SINGLE-IMPACT FICHE – ORGANIC SYSTEMS

IMPACT: AGRICULTURAL LAND USE

Data extracted in October 2021

Note to the reader: This fiche summarises the impact of organic systems on AGRICULTURAL LAND USE[1]. It is based on 3 peer-reviewed synthesis research papers[2], including 9, 71 and 164 individual studies, respectively.

1.WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT: organic farming systems, as compared to conventional systems require more AGRICULTURAL LAND USE per unit of product, with 3 results showing negative effects for cropping systems and 2 for livestock/mixed farming systems. One synthesis paper included uncertain results for both cropping and livestock systems. One synthesis paper indicated that organic systems required 25%-110% more agricultural area, with the highest values for vegetables, meats, dairy and eggs production. The 3 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 one type of system.

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 Agricultural land use per unit of product						0	**3 (3)**	0	1 (1)
Organic livestock systems									
Decrease Agricultural land use per unit of product						0	**2 (2)**	0	1 (1)

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

- 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* →.

As shown in the "Quality score" in **Table 2,** the quality the 7 synthesis papers retrieved ranged from 50% 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".

[1] Agricultural land use per unit of product (also called Agricultural land use efficiency) is calculated (typically by Life-cycle analysis approaches) as the ratio between the total land used and the total amount of target food products obtained along the whole production chain. For crops production systems only, this impact is nearly equivalent to crop yield.

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

2. IMPACTS

The main characteristics and results of the 3 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 agricultural area. 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	Agricultural land use per unit of product	Organic systems, as average, require 25%–110% more land use ($p<0.001$; $n=37$), than conventional systems. Significantly higher land use for all types of organic products: cereals, fruits, vegetables, dairy products, meats, oil crops and pulses.	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 conventional systems in Europe.	Europe	71	Organic production of milk, cereals, beef, pork	Conventional systems	Agricultural land use per unit of product (LCA approach)	This meta-analysis showed that organic farming requires more land than conventional farming.	69%
Mondelaers, K; Aertsens, J; Van Huylenbroeck, G. 2009	Studies assessing the performance of organic systems in comparison to conventional systems.	Global	9	Organic systems	Conventional systems	Agricultural land use efficiency per unit of product	Based on the general results of ten studies of organic farming in developed countries, land use efficiency of 83 per cent for organic farming compared with conventional farming.	50%

*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 3 were relevant for this impact.