SINGLE-IMPACT FICHE
ORGANIC FARMING SYSTEMS

IMPACT: GHG EMISSIONS

Data extracted in October 2021
Fiche created in March 2024

Note to the reader: This fiche summarises the effects of Organic farming systems on GHG EMISSIONS. It is based on 2 synthesis papers[1], including 13 and 71 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effect of organic farming systems on GHG emission (soil N_2O emission, soil CH_4 emission, livestock-derived GHG emission) is reported in **Table 1**.

The table below shows the number of synthesis papers with statistical tests reporting i) a significant difference between the Intervention and the Comparator, that is to say, a significant statistical effect, which can be positive or negative; or ii) a non-statistically significant difference between the Intervention and the Comparator. In addition, we include, if any, the number of synthesis papers reporting relevant results but without statistical test of the effects. Details on the quality assessment of the synthesis papers can be found in the methodology section of this WIKI.

- CH_4 emission: positive effects were reported by 1 synthesis paper for organic cropping systems (arable soils under organic management showed higher methane uptake, than under conventional), and by another one for organic livestock products (lower methane emissions). Non-statistically-tested results were reported in 1 synthesis paper on rice production from paddy soils.
- N_2O emission: positive effects were reported by 2 synthesis papers (1 on organic cropping systems and one for organic systems (as broad category without distiction on different types).
- CH_4 emission: positive effects were reported by 1 synthesis paper for organic cropping systems (arable soils under organic management showed higher methane uptake, than under conventional), while no results were available for livestock/mixed systems. Non-statistically tested results were reported in 1 synthesis paper on rice production from paddy soils.
- N_2O emission: negative effects were reported for organic cropping systems in 1 synthesis paper. Another one reported non-significant effects for organic systems . No results were available for livestock/mixed systems (as broad category without distiction on different types).

All selected synthesis papers included studies conducted in Europe (see **Table 2**).

Table 1: Summary of effects. Number of synthesis papers reporting positive, negative or non-statistically significant effects on environmental and climate impacts. The number of synthesis papers reporting relevant results but without statistical test of the effects are also provided. When not all the synthesis papers reporting an effect are of high quality, the number of synthesis papers with a quality score of at least 50% is indicated in parentheses. The reference numbers of the synthesis papers reporting each of the effects are provided in **Table 3**. Some synthesis papers may report effects for more than one impact or more than one effect for the same impact.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Decrease ghg emissions	CH_4 emission per unit of area	Organic cropping systems	Conventional	1	0	0	1
Decrease ghg emissions	CH_4 emission per unit of product	Organic cropping systems	Conventional	1	0	0	1
Decrease ghg emissions	N_2O emission per unit of area	Organic cropping systems	Conventional	1	0	0	1
		Organic systems	Conventional	1	0	0	0
Decrease ghg emissions	N_2O emission per unit of product	Organic cropping systems	Conventional	0	1	0	1
		Organic systems	Conventional	0	0	1	0

QUALITY OF THE SYNTHESIS PAPERS

The quality of each synthesis paper was assessed based on 16 criteria regarding three main aspects: 1) the literature search strategy and primary studies selection; 2) the statistical analysis conducted; and 3) the evaluation of potential bias. We assessed whether authors addressed and reported these criteria. Then, a quality score was calculated as the percentage of these 16 criteria properly addressed and reported in each synthesis paper. Details on quality criteria can be found in the methodology section of this WIKI.

[1] Synthesis research papers include either meta-analysis or systematic reviews with quantitative results. Details can be found in the methodology section of the WIKI.

2. IMPACTS

The main characteristics and results of the 2 synthesis papers are reported in **Table 2** with the terminology used in those papers, while **Table 3** shows the reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**. Comprehensive information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices, are provided in the **summaries of the synthesis papers** available in this WIKI.

Table 2: Main characteristics of the synthesis papers reporting effects on ghg emissions. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref18	Field studies assessing the performance of organic systems in comparison to conventional systems. In study organic systems organic practices were applied for at least three consecutive years prior to sampling.	Global	13	Organic systems (Arable crops, Grassland, Paddy rice fields)	Conventional systems	N2O emission per unit of area and product; CH4 emission per unit of area and product	There is scientific evidence for lower nitrous oxide emissions from organically managed soils when scaled to the area of cultivated land but higher emissions when crop yield-scaled. This discrepancy is due to the observed 26% lower crop yield under organic management. All arable soils showed an average methane uptake, which was slightly higher (both area-scaled and yield-scaled) under organic than under non-organic management.	50%
Ref27	Field studies, modelling studies and Life Cycle Assessment studies assessing the performance of organic systems in comparison to conventional systems in Europe.	Europe	71	Organic production of milk, beef, pork, olives, cereals	Conventional production of milk, beef, pork	GHG emissions (LCA approach) per unit of product	N2O emission per unit of area result significantly lower for all oganic production systems, while non significantly different per unit of product.	69%

Table 3: Reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Decrease ghg emissions	CH4 emission per unit of area	Organic cropping systems	Conventional	Ref18			Ref18
Decrease ghg emissions	CH4 emission per unit of product	Organic cropping systems	Conventional	Ref18			Ref18
Decrease ghg emissions	N2O emission per unit of area	Organic cropping systems	Conventional	Ref18			Ref18
		Organic systems	Conventional	Ref27			
Decrease ghg emissions	N2O emission per unit of product	Organic cropping systems	Conventional		Ref18		Ref18
		Organic systems	Conventional			Ref27	

3. FACTORS INFLUENCING THE EFFECTS ON GHG EMISSIONS

Table 4: List of factors reported to significantly affect the size and/or direction of the effects on ghg emissions, according to the synthesis papers reviewed.

Factor	Reference number
Per unit of field area: Positive; Per unit of product: Negative.	Ref18

4. KNOWLEDGE GAPS

Table 5: Knowledge gap(s) reported by the authors of the synthesis papers included in this review.

Ref Num	Gap
Ref18	Only one comparative study on rice paddies has been published up to date. All 19 retrieved studies were conducted in the Northern hemisphere under temperate climate.

5. SYNTHESIS PAPERS INCLUDED IN THE REVIEW

Table 6: List of synthesis papers included in this review. More details can be found in the summaries of the meta-analyses.

Ref Num	Author(s)	Year	Title	Journal	DOI
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Ref Num	Author(s)	Year	Title	Journal	DOI
Ref18	Skinner, C; Gattinger, A; Muller, A; Mader, P; Fliessbach, A; Stolze, M; Ruser, R; Niggli, U.	2014	Greenhouse gas fluxes from agricultural soils under organic and non-organic management - A global meta-analysis	Science of the Total Environment 468–469, 553–563	10.1016/j.scitotenv.2013.08.098
Ref27	Tuomisto HL; Hodge ID; Riordana P; Macdonald DW	2012	Does organic farming reduce environmental impacts? – A meta-analysis of European research	Journal of Environmental Management 112, 309-320	10.1016/j.jenvman.2012.08.018

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