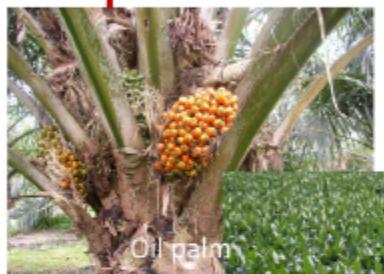


Study on the "Relative Sustainability of Vegetable Oils"

- LCA of five different vegetable oils



RSPO
Roundtable on Sustainable Palm Oil

Five Edible Oils

- a comparison

Jannick H Schmidt

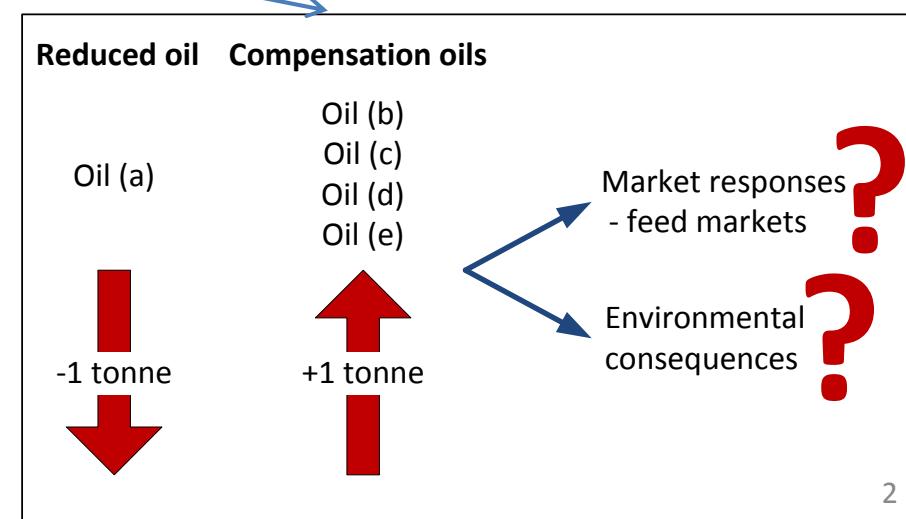
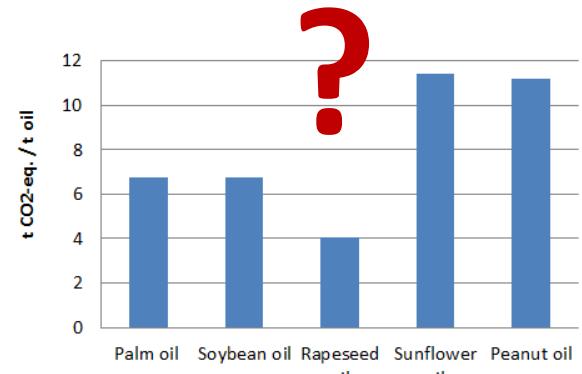
Medan 12th November 2013

2.-0 LCA consultants
Skibbrogade 5, 1, 9000 Aalborg, Denmark
www.lca-net.com

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LCA consultants

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



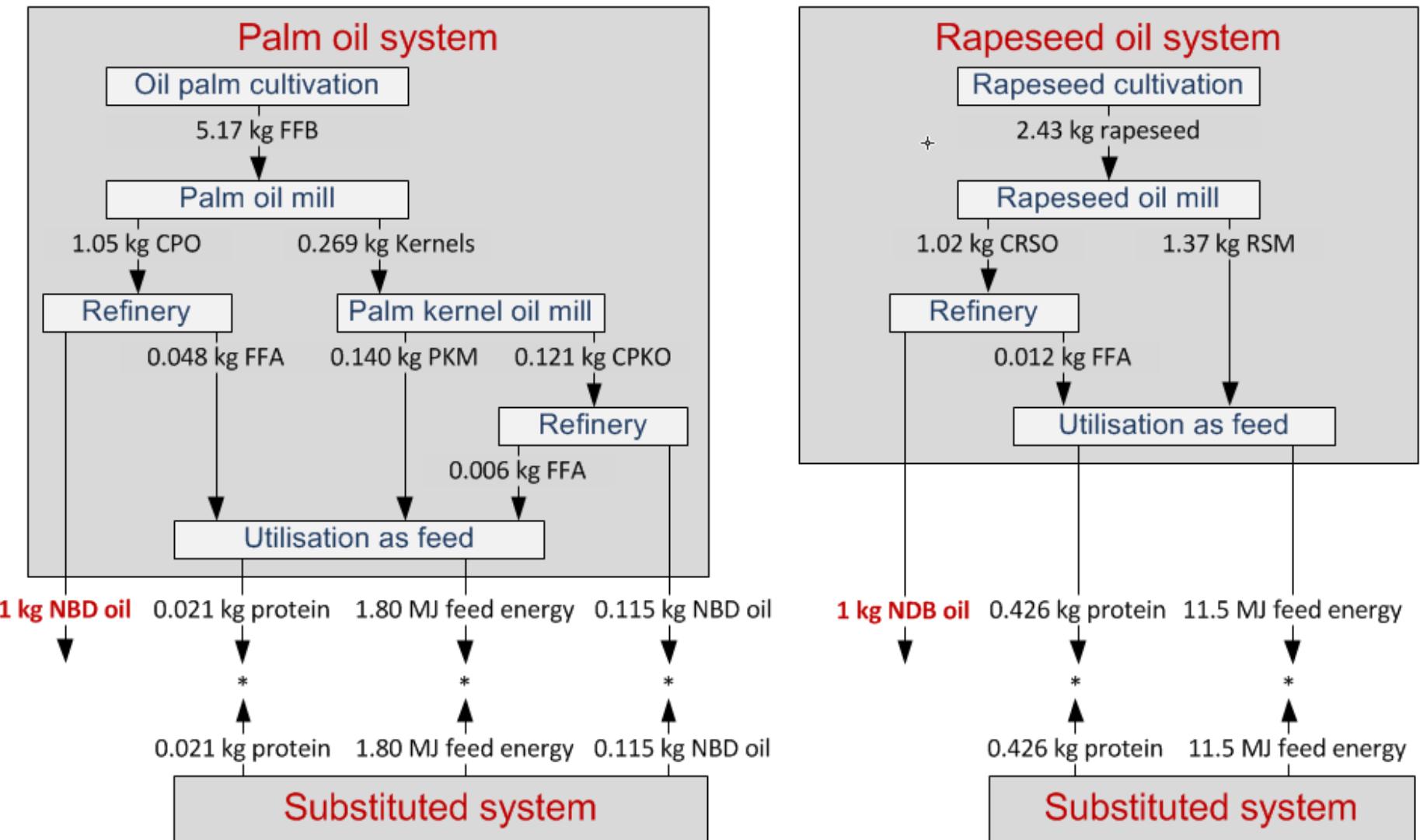
Methods and data

- **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 compararability => 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)

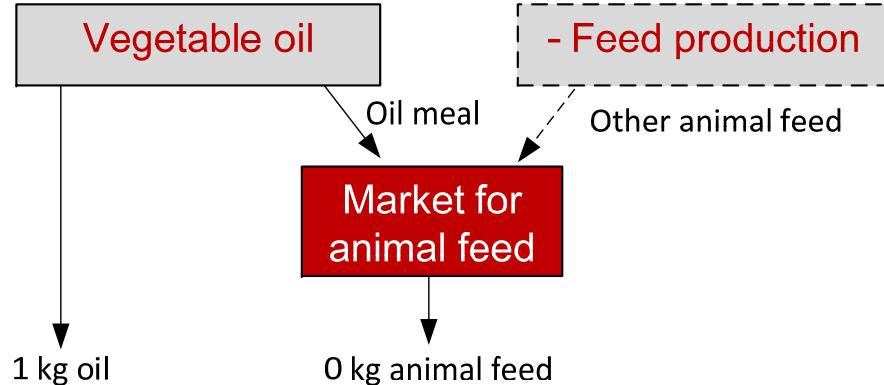


Market responses and comparability (3 of 3)

- By-products; two cases

Most common case case:

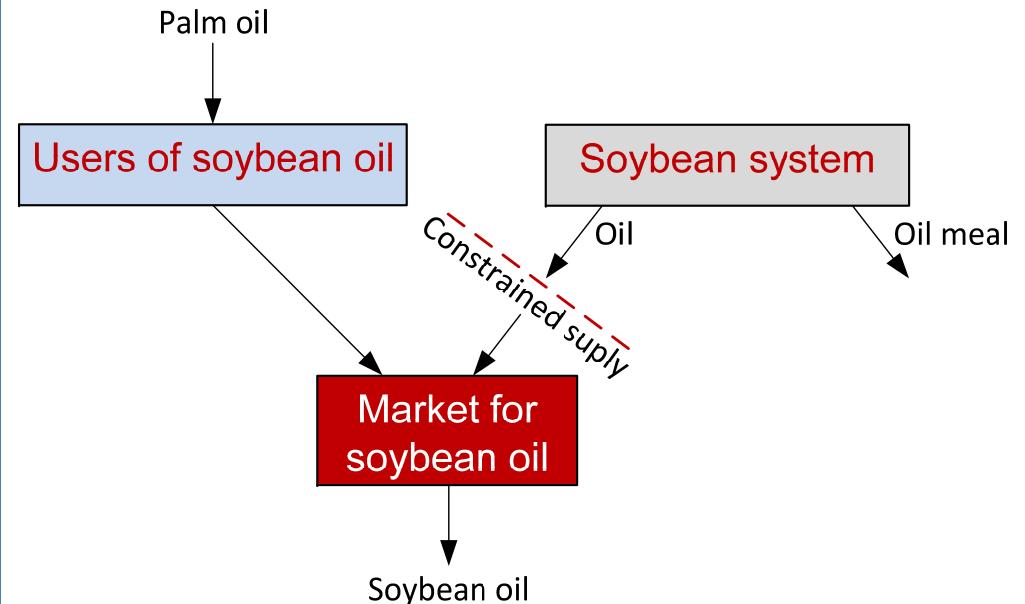
- Palm oil
- Rapeseed oil
- Sunflower oil
- Peanut oil



Demand for oils
=> effect = oil minus feed

Special case:

- Soybean oil



Demand for soybean oil
=> effect equal to palm oil

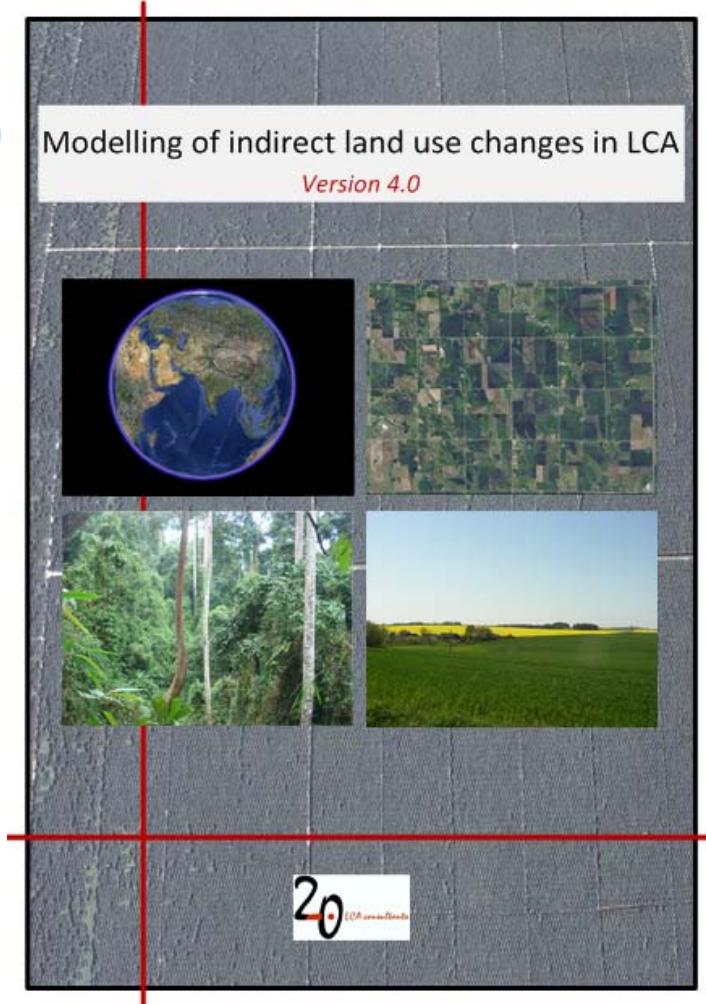
Indirect land use changes

- 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)

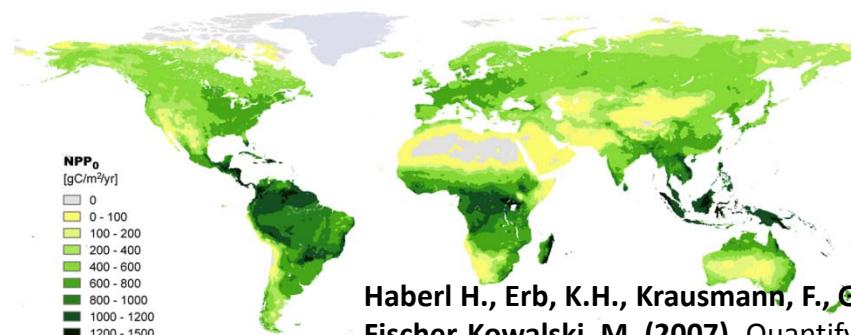
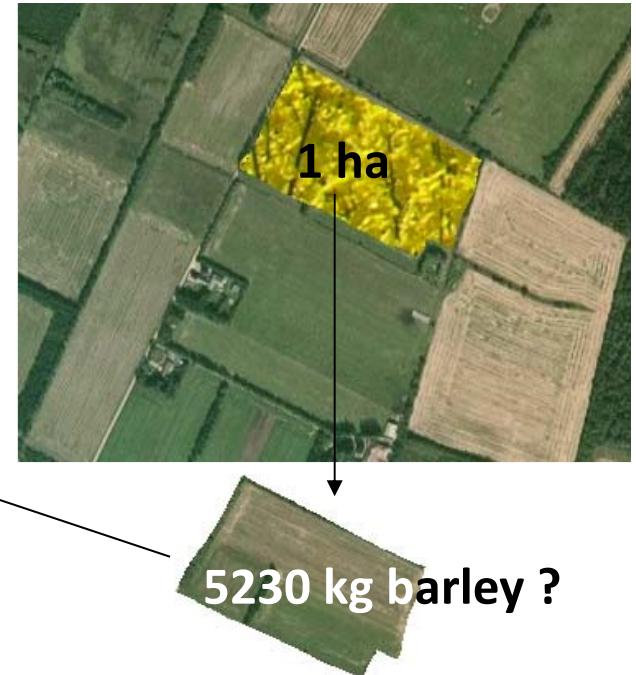
More info at:

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

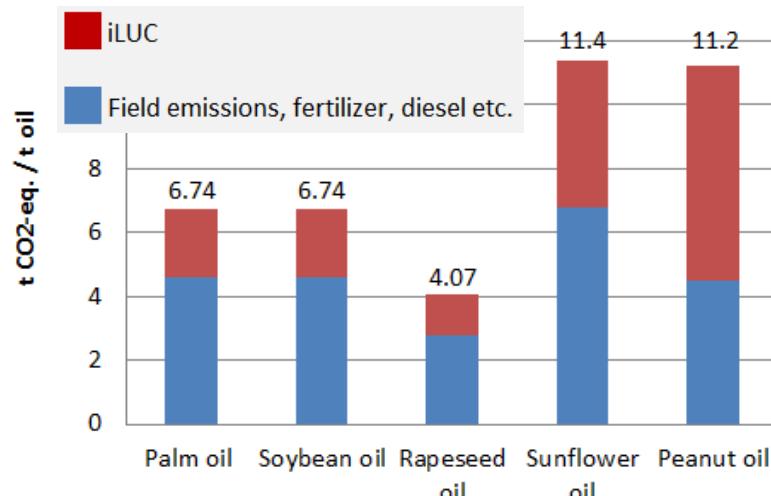


Haberl H., Erb, K.H., Krausmann, F., Gaube, V., Bondeau, A., Plutzar, C., Gingrich, S., Lucht, W., Fischer-Kowalski, M. (2007). Quantifying and mapping the global human appropriation of net primary production in Earth's terrestrial ecosystem. Proceedings of the National Academy of Sciences of the USA.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

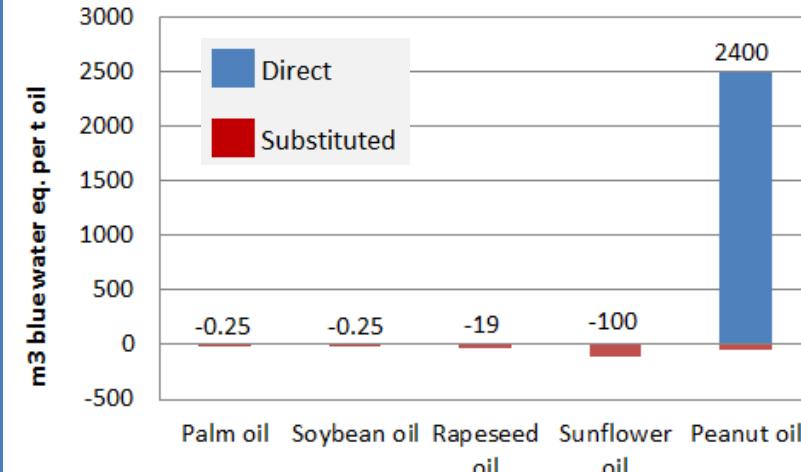
Results

- Impacts per tonne of oil

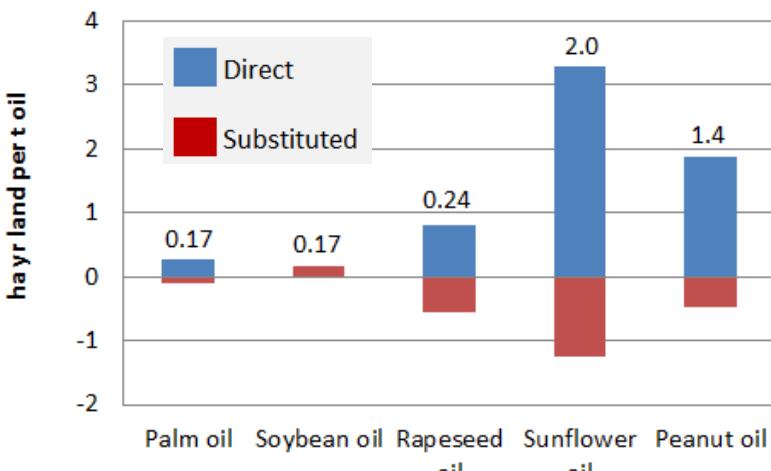
GHG-emissions (t CO₂-eq.)



Water stress index (m³ blue water eq.)



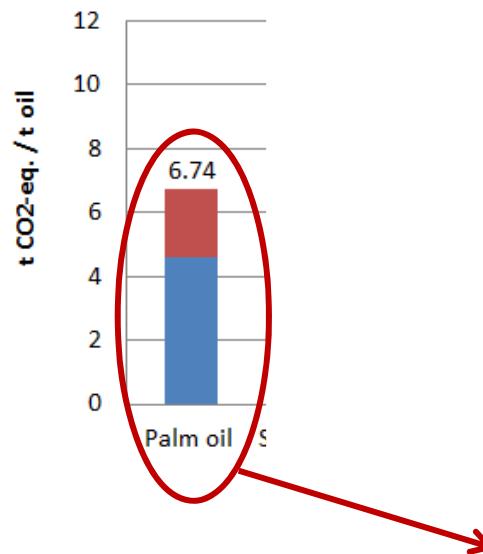
Land use (ha yr)



Results

- What is behind the numbers?

GHG-emissions (t CO₂-eq.)

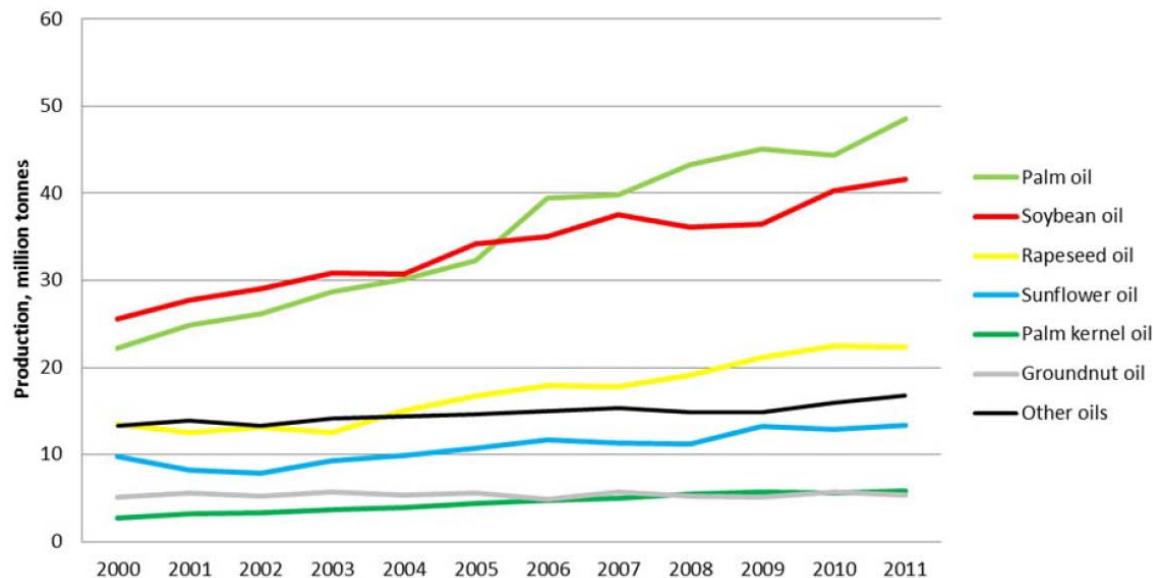


| | kg CO ₂ -eq | Total |
|--|------------------------|-------------|
| Palm oil | | |
| Palm cultivation | | |
| Field emission (N ₂ O) | 0.58 | |
| Peat emissions (CO ₂ and N ₂ O) | 2.4 | |
| iLUC oil palm | 2.5 | |
| Fertiliser | 0.19 | |
| Energy/other | 0.052 | 5.8 |
| Palm oil mill | | |
| POME 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 | |
| Total | | 6.74 |

Results

- Reducing and compensating scenarios

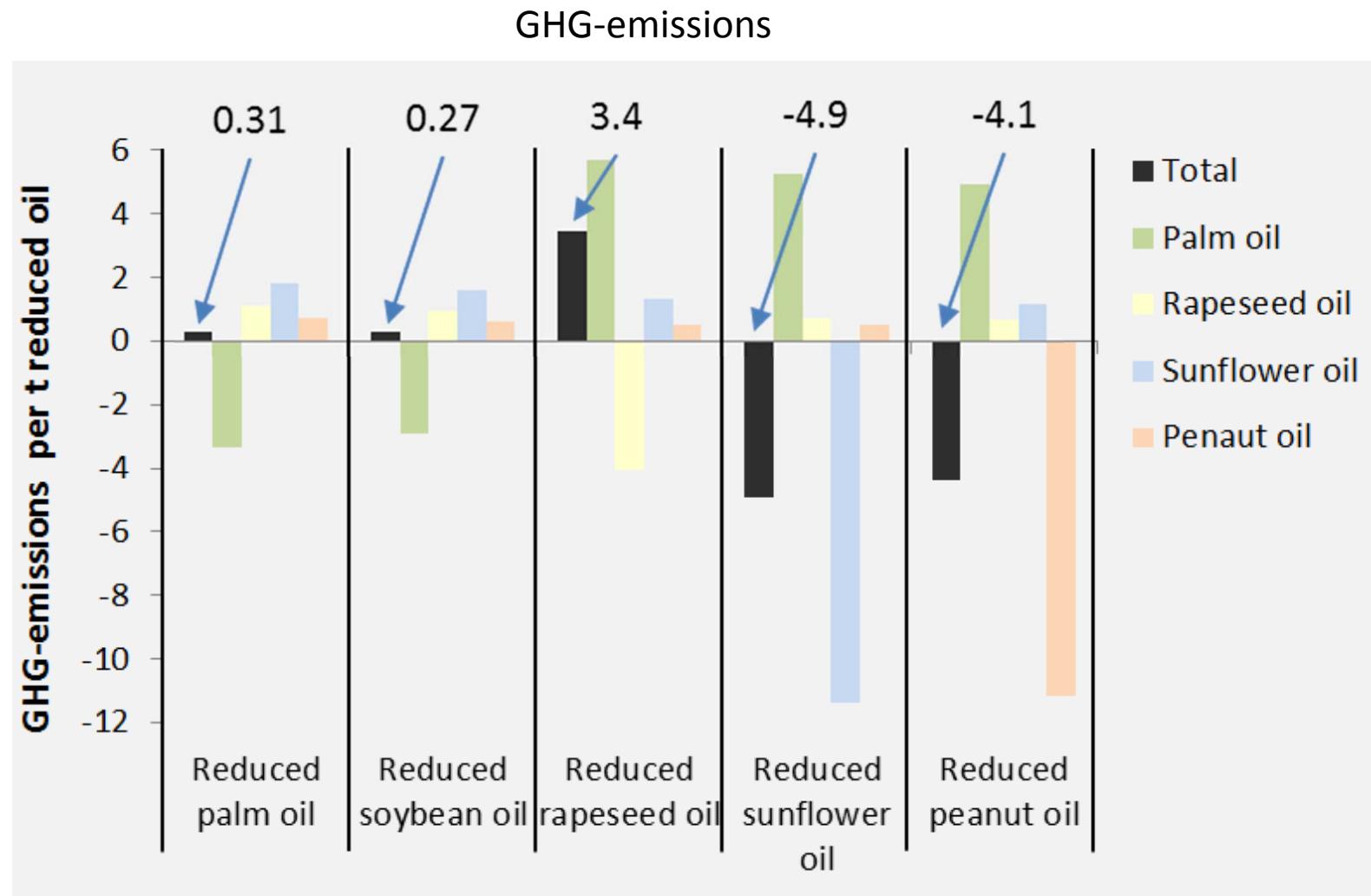
Worlds production of major vegetable oils



| Unit = tonne oil | | Reduced oil | | | | |
|------------------|---------------|-------------|-------------|--------------|---------------|------------|
| | | Palm oil | Soybean oil | Rapeseed oil | Sunflower oil | Peanut 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 |
| | Peanut oil | 0.06 | 0.06 | 0.05 | 0.04 | -1.00 |
| | Total | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

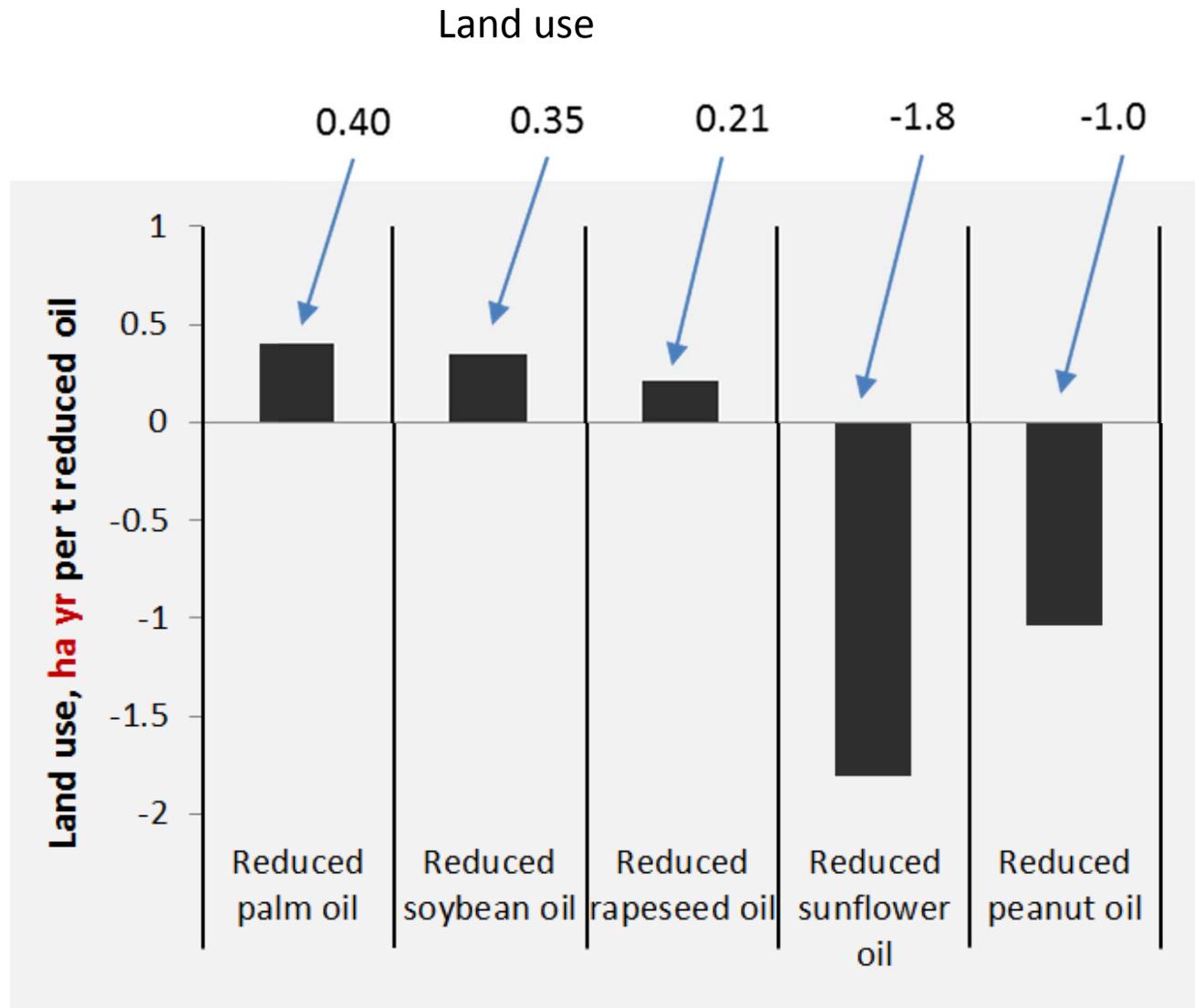
Results

- Reducing and compensating scenarios



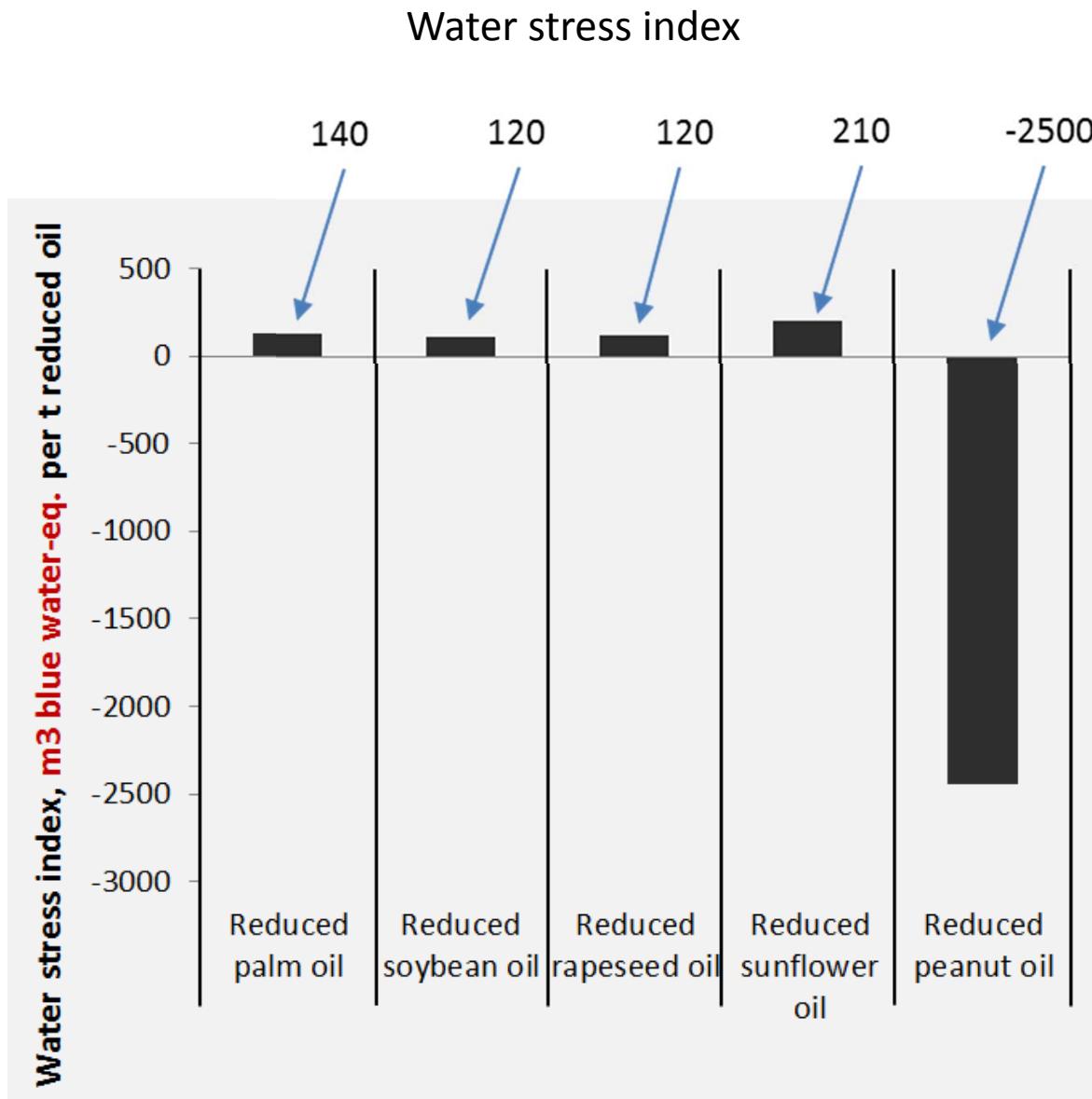
Results

- Reducing and compensating scenarios



Results

- Reducing and compensating scenarios

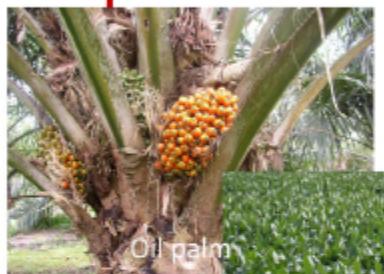


Conclusions

- **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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