SINGLE-IMPACT FICHE – ORGANIC SYSTEMS

IMPACT: EUTROPHICATION

Data extracted in October 2021

Note to the reader: This fiche summarises the impact of organic systems on EUTROPHICATION[1]. It is based on 2 peer-reviewed synthesis research papers[2], including 71 and 164 studies, respectively.

1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT: The effect on EUTROPHICATION of organic farming systems, as compared to conventional systems are reported as:
    - Eutrophication potential per unit of area: no results were available.
    - Eutrophication potential per unit of product: for organic cropping systems, 2 synthesis papers reported no significant effect and one negative effect. Different results were reported for livestock/mixed farming systems, with one synthesis paper reporting negative effects and one reporting no significant effect. Uncertain* results were reported by one synthesis paper for specific categories of products (e.g. cereals, dairy products, meats, eggs), due to lack of sufficient data to perform full statistical analysis.

The 2 synthesis papers included studies conducted in Europe.

Table 1. Summary of effects. The effect with the higher score is marked in bold and the cell coloured. The numbers between parentheses indicate the number of synthesis papers with a quality score of at least 50%. Details on quality criteria can be found in the next section. Some synthesis papers reported effects for more than type of system.

* Number of synthesis papers that report relevant results but without statistical test comparison of the intervention and the control.

- QUALITY OF TH

Impact	Metric	Impacts per unit of agricultural land				Impacts per unit of product			
		Positive	Negative	No effect	Uncertain *	Positive	Negative	No effect	Uncertain *
Organic cropping systems									
Decrease Eutrophication						0	1 (1)	**2 (2)**	1 (1)
Organic livestock systems									
Decrease Eutrophication						0	**1 (1)**	1 (1)	1 (1)

- QUALITY OF THE SYNTHESIS PAPERS: *The quality score summarises 16 criteria assessing the quality of three main aspects of the synthesis papers: 1) the literature search strategy and studies selection; 2) the statistical analysis; 3) the potential bias. Details on quality criteria can be found in this document →.*

[1] Eutrophication potential per unit of product (a measure of nutrification) is reported in PO_4 equivalents and includes eutrophication potential from phosphate, nitrogen oxides, ammonia, and ammonium, among others. Eutrophication is a measurement of the increase in nutrients entering an ecosystem. Eutrophication has substantial environmental impacts including, but not limited to, algal blooms and aquatic dead zones. Emissions are accounted for all 'cradle-to-farm gate' activities (Clark and Tilman, 2017, 10.1088/1748-9326/aa6cd5).

[2] Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results

As shown in the "Quality score" in **Table 2,** the quality the 2 synthesis papers retrieved ranged from 63% to 69%. The least frequently satisfied quality criteria were: "Search string", "Number of studies of each step", "Individual effect sizes", "Individual studies weighted", "Heterogeneity of results analysed" and "Publication bias analysed".

2. IMPACTS

The main characteristics and results of the 2 synthesis papers[1] are summarized in **Table 2**. The references are ordered chronologically with the most recent publication date first.

Table 2. Main characteristics of the synthesis papers reporting impacts on eutrophication. All detailed results of each synthesis study are reported in the summary reports →.

Reference	Population	Geographical scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Clark, M; Tilman, D. 2017	LCA studies assessing the performance of organic systems in comparison to conventional systems. Emissions are accounted for all 'cradle-to-farm gate' activities.	Global. *	164	Organic Cereals, Organic pulses and oil crops, Organic fruits, Organic Vegetables, Organic meats, Organic dairy products and eggs	Conventional systems	Eutrophication potential per unit of product (a measure of nutrification) is reported in PO_4 equivalents and includes eutrophication potential from phosphate, nitrogen oxides, ammonia, and ammonium, among others. Eutrophication is a measurement of the increase in nutrients entering an ecosystem. Eutrophication has substantial environmental impacts including, but not limited to, algal blooms and aquatic dead zones. Emissions are accounted for all 'cradle-to-farm gate' activities.	Organic systems (all types as average) showed 37% higher ($p = .0383$; $n = 20$) eutrophication potential per unit of product than conventional systems. For organic cereals, vegetables and meats eutrophication potentials per unit product resulted significantly higher, as compared to conventional products. For organic pulses, oil crops, dairy products and eggs, eutrophication potential per unit product resulted in no significant change, as compared to conventional products.	62%
Tuomisto HL; Hodge ID; Riordana P; Macdonald DW 2012	Field studies, modelling studies and Life Cycle Assessment studies assessing the performance of organic systems in comparison to conventiona	Europe	71	Organic production of milk, cereals, beef, pork	Conventional systems	Eutrophication potential per unit of product (LCA approach)	There is not a single organic or conventional farming system, but a range of different systems, and thus, the level of many environmental impacts depend more on farmers' management choices than on the general farming systems.	69%

l systems in Europe.

*In Clark and Tilman (2017), the majority of LCA publications included are from agricultural systems in Europe, North America, and Australia and New Zealand (86% of systems are from these regions). Systems from China (2%), Japan (2%), the rest of Asia (5%), South America (4%), and Africa (.4%) are much less common. The results presented here are therefore indicative of highly industrialized systems and should be interpreted with this in mind.

3. KNOWLEDGE GAPS

The synthesis papers did not indicate relevant knowledge gaps.

4. SYSTEMATIC REVIEW SEARCH STRATEGY

Keywords	TOPIC: ("organic farm*" OR "organic agriculture" OR "organic system*" OR "organic product*") AND TOPIC: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") TOPIC: ((organic near/4 farm*) OR (organic near/4 agric*) OR (organic near/4 produc*) OR (organic near/3 livestock) OR (organic near/3 animal)) AND TOPIC: ("animal*" OR "livestock" OR "ruminant*" OR "small ruminant*" OR "cattle" OR "dairy cattle" OR "dairy" OR "beef cattle" OR "sheep" OR "ewe*" OR "lamb*" OR "swine" OR "pig*" OR "porcine*" OR "goat*" OR "rabbit*" OR "poultry" OR "chicken*" OR "broiler*" OR "turkey*" OR "hen*" OR "horse*" OR "mule*" OR "milk" OR "egg" OR "beef" OR "cheese" OR "meat" OR (animal near/2 protein*) OR "yogurt" OR "bacon" OR "pork") AND TOPIC: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis")
Search dates	No time restrictions
Databases	Web of Science and Scopus, run for the first time in July 2020 and updated in September 2021 and October 2021.
Selection criteria	Four main criteria led to the exclusion of a synthesis paper: (1) the paper does not deal with organic systems; (2) the paper does not assess the impacts of organic systems in comparison to another cropping system; (3) the paper report results on the effect of specific farming practices (e.g. organic fertilisation, green manure, alternative pest control techniques, etc.) which are part of organic systems, instead of the effect of the whole farming system; (4) the paper is neither a meta-analysis nor a systematic review including quantitative results. Synthesis papers that passed the relevance criteria were subject to critical appraisal carried out on paper-by-paper basis. From the 220 potentially relevant synthesis papers, 140 were excluded after reading the title and abstract, and 50 after reading the full text according to the above-mentioned criteria. Finally, 30 synthesis papers were selected for organic farming systems, from which 2 were relevant for this impact.