Agribusiness 2020

New Horizons for the UK Agri-food supply chain

Measuring the impacts of switching agriculture in England & Wales to organic management

Dr Laurence Smith
Royal Agricultural University

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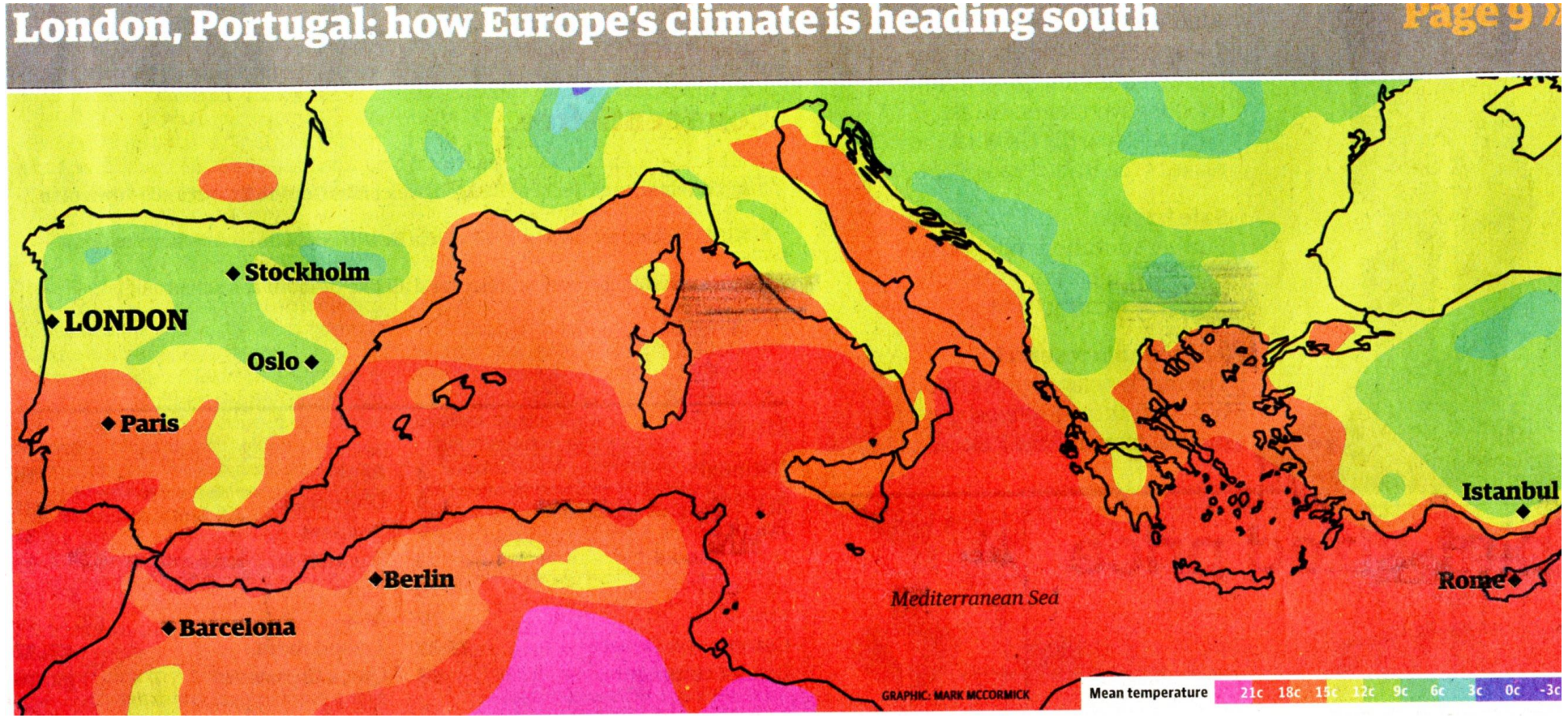

Guardian 15/5/07 – reporting French work

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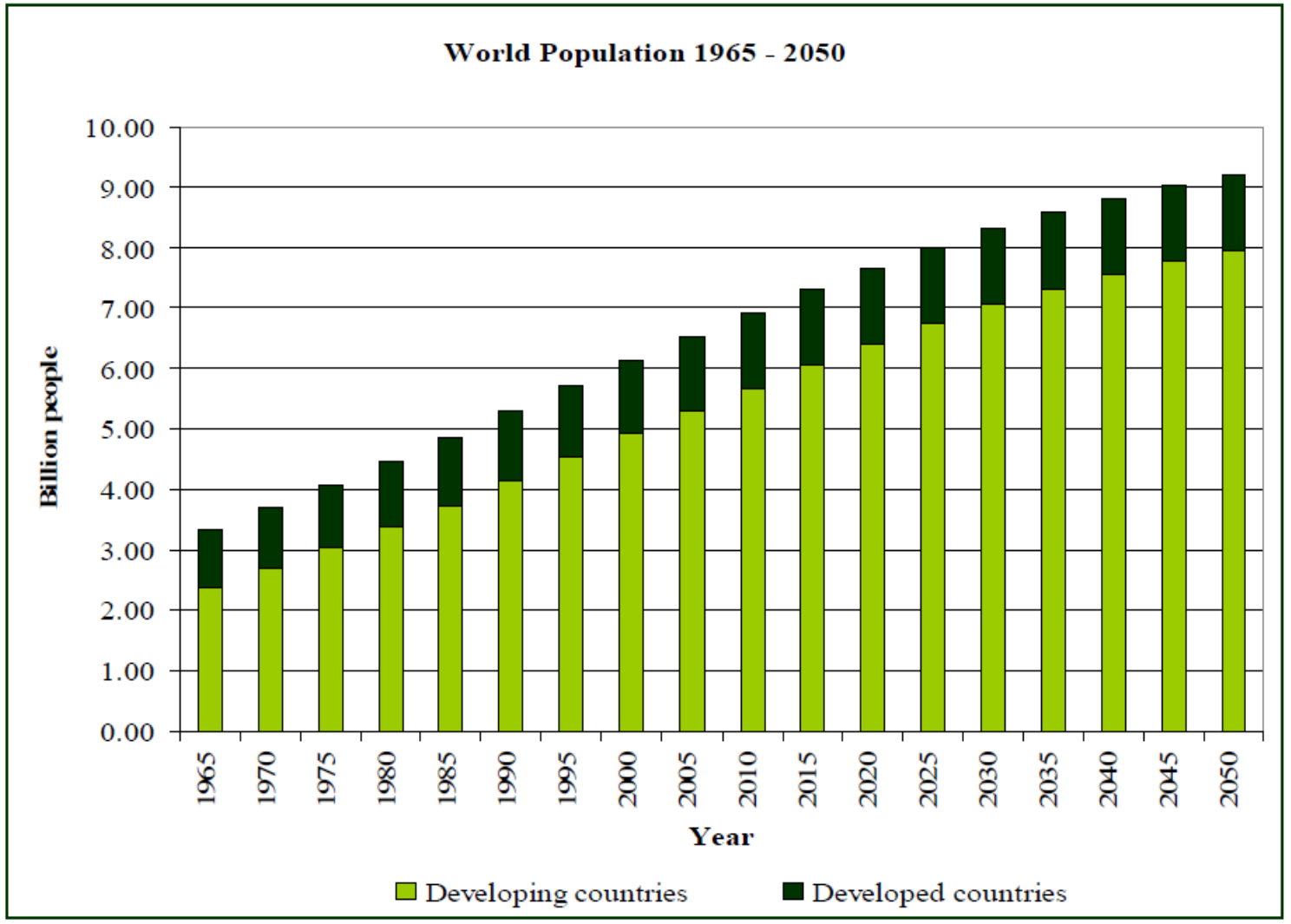

Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2007)

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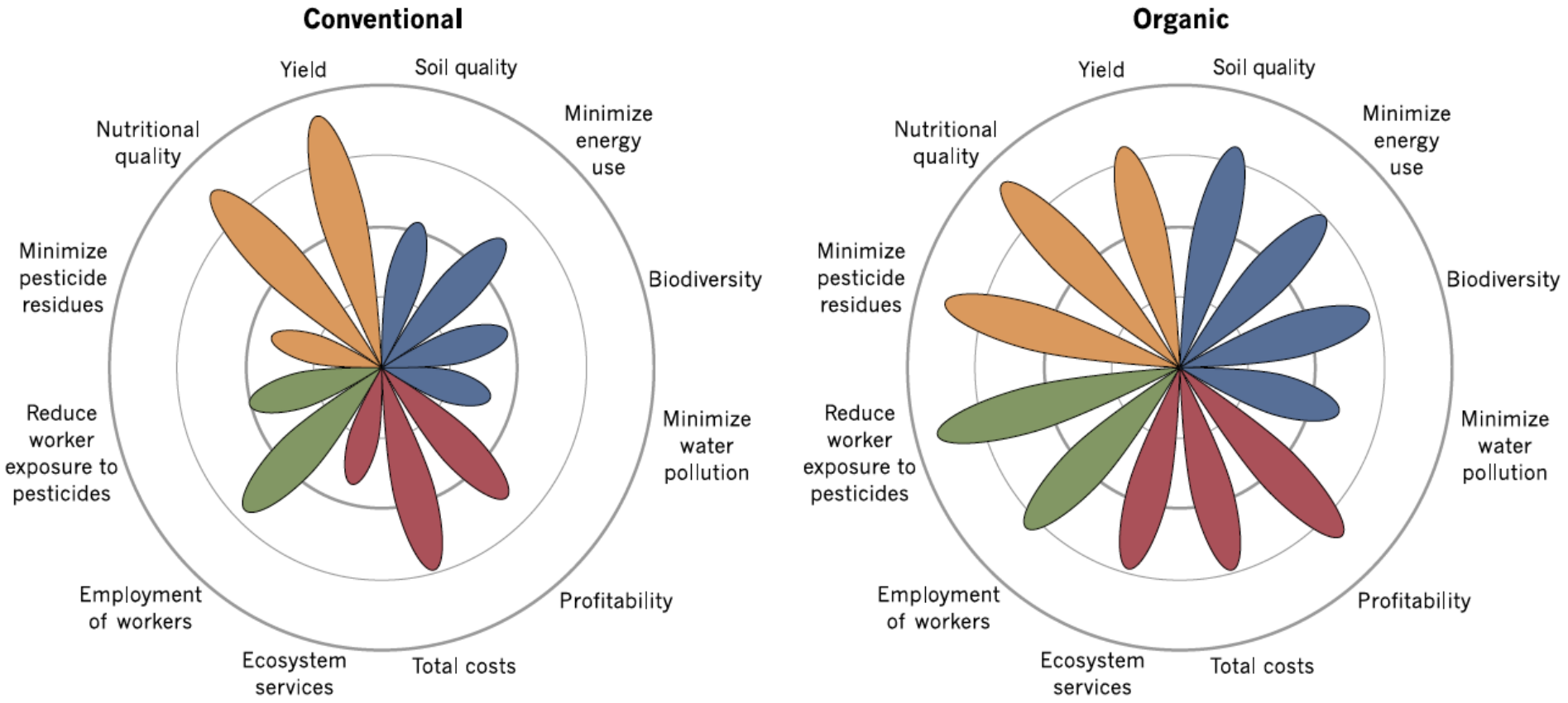
What role for organic agriculture?



Reganold and Wachter (2016) *Nature Plants* 2, 15221

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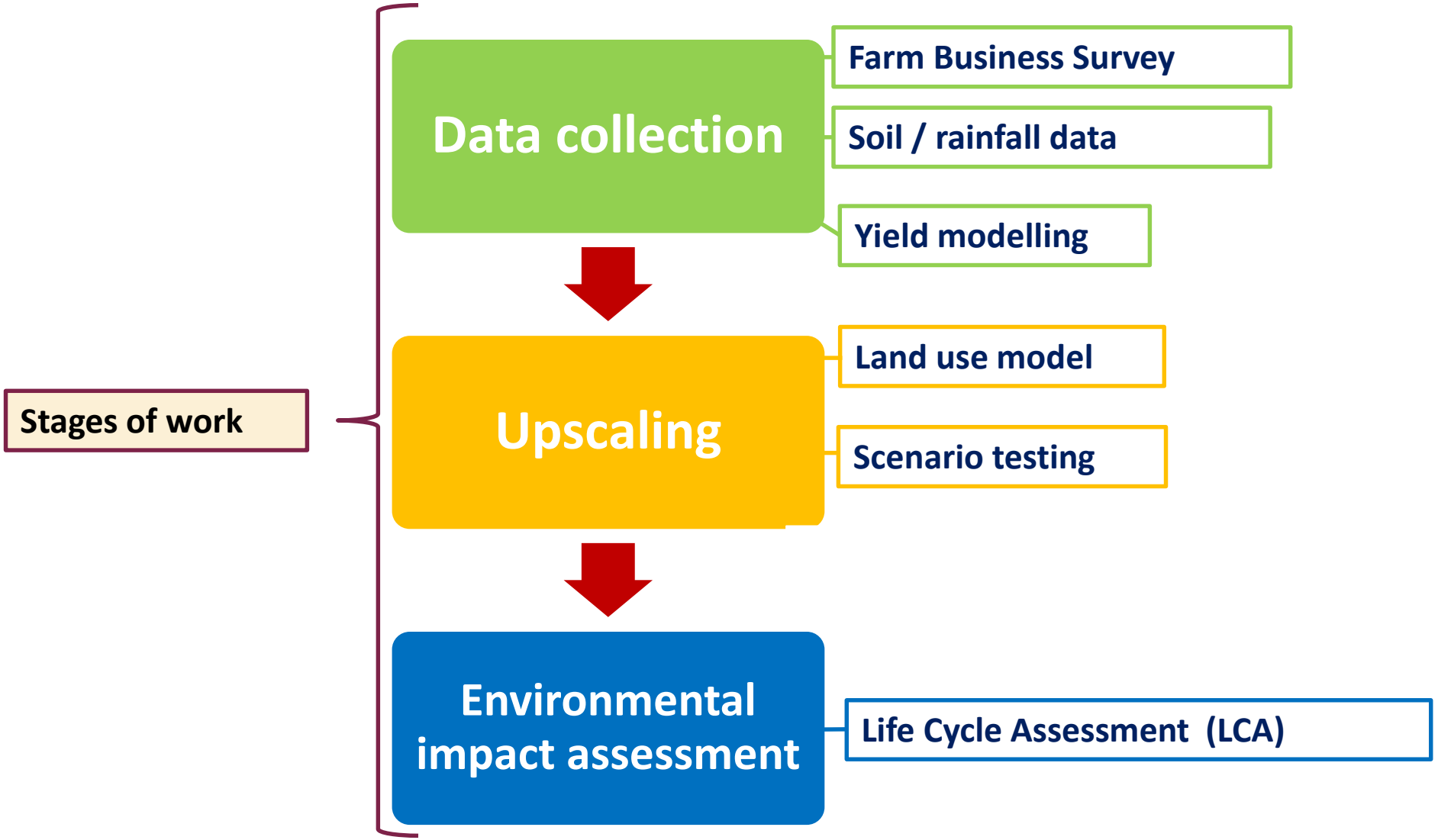
Research Question: to what extent would a large scale conversion to organic agriculture meet demands for a more productive agriculture with lower GHGs?



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Data collection

Construction of farm types

Farm Business Survey data, 200 organic farms in total

Yield modelling

NDICEA modelling for 16 soil / rainfall bands at 3 rates of N fixation

NDICEA stikstofplanner

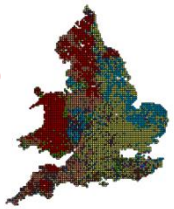
N crop rotation model

Land and farm type area estimates

UK Meteorological Office, National Soil Resources Institute and Defra datasets

Soil and rain map

Farm type map



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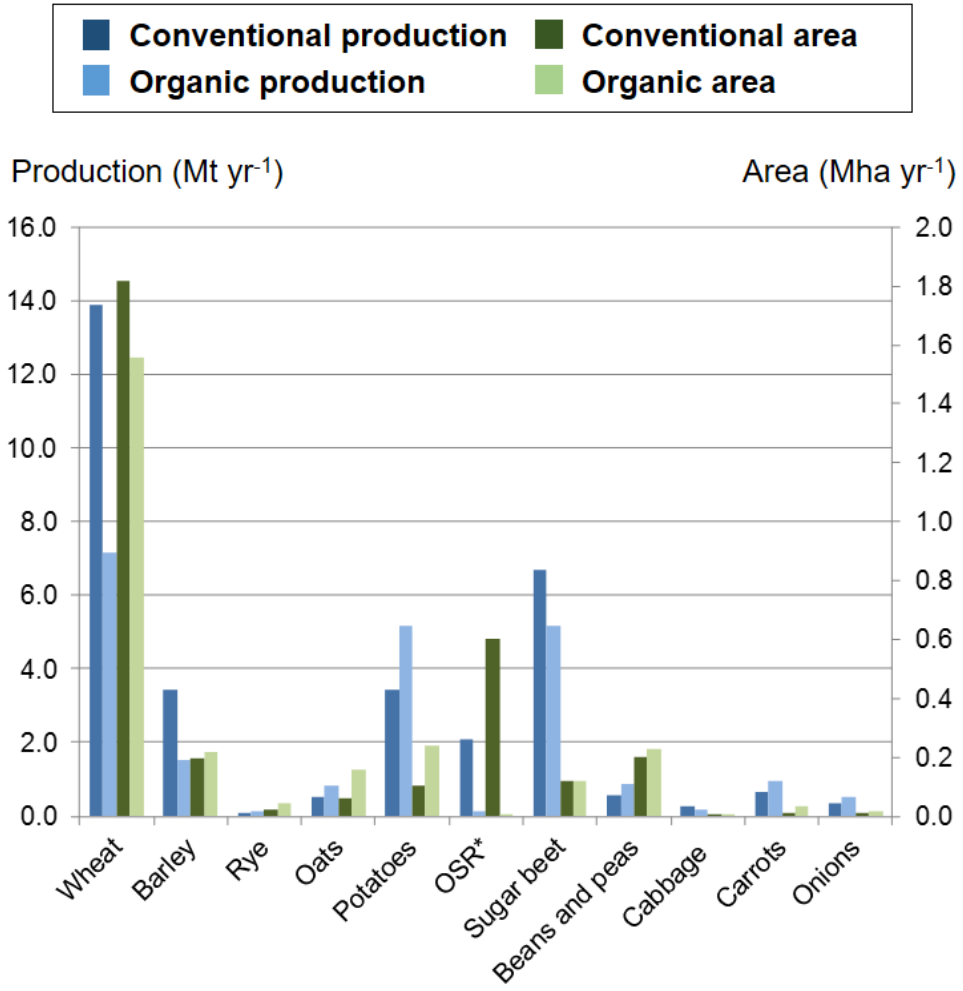
Upscaling

Crop production impacts 100% organic England and Wales



Smith et al (2018) Land Use Policy doi: 10.1016/j.landusepol.2018.02.035
Smith et al (2019) Nature Communications doi: 10.1038/s41467-019-12622-7

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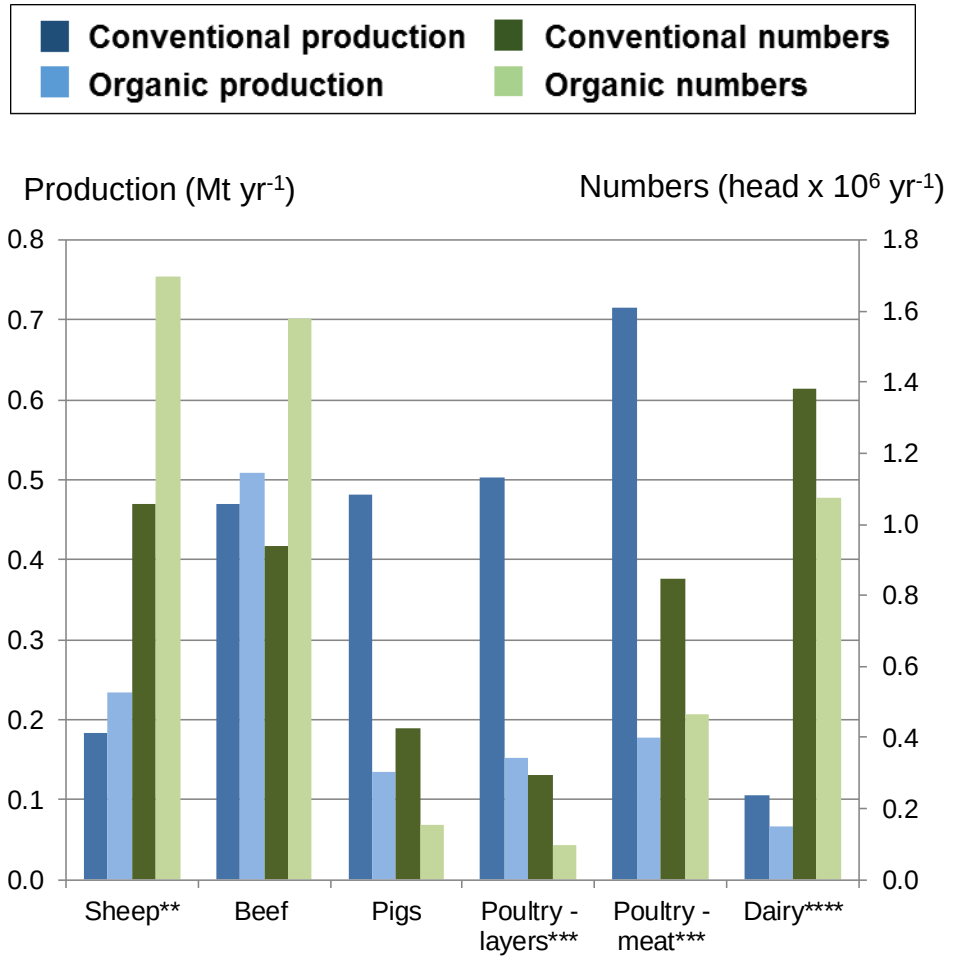
Upscaling

Livestock production impacts 100% organic England and Wales



Smith et al (2018) **Land Use Policy doi: 10.1016/j.landusepol.2018.02.035**
Smith et al (2019) Nature Communications **doi: 10.1038/s41467-019-12622-7**

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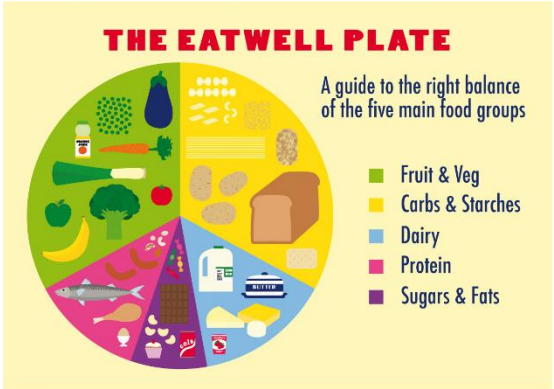
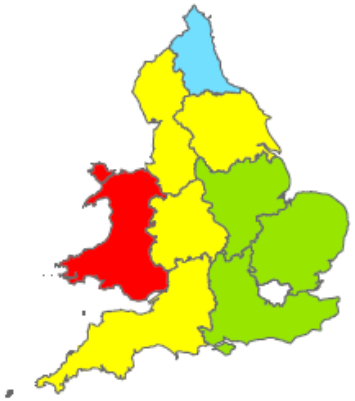
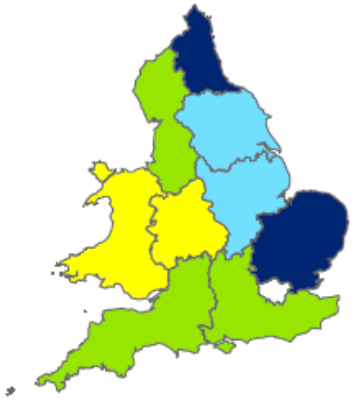
Upscaling

Output by Public Health England's "Eatwell Plate" Group: % food energy output under organic management compared to 2010 non-organic baseline

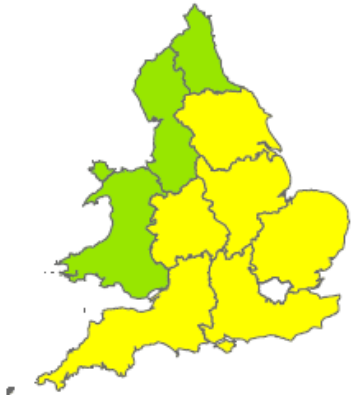




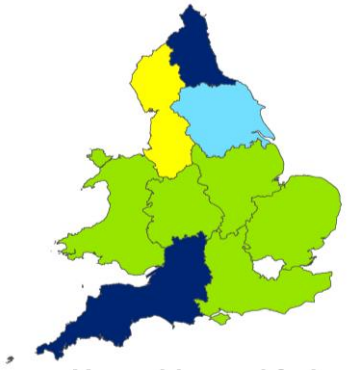
Dairy



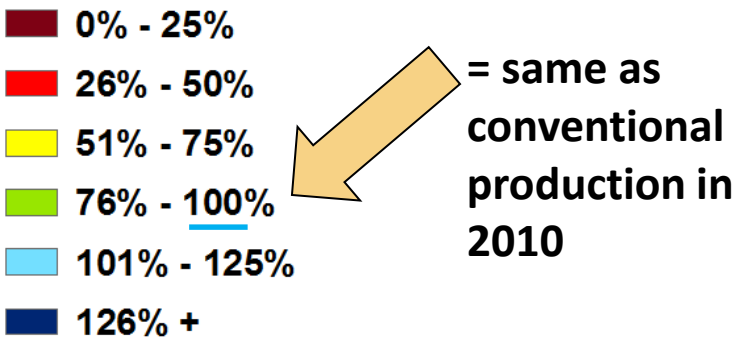
Protein



Starchy carbohydrates



Vegetables and fruit



= same as conventional production in 2010

Smith et al (2018) Land Use Policy doi: 10.1016/j.landusepol.2018.02.035

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Environmental Impact Assessment

Life Cycle Assessment

Kg CO_2 equivalent per tonne of product

- **Methane CH_4**

- **Nitrous oxide N_2O**

- **Carbon dioxide CO_2**

Agri-LCA model (Williams et al. 2006)

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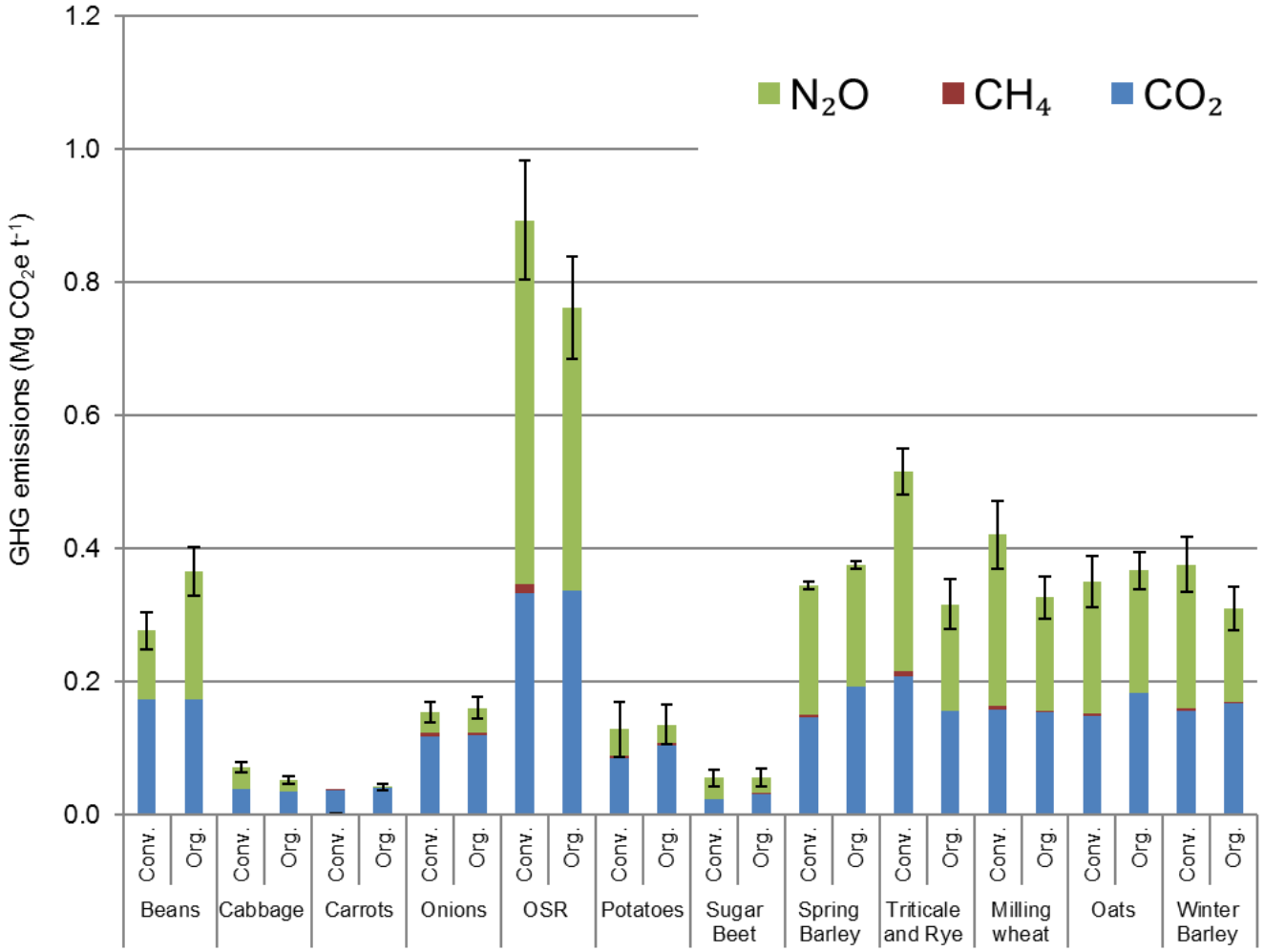
Environmental Impact Assessment

GHGs per tonne of product - crops



Smith et al (2019) Nature Communications **doi: 10.1038/s41467-019-12622-7**

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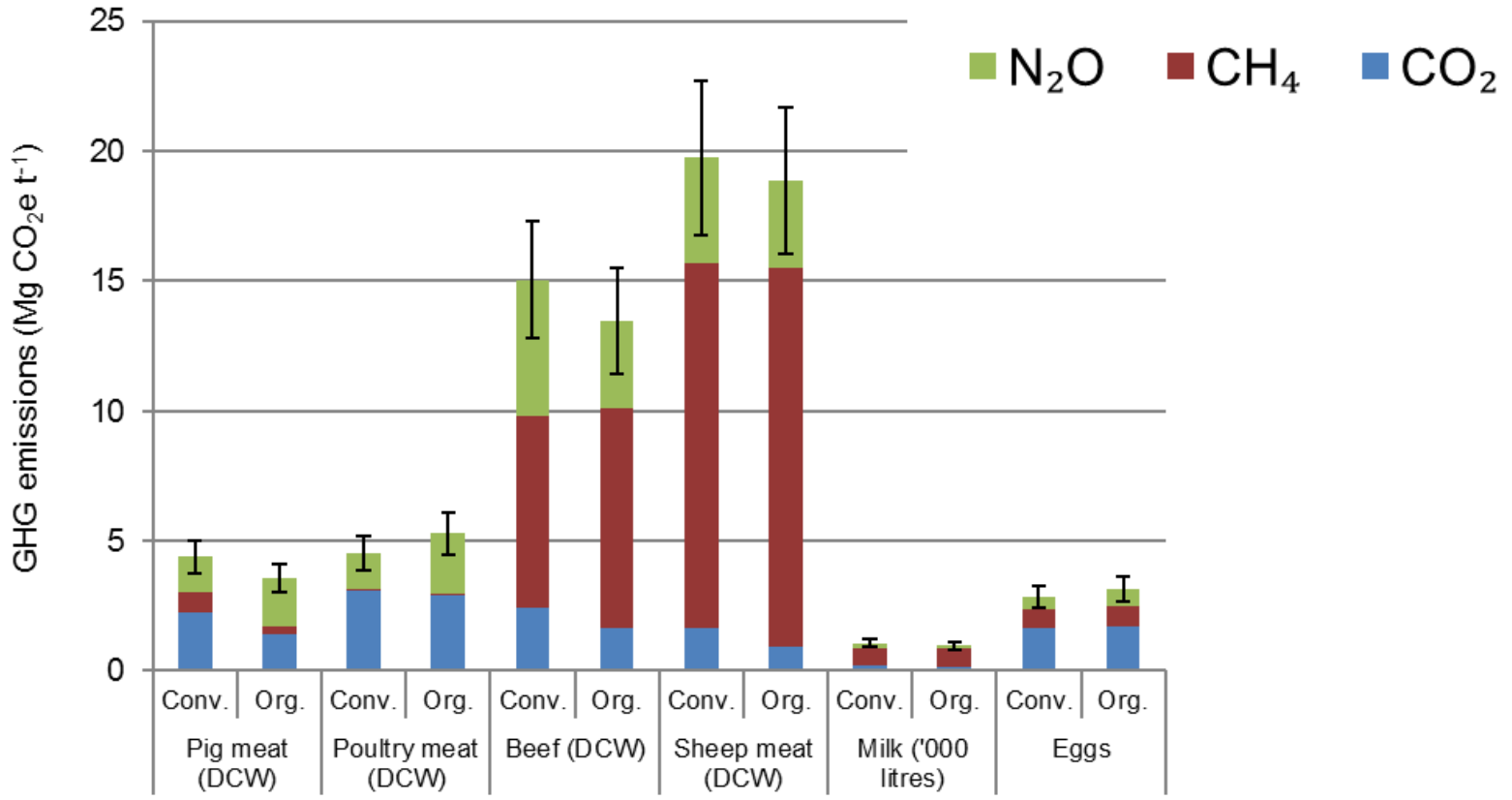
Environmental Impact Assessment

GHGs per tonne of product - livestock



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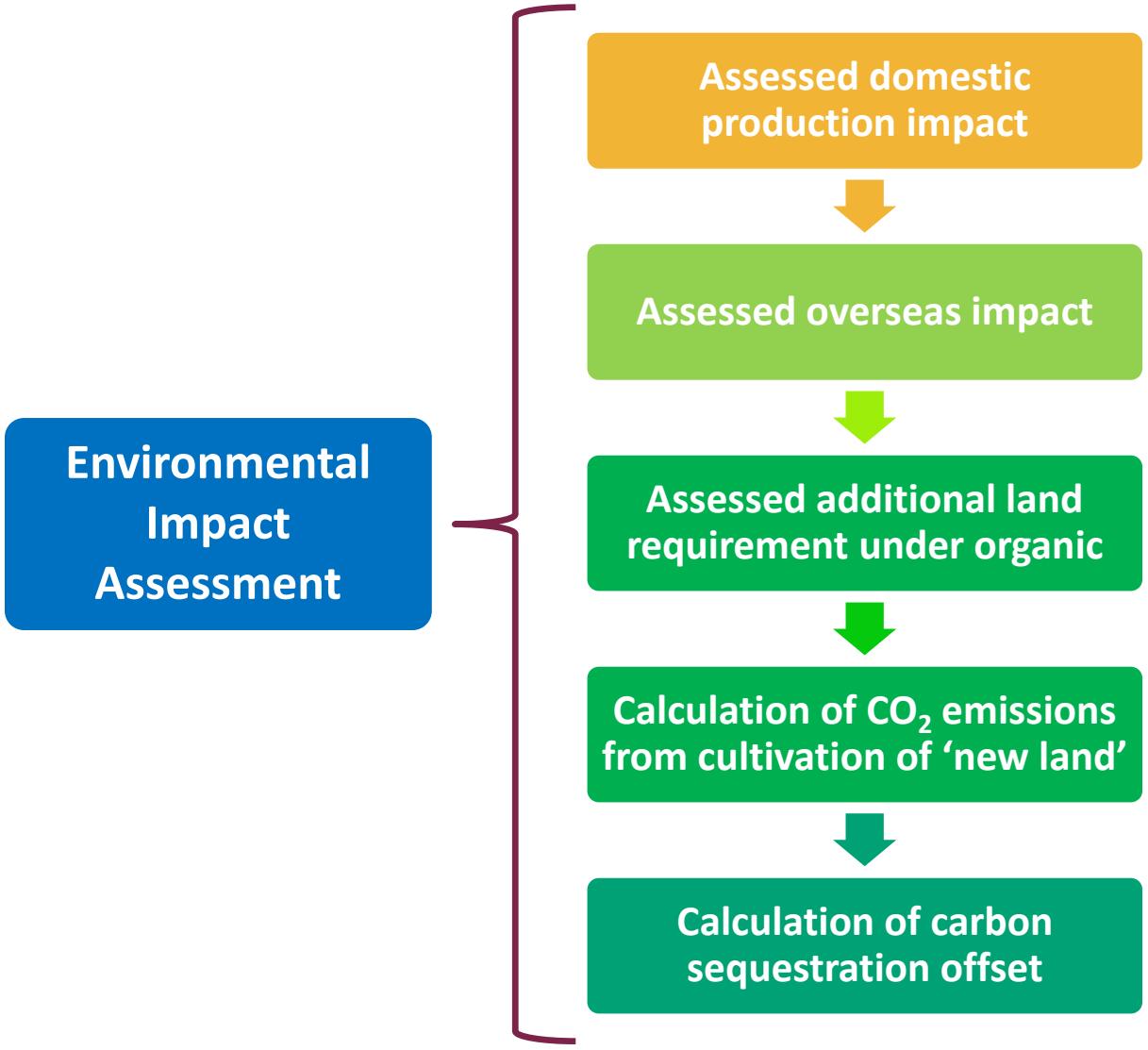
Scaling up the impact of 100% organic



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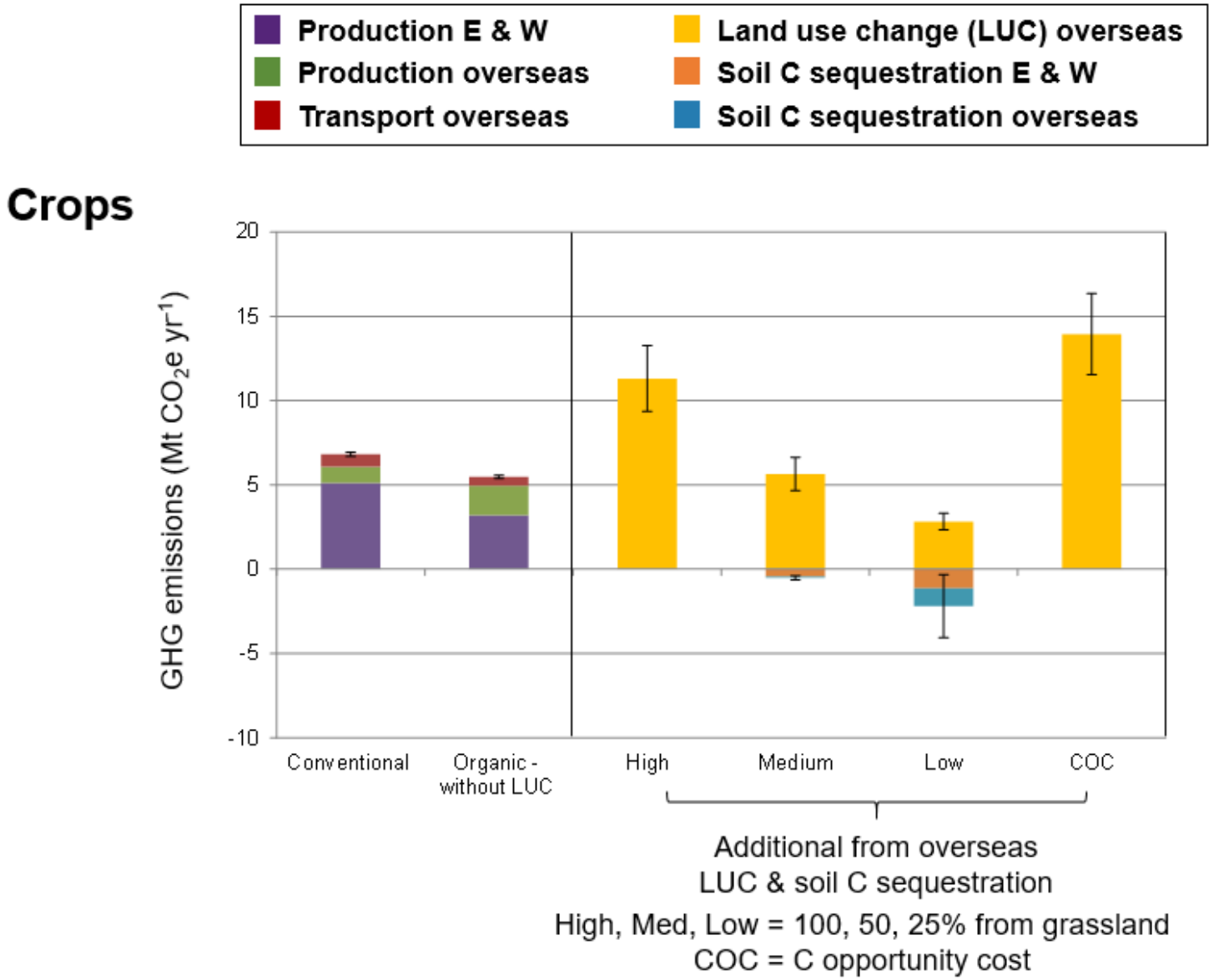
Greenhouse gas balance under 100% conversion to organic in England & Wales



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Environmental Impact Assessment

Food production implications
Animal and crop production & imports

- Under 100% organic, less grain (wheat, barley etc.)
- Much less oil seed production
  - But “surplus grain” and oil seed meals fed to livestock
  - Consequences
- Restricts poultry and pig production
- Much less impact on ruminants (cattle & sheep)

- Under 100% organic, existing imports from the Mediterranean basin and tropics need more land

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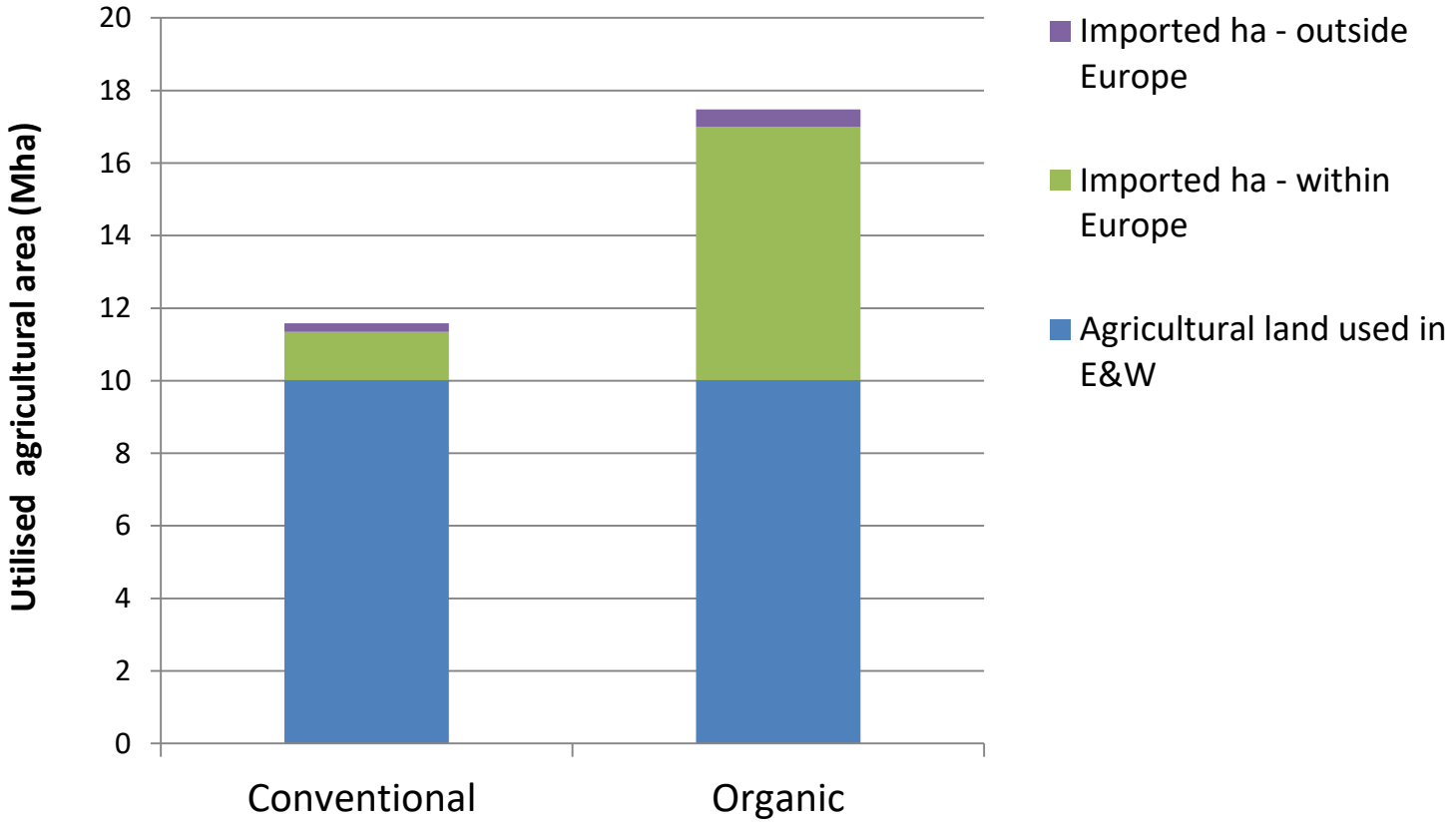
Environmental Impact Assessment

Imported hectares - conventional and 100% organic scenarios, crops plus livestock:



Smith et al (2019) Nature Communications doi: 10.1038/s41467-019-12622-7

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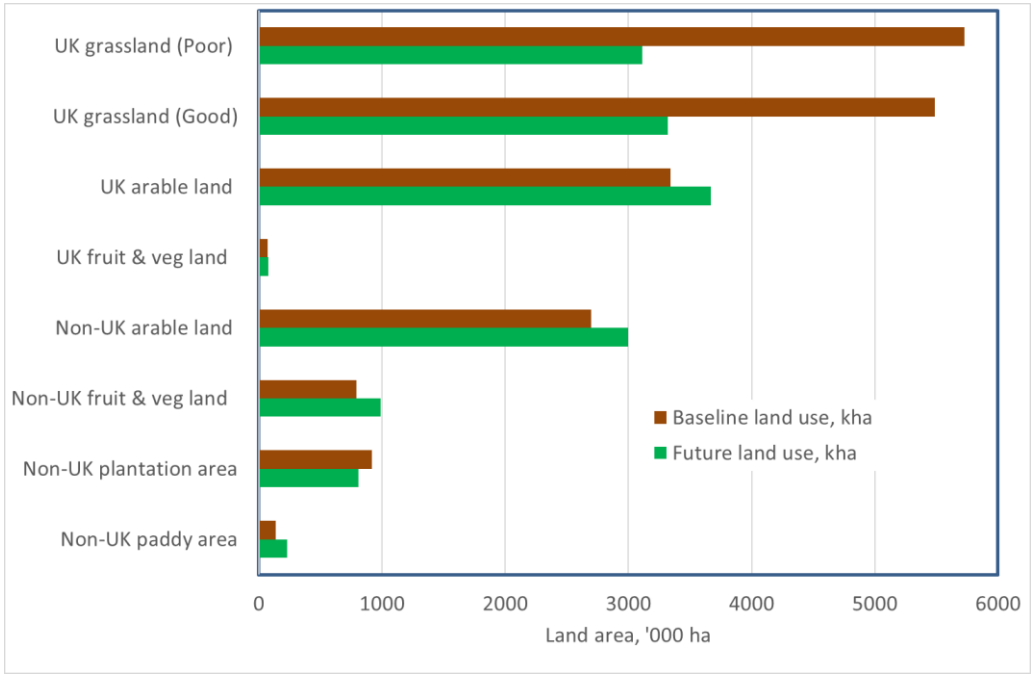
Summary

- We assess the consequences for net GHG emissions of a 100% shift to organic food production in England and Wales
- We predict major shortfalls in production of most agricultural products
- Direct emissions are reduced with organic farming
- But when increased overseas land use to compensate for shortfalls are factored in, net emissions are greater
- Enhanced soil carbon sequestration could offset only a small part of the overseas emissions

Food production implications
Animal and crop production & imports

- Feeding the nation with the **current** diet demands more land with lower intensity production
- Is the current diet ideal?
- Move to Eatwell Plate

- 14% reduction in GHG emissions
- Reduced land use



Williams et al. (2017) Assessing the environmental impacts of healthier diets. Final report to Defra on project FO0427

Food production implications
National and global

- Meeting increasing demand to feed the word and meeting GHG emission reduction targets is a challenge
- Extrapolating from the UK, 100% global organic without dietary change seems unlikely to work
- Meeting UK (or global) nutritional targets with 100% organic conversion is another worthy study, but not this one.

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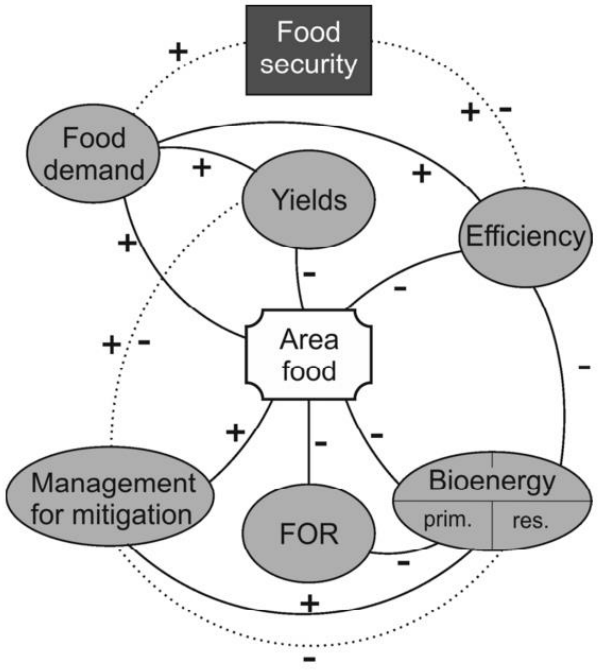
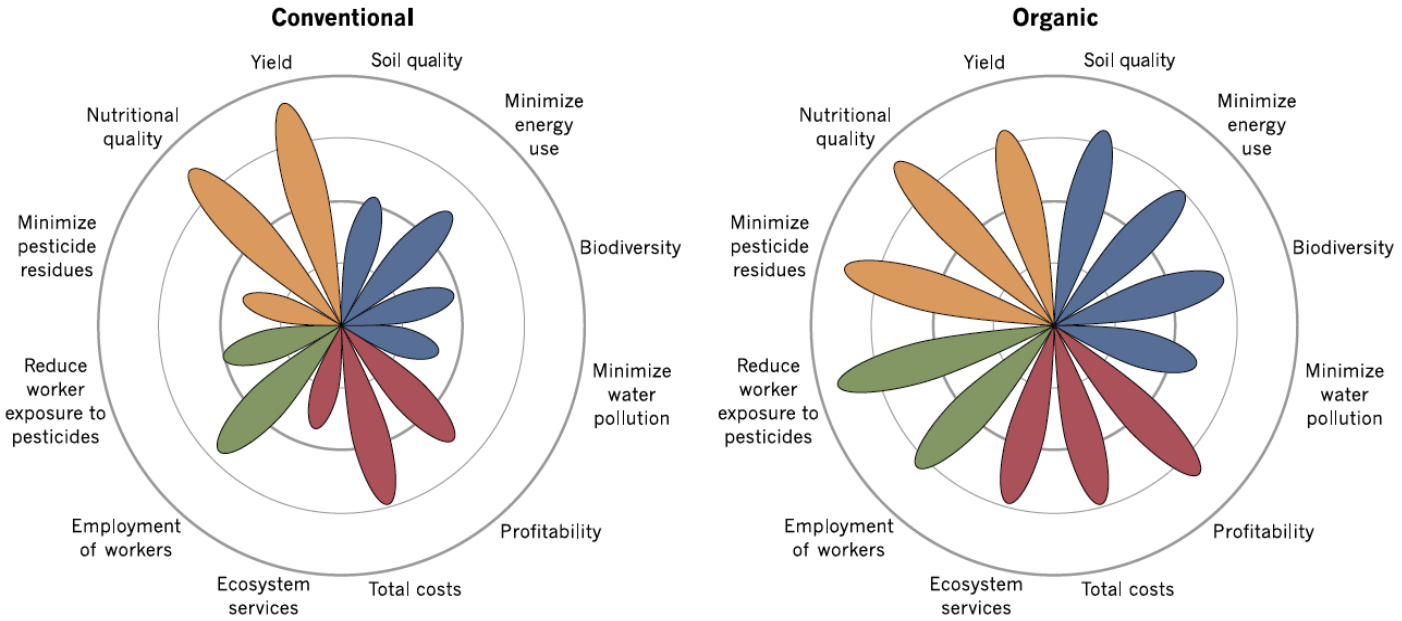
Implications for the organic sector

- Organic-specific crop breeding
- Protein sources and production for organic livestock (primarily plant based but alternative insect, algal approaches might also be appropriate)
- Food systems perspectives



Smith, Pete, et al. (2013)
Global Change Biology 19.8: 2285-2302



Reganold and Wachter (2016)
Nature Plants 2, 15221

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Cranfield UNIVERSITY

THE ORGANIC RESEARCH CENTRE ELM FARM

THE RATCLIFF FOUNDATION

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Thank-you

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