Does organic farming reduce environmental impacts?

Dr Hanna Tuomisto

London School of Hygiene & Tropical Medicine

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Introduction

- Organic farming aims at reducing negative environmental impacts
- IFOAM standards state:

"organic agriculture should fit the cycles and balances in nature without exploiting it by using local resources, recycling, reuse and efficient management of materials and energy"

- Aim of the study was to review the finding of studies comparing environmental impacts of organic and conventional farming

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Does organic farming reduce environmental impacts? – A meta-analysis of European research

H.L. Tuomisto [a,*], I.D. Hodge [b], P. Riordan [a], D.W. Macdonald [a]

[a] Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, The Recanati-Kaplan Centre, Tubney House, Abingdon Road, Tubney, Oxon OX13 5QL, UK
[b] Deparment of Land Economy, University of Cambridge, Cambridge CB3 9EP, UK

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ABSTRACT

Organic farming practices have been promoted as, *inter alia*, reducing the environmental impacts of agriculture. This meta-analysis systematically analyses published studies that compare environmental impacts of organic and conventional farming in Europe. The results show that organic farming practices generally have positive impacts on the environment per unit of area, but not necessarily per product unit. Organic farms tend to have higher soil organic matter content and lower nutrient losses (nitrogen

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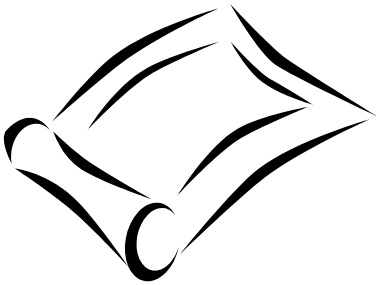
Selection criteria of the papers

- Literature search terms: [organic AND conventional AND farming] OR [organic AND conventional AND agriculture]

- All papers published before 26th September 2009
- i) the study was related to European farming systems,
- ii) the study compared organic and conventional farming and provided quantitative results at least one of the following aspects: soil organic carbon, land use, energy use, GHG emissions, eutrophication potential, acidification potential, nitrogen leaching, phosphorus losses, ammonia emissions or biodiversity,
- iii) the paper was published in a scientific peer-reviewed journal
- 109 papers included



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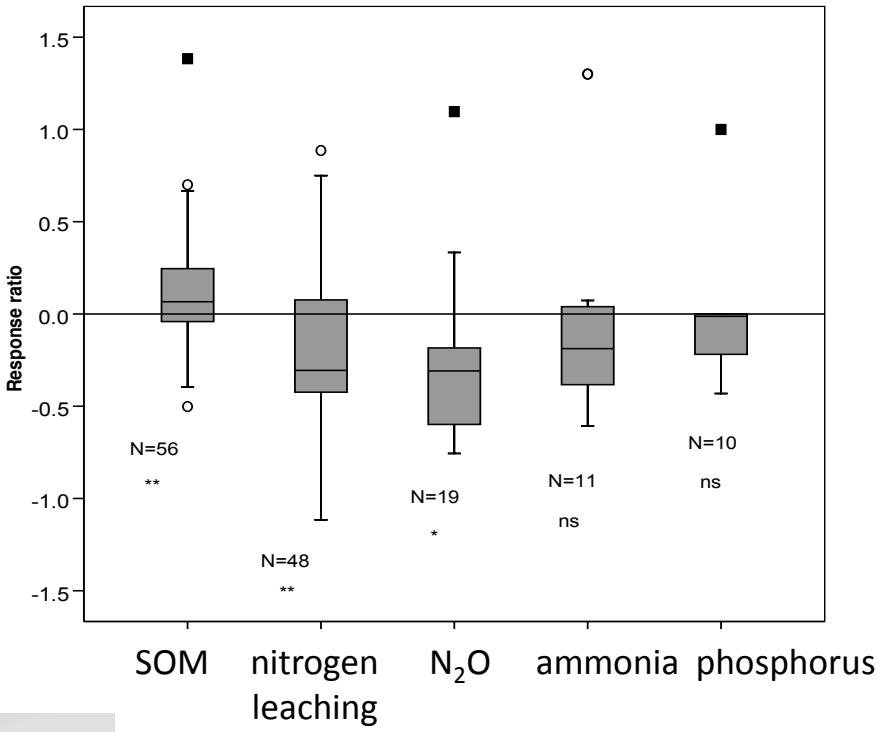
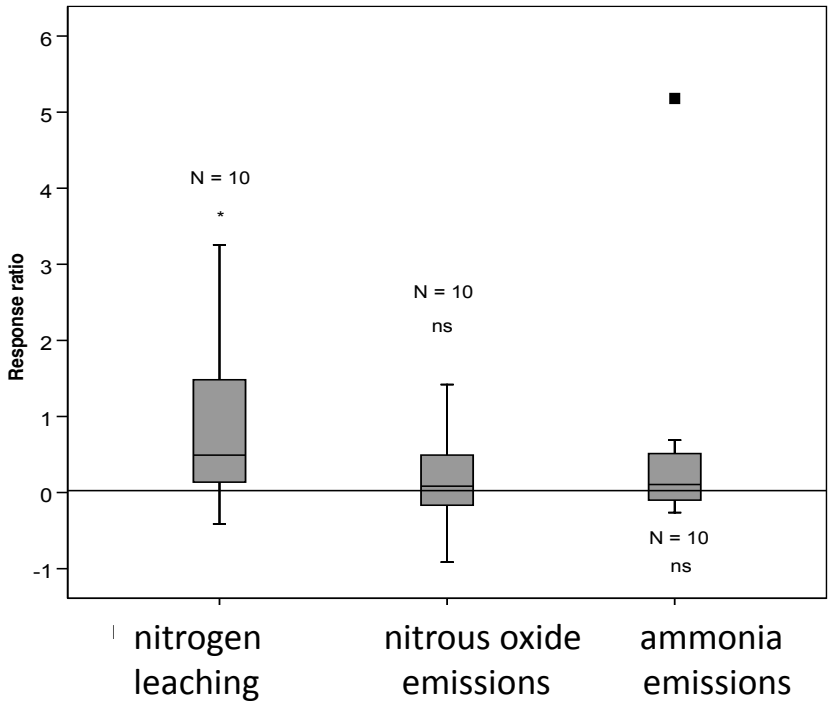
A Non-LCA impacts per unit of field area



B Non-LCA impacts per unit of product



*Median response ratios, quartiles, extreme values and outliers (O = 1.5-3 and ◆ > 3 box lengths from the upper or lower edge of the box) for non-LCA (Life Cycle Assessment) impacts (A): soil organic matter (SOM), phosphorus (P) losses, nitrogen (N) leaching, nitrous oxide emissions per unit of area and ammonia emissions per unit of area; and LCA impacts: energy use, greenhouse gas emissions (GHG), acidification potential (AP), eutrophication potential (EP) and land use (LU) per product unit. (+ impacts from organic farming are higher, - impacts from organic farming are lower, N=number of cases in the sample, ns=not significantly different from zero P>0.05, **P<0.01, *P<0.05)*

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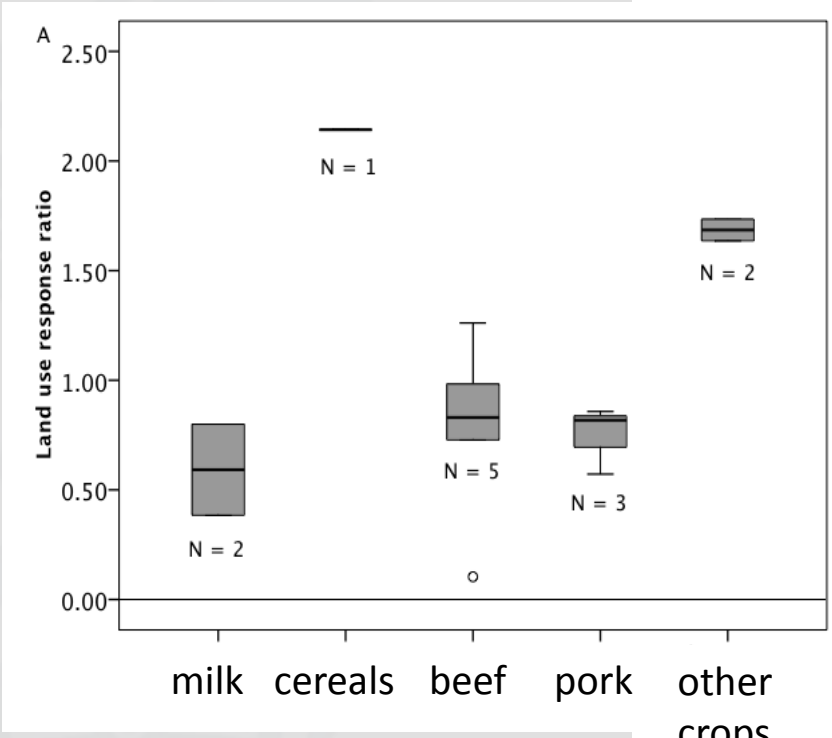
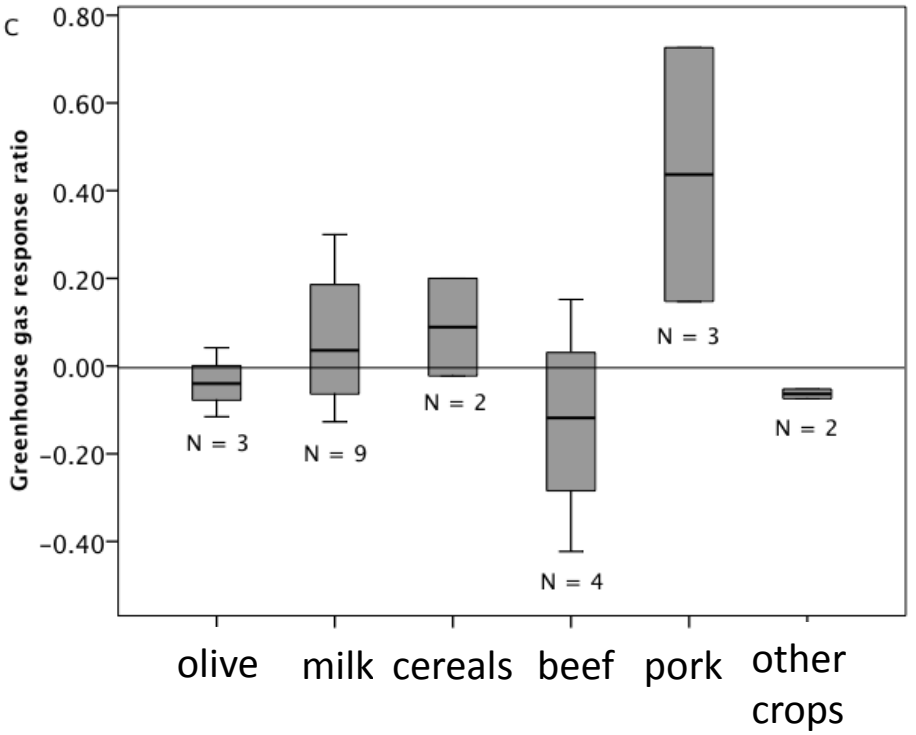
LCA impacts per unit of product

Land use response ratio



Greenhouse gas response ratio



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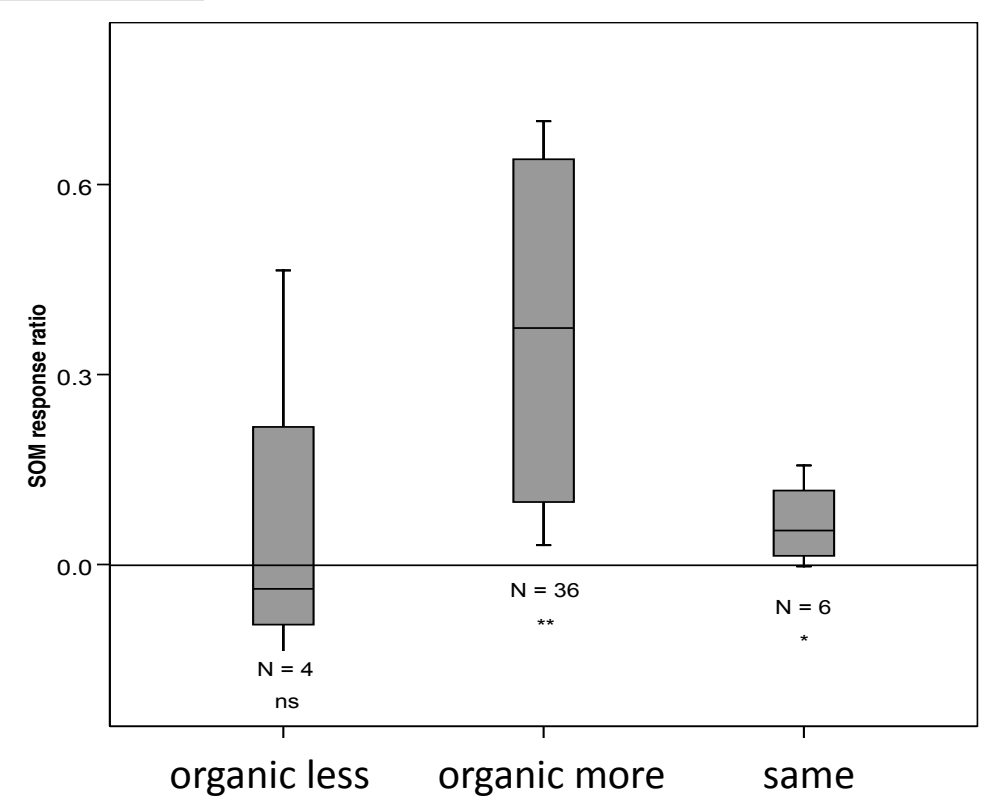
Soil organic matter



Response ratios for soil organic matter (SOM) when cases are grouped based on the relative manure inputs between the systems.

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Yields

	N	Min	Max	Mean	SD
Winter wheat	16	0.41	0.86	0.62	0.12
Spring wheat	5	0.70	0.87	0.78	0.06
Barley	14	0.25	0.85	0.65	0.18
Oat	5	0.40	0.80	0.61	0.17
Other cereals	4	0.48	0.83	0.67	0.15
Potato	11	0.17	1.32	0.68	0.37
Vegetables	13	0.60	1.00	0.79	0.16
Sugar beet	2	0.76	1.11	0.94	0.25
Leys	20	0.65	1.10	0.85	0.11
Olive	1	0.68	0.68	0.68	0.00
Citrus	1	0.68	0.68	0.68	0.00
Melons	2	1.64	1.81	1.73	0.11
Oilseed rape	2	0.53	1.11	0.82	0.40

Relative minimum, maximum and mean yields (organic/conventional), standard deviation of the means (SD) and number of cases (N).

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Biodiversity impacts

	Relative impact of organic (number of studies)		
Taxon	**positive**	**negative**	**no difference**
Birds	9	0	4
Mammals	3	0	0
Butterflies	3	0	3
Spiders	8	0	3
Earthworms	8	0	6
Beetles	16	2	5
Other arthropods	10	5	4
Plants	21	1	3
Soil microbes	18	1	11
TOTAL	**96**	**9**	**39**

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CONCLUSIONS

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Summary of the results

	Allocation unit Unit of field area	Unit of product
1) Nitrogen leaching	+++	
2) Phosphorus losses	+/-	
3) Soil organic matter	+	
4) Ammonia emissions	++	--
5) Nitrous oxide emissions	++	-
6) Energy use		++
7) Greenhouse gas emissions		+/-
8) Acidification potential		-
9) Land use		---
10) Eutrophication potential		---
11) Biodiversity	+++	

A summary of the results of the meta-analysis comparing environmental impact of organic farming on environment (the symbols are based on the median response ratios of each indicator as follows: <-0.30 (+++), -0.30…-0.175 (++), -0.175…-0.05 (+), - 0.05…0.05 (+/-), 0.05…0.175 (-), 0.175-0.30 (--), >0.30 (---), for biodiversity indicator the symbol presents the ratio of studies showing positive impacts from organic farming)

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Recommendations

- High yields important also from the environmental point of view
  - Challenge to improve yields without harming the environment
  - Nutrient management a key
- Farming systems that combine the best practices from organic and conventional farming may lead in the optimal result.
- The optimal system depends on the circumstances

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THANK YOU

hanna.tuomisto@lshtm.ac.uk

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References

- Tuomisto et al. 2012. Does organic farming reduce environmental impacts? – A meta-analysis of European research. Journal of Environmental Management, 112, 309-320.
- Photos: freeimages.com

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