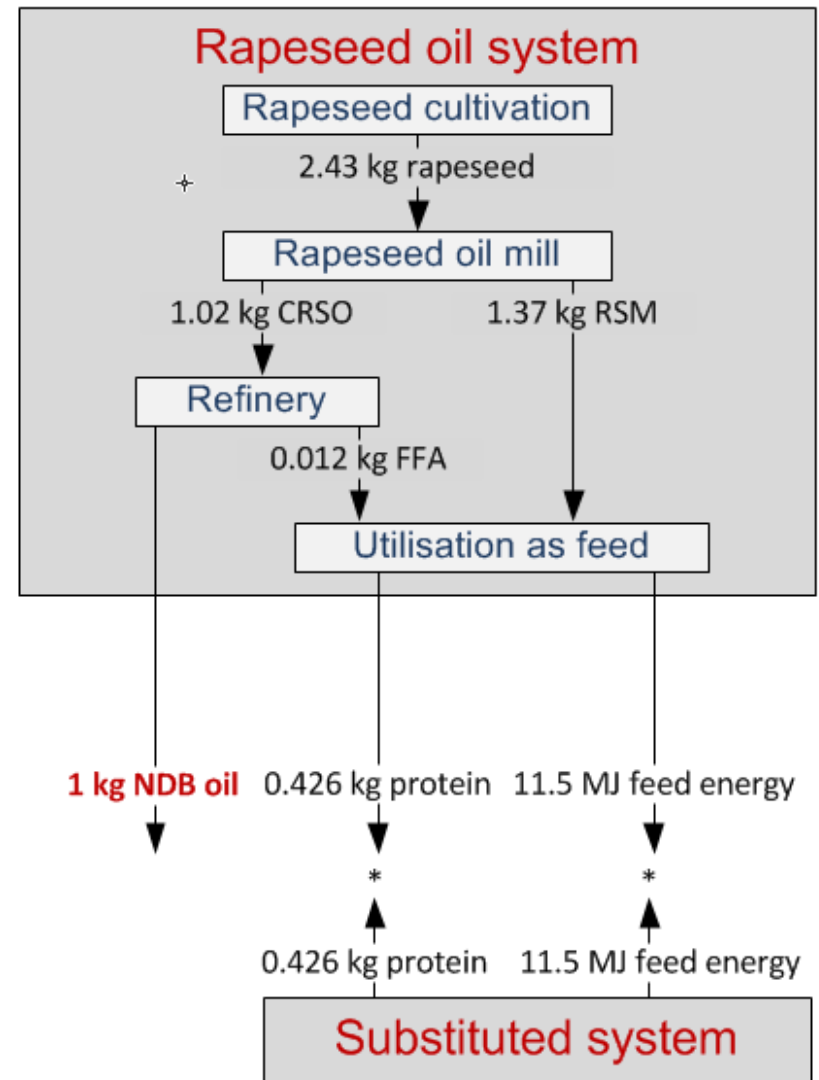
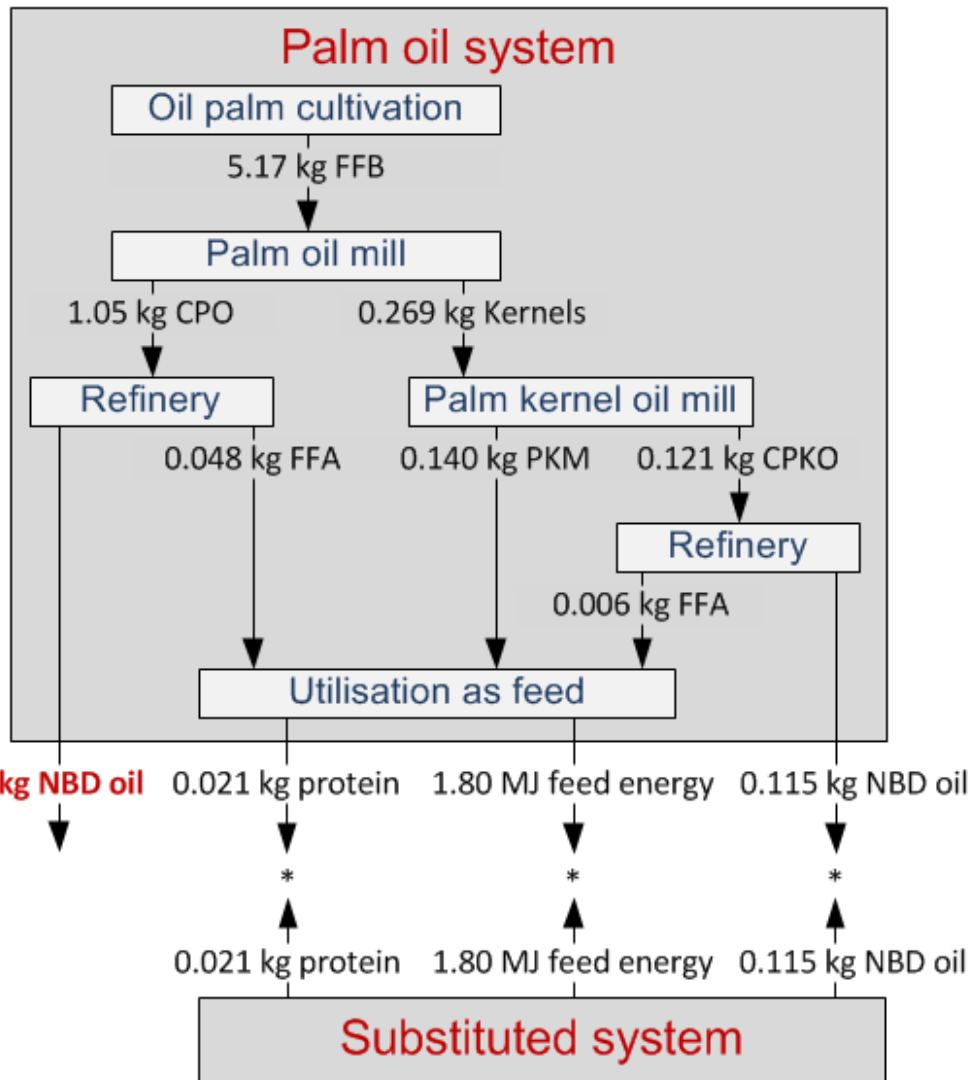
- **Market responses**

- Oil system's by-products => animal feed (oil meals)
- Changes in vegetable oils will have effects on feed markets (protein and energy feeds)

- **Comparability of oil systems**

- Different oils come with different amounts of feed co-products
- Therefore equivalence of compared systems must be ensured

Market responses and comparability (2 of 3)

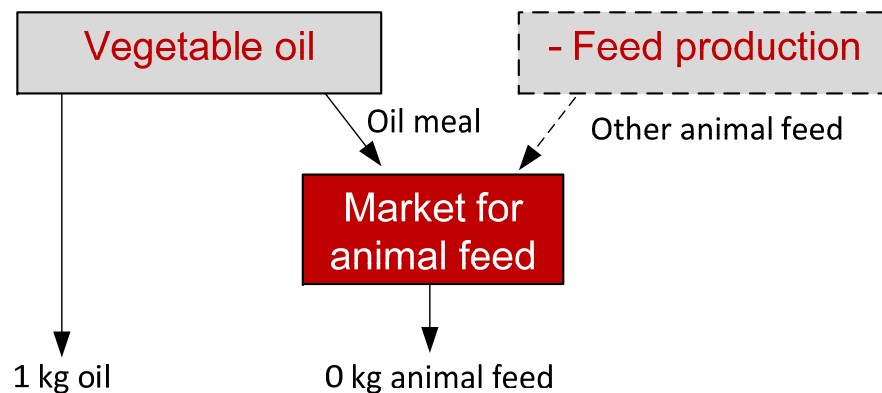


Market responses and comparability (3 of 3)

- By-products; two cases

Most common case case:

- Palm oil
- Rapeseed oil
- Sunflower oil
- Peanut oil

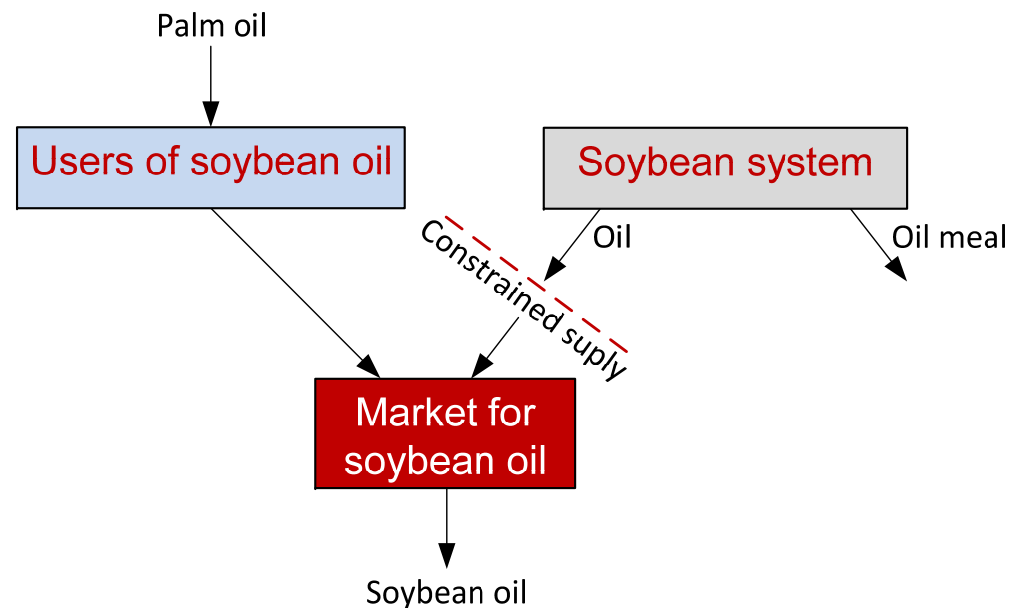


Demand for oils

=> effect = oil minus feed

Special case:

- Soybean oil



Demand for soybean oil

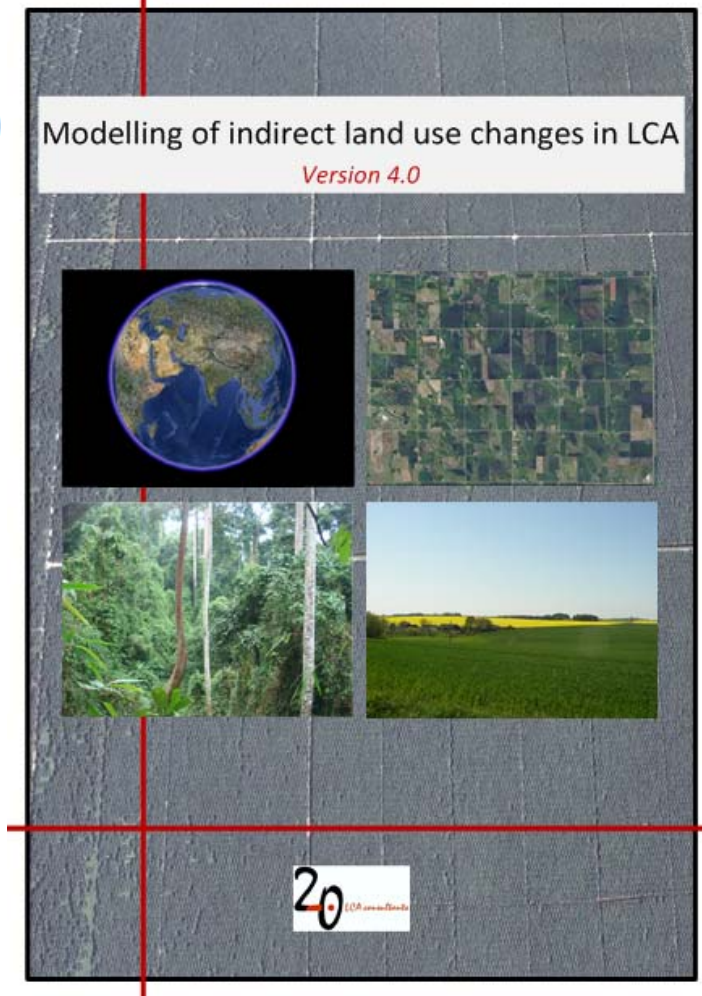
=> effect equal to palm oil

Indirect land use changes

- Novel model used
- The **iLUC – initiative** (since 2010)
 - Aalborg University, Department of Planning and Development, AAU (plan.aau.dk)
 - Arla Foods (arla.com)
 - Concito (concito.dk)
 - CSIRO (csiro.au)
 - DuPont Nutrition and Health (dupont.com)
 - DONG Energy (dong.dk)
 - ecoinvent (ecoinvent.org)
 - National Agricultural Research Center, Japan (naro.affrc.go.jp)
 - Niras (niras.dk)
 - Round Table on Sustainable Palm Oil, RSPO (rspo.org)
 - Sustainability Consortium (sustainabilityconsortium.org)
 - Swedish University of Agriculture Sciences, SLU (slu.se)
 - TetraPak (tetrapak.com)
 - Unilever (unilever.com)
 - United Plantations Berhad (unitedplantations.com)
 - University of Copenhagen, The Faculty of Life Sciences, LIFE (life.ku.dk)

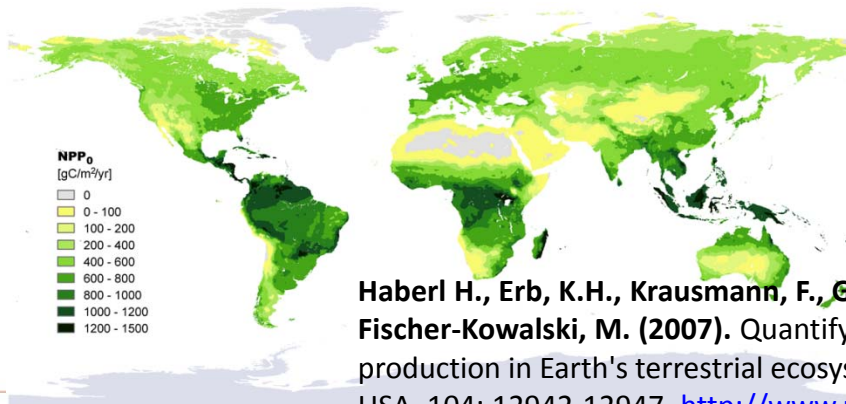
More info at:

www.lca-net.com/projects/iluc_model/



Indirect land use changes

- 10% of global CO₂ from LUC
- Driver => demand for land
- 'Land' is a global asset
- Cultivation requires capital inputs (assets)
 - Tractor, Machinery
 - ... and land
- How is 'land' produced? => Land transformation & intensification
- iLUC is caused by the use of productive land:
 - Productivity of land
 - 0.6 hectare year in Malaysia/Indonesia = 1 hectare year in Europe

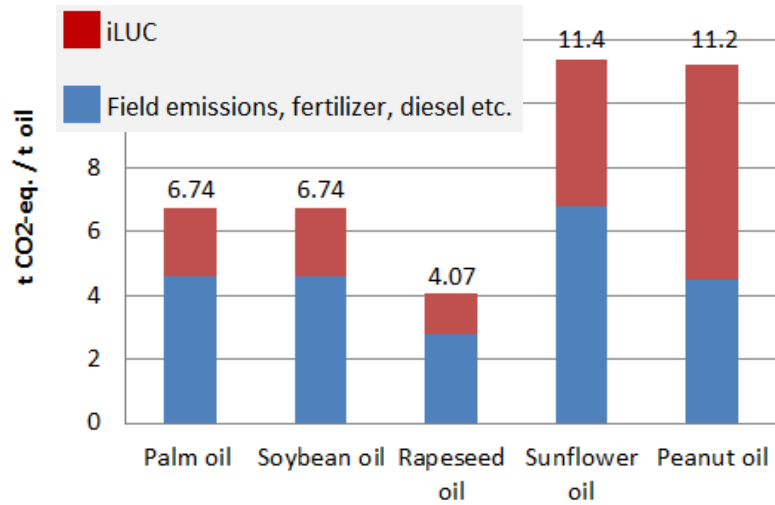


Haberl H., Erb, K.H., Krausmann, F., Gaube, V., Bondeau, A., Plutzer, C., Gingrich, S., Lucht, W., Fischer-Kowalski, M. (2007). Quantifying and mapping the global human appropriation of net primary production in Earth's terrestrial ecosystem. Proceedings of the National Academy of Sciences of the USA. 104: 12942-12947. <http://www.uni-klu.ac.at/socec/inhalt/1191.htm>

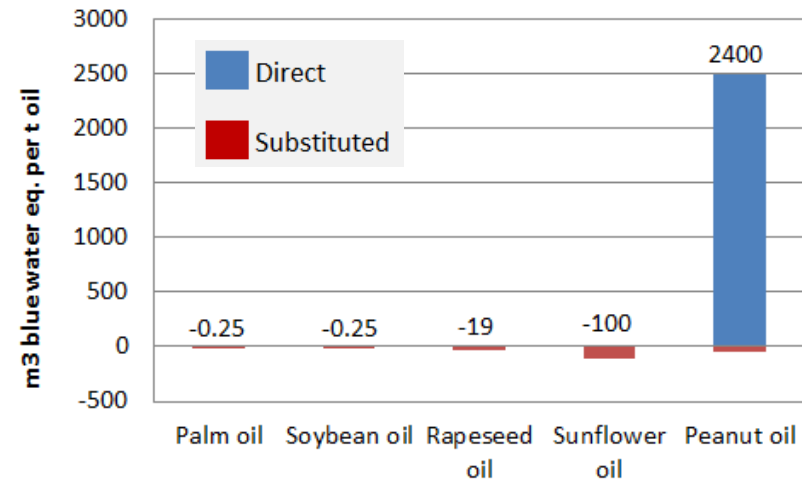
Results

- Impacts per tonne of oil

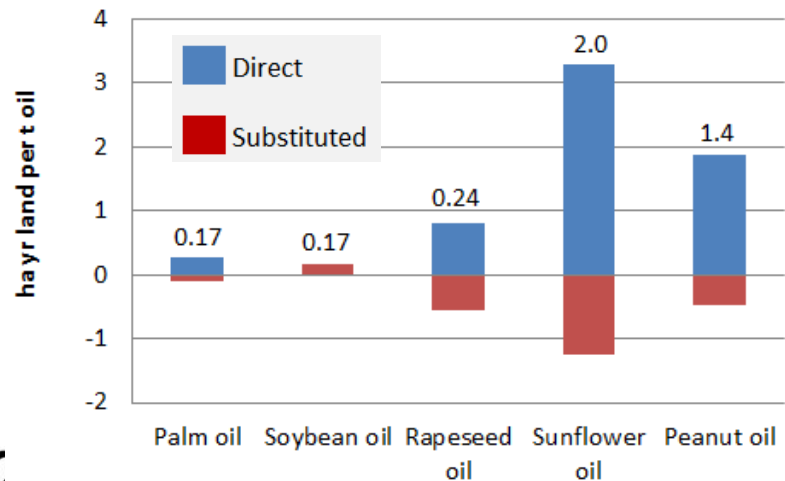
GHG-emissions (t CO₂-eq.)



Water stress index (m³ blue water eq.)



Land use (ha yr)



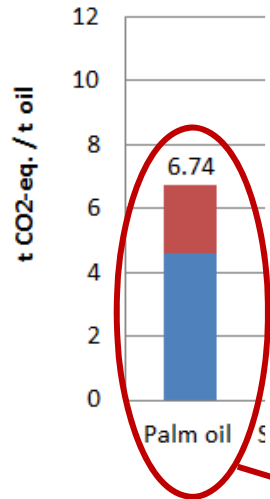
best —
 1
 Ranking
 2
 3
 worst



Results

- What is behind the numbers?

GHG-emissions (t CO₂-eq.)

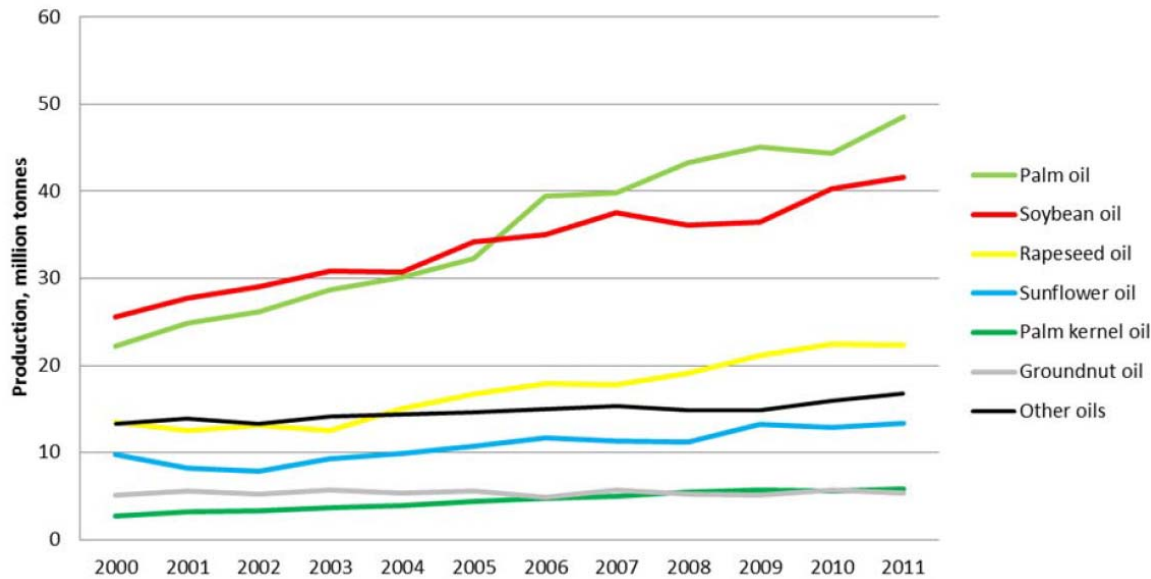


Palm oil	kg CO ₂ -eq	Total
Palm cultivation		
Field emission (N ₂ O)	0.58	
Peat emissions (CO ₂ and N ₂ O)	2.4	
iLUC oil palm	2.5	
Fertiliser	0.19	
Energy/other	0.052	5.8
Palm oil mill		
POME emissions (CH ₄)	1.0	
By-product: utilisation of kernels for oil and meal		
Barley and soybean meal excl. iLUC	-0.015	
iLUC barley	-0.11	
iLUC soybean	-0.085	
By-product: utilisation of POME as fertiliser	-0.014	
By-product: utilisation of EFB as fertiliser	-0.0075	
Energy/transport/other	0.25	1.0
Palm oil refinery		
Energy/transport/other	0.12	
By-product: utilisation of free fatty acids as animal feed		
Barley and soybean meal excl. iLUC	-0.056	
iLUC barley	-0.24	
iLUC soybean	0.089	-0.079
Total		6.74

Results

- Reducing and compensating scenarios

Worlds production of major vegetable oils

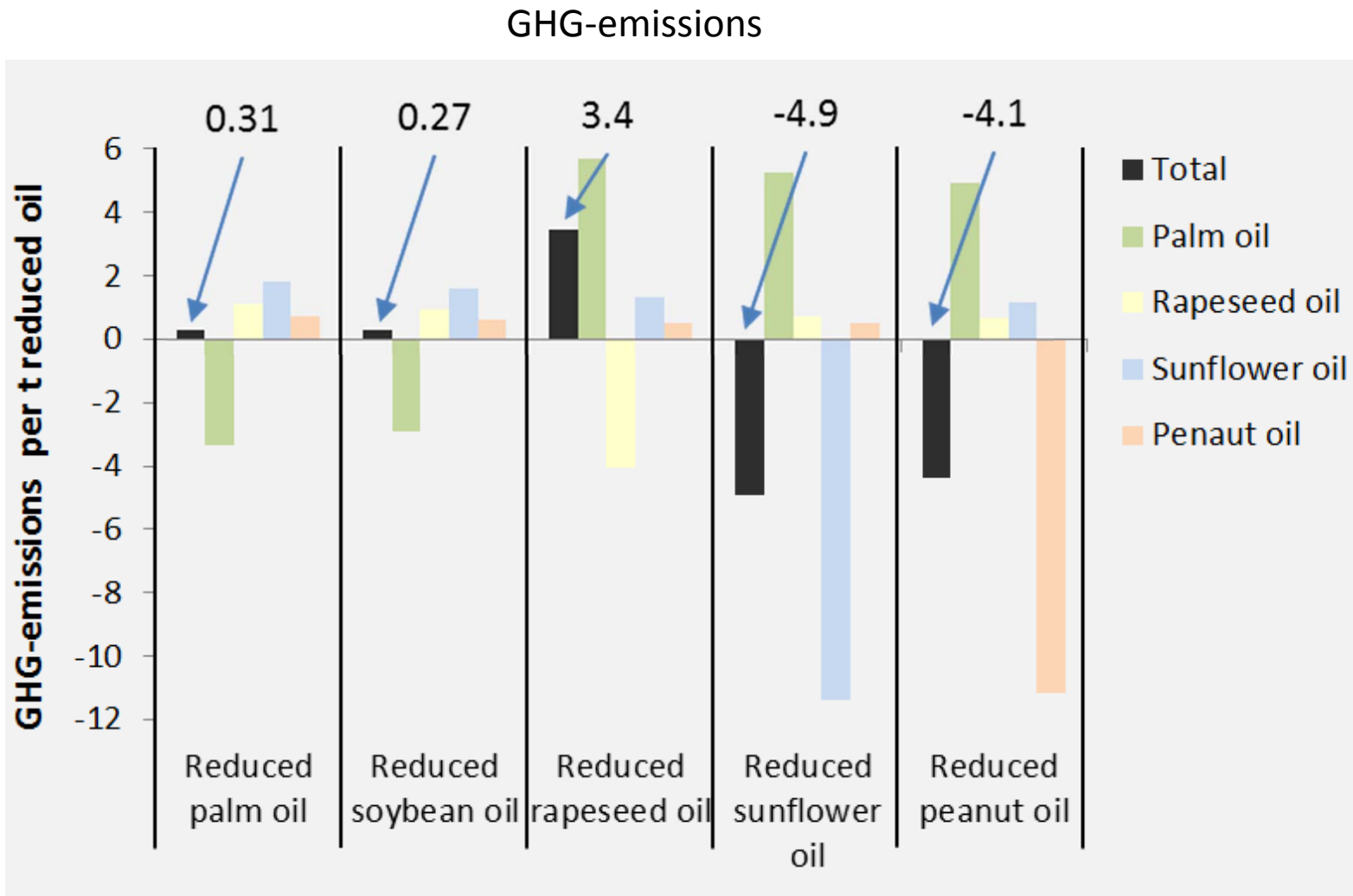


Unit = tonne oil

		Reduced oil				
		Palm oil	Soybean oil	Rapeseed oil	Sunflower oil	Penaut oil
Affected oil	Palm oil	-1.00	0.57	0.84	0.78	0.73
	Soybean oil	0.50	-1.00	0.00	0.00	0.00
	Rapeseed oil	0.27	0.23	-1.00	0.18	0.17
	Sunflower oil	0.16	0.14	0.12	-1.00	0.10
	Penaut oil	0.06	0.06	0.05	0.04	-1.00
Total		0.00	0.00	0.00	0.00	0.00

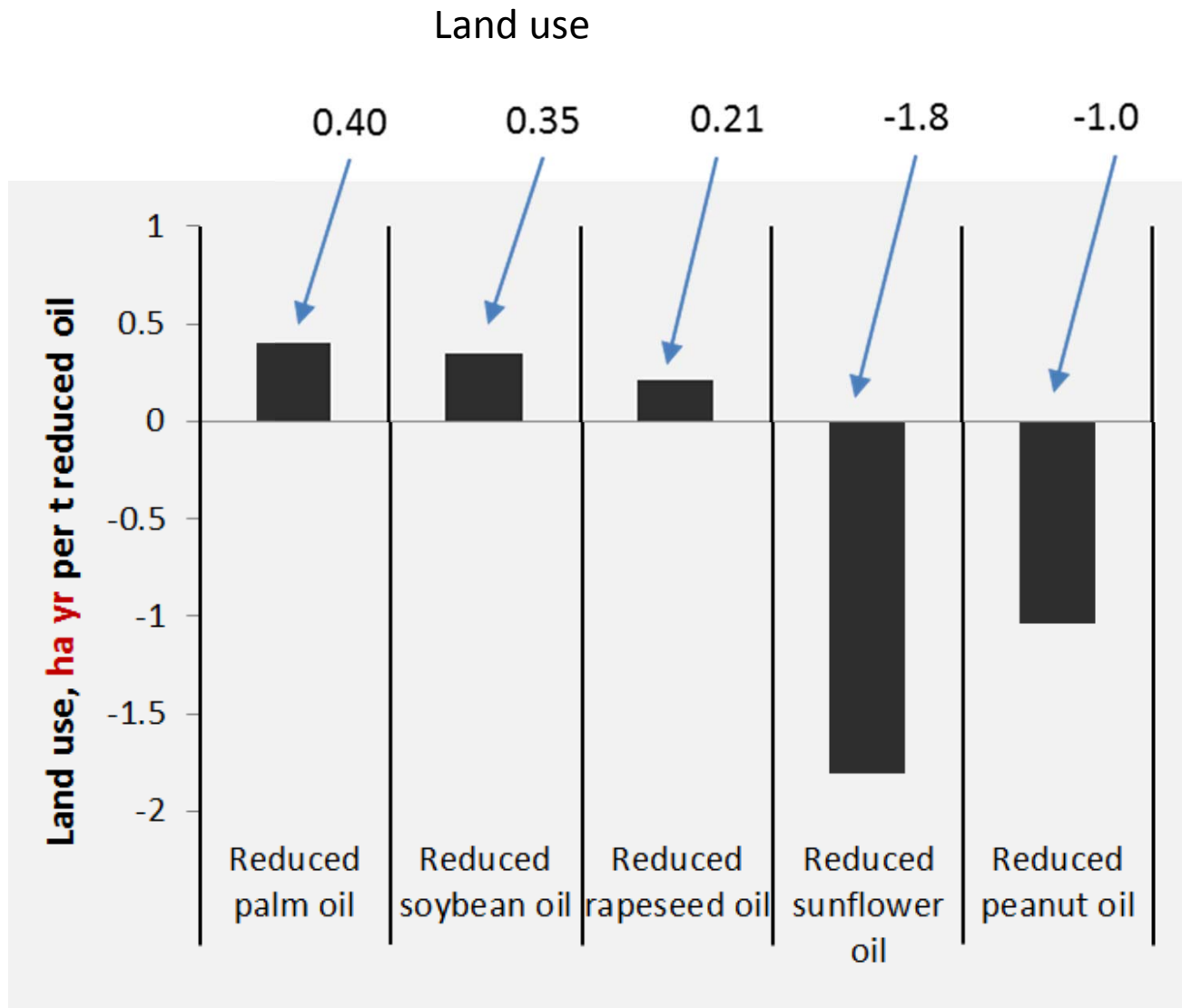
Results

- Reducing and compensating scenarios



Results

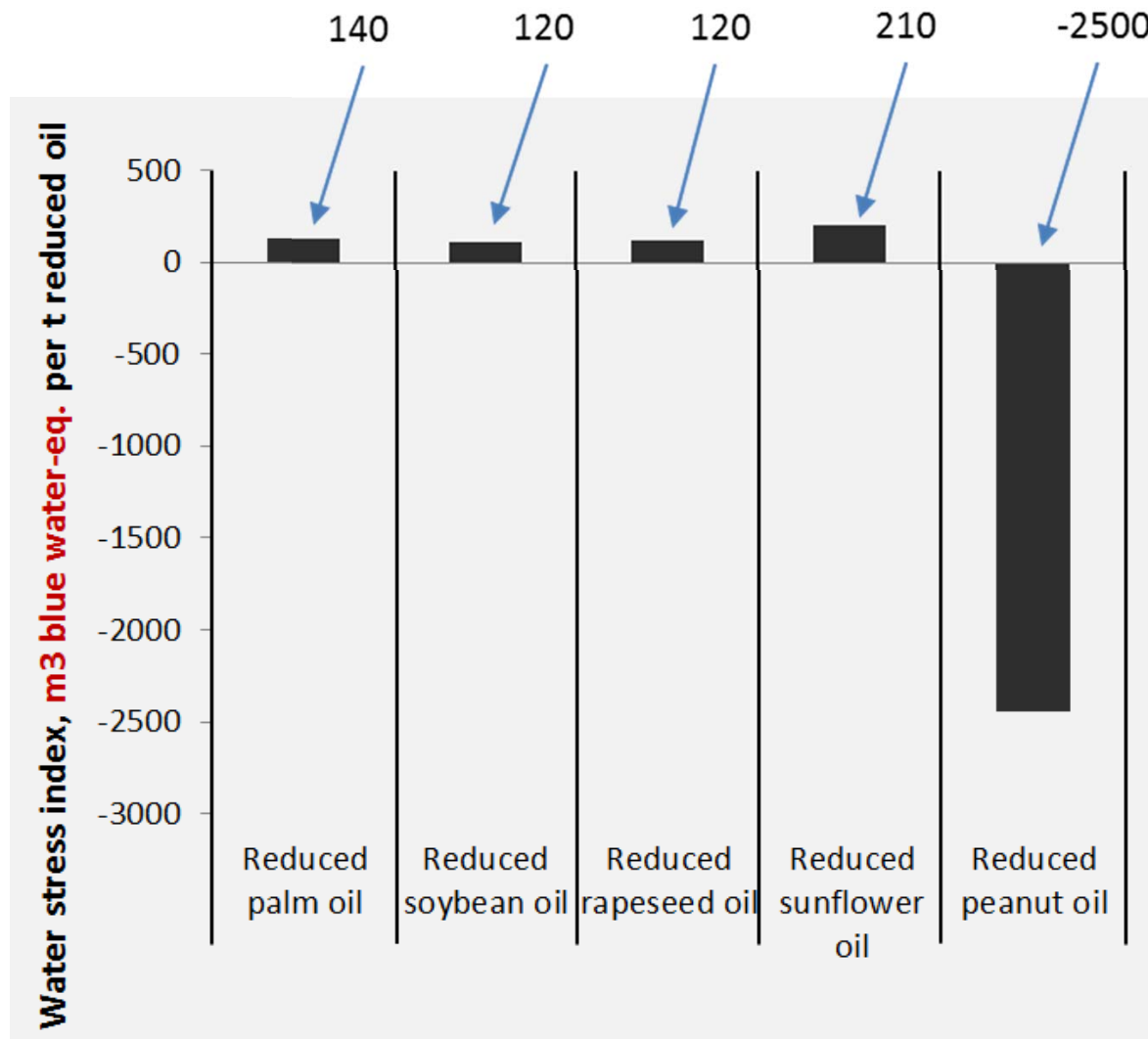
- Reducing and compensating scenarios



Results

- Reducing and compensating scenarios

Water stress index

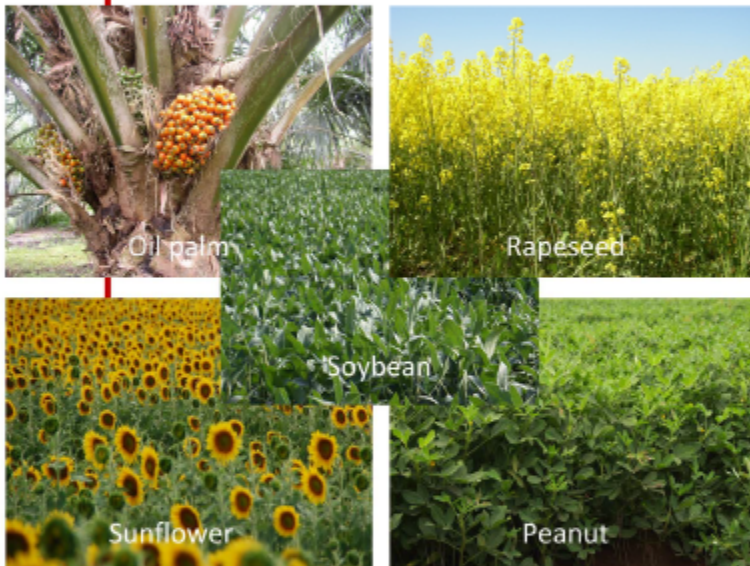


Conclusions

- **Results per tonne of oil**
 - **Low impact oils:** palm, soybean and rapeseed
 - **High impact oils:** sunflower and peanut
- **Reducing and compensating scenarios**
 - There are tradeoffs in substituting any particular vegetable oil
 - Generally beneficial to replace high impact oils with low impact oils
- **Improvement options for palm oil**
 - Reduce peat
 - Capture methane from POME
 - Increase yields (good management)

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