SINGLE-IMPACT FICHE – ORGANIC SYSTEMS

IMPACT: BIODIVERSITY

Data extracted in September 2020

Note to the reader: This fiche summarises the impact of organic systems on BIODIVERSITY. It is based on a review of 13 peer-reviewed synthesis research papers[1]. Each synthesis paper includes a number of individual studies, which ranges in this case from 7 to 94.

1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT: Out of the 13 synthesis papers dealing with biodiversity impacts, 11 show positive effect of organic systems on biodiversity (see Table 1). Organic systems impacts are compared to conventional systems. Almost of all the studies reviewed included experiments conducted in Europe.

Table 1. Summary of impacts. The effect with the higher score is marked in bold and the cell coloured. The numbers between parenthesis indicate the number of synthesis papers[1] with a quality score of at least 50%. Details on quality criteria can be found in the next section.

Impact	Comparator	Positive	Negative	No effect	Uncertain
Increase biodiversity	Conventional systems	**11 (10)**	0	0	2 (0)

Positive effects are reported for species richness and/or abundance and concerned a large range of organisms, in particular arthropods (especially insects), birds, and soil organisms. One of the synthesis papers reports that biodiversity gains are enhanced when average crop field size in the landscape increases. Two synthesis papers report uncertain results; one was focused on microbial biomass in Brazil, and the other did not report any quantitative results.

- 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" of the table in section 2, the quality level ranges from 25% to 100%, with only three synthesis papers with a quality score lower than 50%. The least frequently satisfied quality criteria were "publication bias analysed" (satisfied in 4 synthesis papers) and "individual studies weighted" (satisfied in 5 synthesis papers).

2. IMPACTS

The main characteristics and results of the 13 synthesis papers are summarized in the table presented below. The references are ordered chronologically with the most recent publication date first.

[1] Research synthesis papers include meta-analysis or systematic reviews.

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

Nr	Reference	Population	Geographical scale	Intervention	Comparator	Conclusion	Quality score	Global effect
1	Smith, OM; Cohen, AL; Reganold, JP; Jones, MS; Orpet, RJ; Taylor, JM; Thurman, JH; Cornell, KA; Olsson, RL; Ge, Y; Kennedy, CM; Crowder, DW. 2020	Organic and conventional systems.	Global	Organic systems	Conventional systems	Organic sites had greater biodiversity (34%) than conventional sites. Biodiversity gains increased as average crop field size in the landscape increased, suggesting organic farms provide a "refuge" in intensive landscapes.	88%	Positive
2	Smith, OM; Cohen, AL; Rieser, CJ; Davis, AG; Taylor, JM; Adesanya, AW; Jones, MS; Meier, AR; Reganold, JP; Orpet, RJ; Northfield, TD; Crowder, DW. 2019	Organic and conventional systems.	Global	Organic systems	Conventional systems	Higher mean biotic abundance and richness and lower variability (in biotic abundance and richness) in organic systems than in conventional systems.	56%	Positive
3	Doring, J; Collins, C; Frisch, M; Kauer, R. 2019	Organic, biodynamic viticulture and conventional systems.	Global	Organic systems	Conventional systems	Biodiversity at different trophic levels was enhanced under organic and biodynamic viticulture compared to conventional management.	25%	Positive
4	Katayama, N; Bouam, I; Koshida, C; Baba, YG. 2019	Four systems: Organic (Org), conventional (Conv), integrated (Int) and abandonned (Aba) systems of perennial orchards and vineyards, which produce a variety of fruit and nut crops, + (semi) natural habitats.	Global	Organic systems	Conventional and integrated systems	Organic farming restored both richness and abundance, including a variety of (dis)service-providing organisms.	94%	Positive

Nr	Reference	Population	Geographical scale	Intervention	Comparator	Conclusion	Quality score	Global effect
5	Lori, M; Symnaczik, S; Mader, P; De Deyn, G; Gattinger, A. 2017	Organic and conventional systems	Global	Organic systems	Conventional systems	This study shows that overall organic farming enhances total microbial abundance and activity in agricultural soils at a global scale.	100%	Positive
6	Lichtenberg, EM; Kennedy, CM; Kremen, C; Batary, P; Berendse, F; Bommarco, et al.. 2017	Agroecosystems, including organic systems.	Global	Organic systems	Conventional systems	Results suggest that organic farming promotes diverse arthropod metacommunities that may provide temporal and spatial stability of ecosystem service provisioning.	88%	Positive
7	Tuck, SL; Winqvist, C; Mota, F; Ahnstrom, J; Turnbull, LA; Bengtsson, J. 2014	Organic and conventional systems.	Global	Organic systems	Conventional systems	This analysis shows that organic farming usually has large positive effects on average species richness compared with conventional farming.	94%	Positive
8	Montañez, MN; Amarillo-Suárez, A. 2014	Organic and conventional systems.	Global	Organic systems	Conventional systems	Organic crops certainly increase the taxonomic richness and abundance of insects as well as the richness of insects within trophic guilds (herbivores, predators, pollinators and parasitoids). Thus, the belief that organic agriculture contributes to the conservation of biodiversity is supported by the analyses performed here for the case of insects. An additional and important result that emerged from this study is that both the agrosystem and the surrounding landscape are relevant to the conservation of biodiversity.	75%	Positive
9	Wilcox, JC; Barbottin, A; Durant, D; Tichit, M;	Organic and conventional systems.	Europe and North America	Organic systems	Conventional systems	Organic farming systems supported on average higher bird numbers (1 to 3 more birds) than conventional systems. However, this	81%	Positive

Nr	Reference	Population	Geographical scale	Intervention	Comparator	Conclusion	Quality score	Global effect
	Makowski, D. 2013					positive effect was significant in less than half of the experiments, showing that the uncertainty about the estimated effects is high. Skylarks nesting territories were two-times higher in legume and set-aside fields than in other crops during the breeding season.		
10	Tuomisto, HL; Hodge, ID; Riordana, P; Macdonald, DW. 2012	Organic and conventional systems.	Europe	Organic systems	Conventional systems	The effects of conventional and organic farming systems on biodiversity are uncertain.	44%	Uncertain
11	Crowder, DW; Northfield, TD; Gomulkiewicz, R; Snyder, WE. 2012	Organic and conventional managed farms.	Global	Organic managed farms	Conventional managed farms	Total organism abundance and rarefied evenness of a broad range of organisms (arthropods, birds, non-bird vertebrates, plants, soil organisms), significantly increased following implementation of organic farming. Change in richness was not predictive of change in eveness.	75%	Positive
12	Kaschuk, G; Alberton, O; Hungria, M. 2010	Organic and conventional systems.	Brazil	Organic systems	Conventional systems	Organic farming resulted in higher soil microbial biomass-C and microbial quotient and reduce metabolic quotient.	44%	Uncertain
13	Bengtsson, J; Ahnstrom, J; Weibull, AC. 2005	Organic and conventional systems.	Global	Organic systems	Conventional systems	On average, the increase in species richness was around 30% compared with conventional farming.	69%	Positive

3. KNOWLEDGE GAPS

[They are extracted from each synthesis paper, synthesized and consolidated]

- Orchards/vineyards: The contribution of an enhanced biodiversity to abundance and biodiversity of antagonistic insects in vineyards should be further investigated and quantified. Future meta-analytic studies should focus on the role of large-scale factors on biodiversity and ecosystem services in orchards/vineyards.
- Data overrepresented in temperate/mesothermal climate zones. More studies are needed in tropical, subtropical and Mediterranean climates.
- Publications often did not provide detailed information on the agricultural characteristics of the fields or farms used in the study.
- Birds biodiversity metrics: Only a few metrics, such as mean bird abundance per ha, were used in several articles. Authors commonly failed to provide measures of variation or replicate numbers for the metrics measured. Few publications provided quantitative information that both linked bird populations to farming practices and could be combined with metrics from other studies.
- A key challenge for future research lies in unravelling the ecological processes that allow independent movement in evenness and richness, despite their, often, similar contributions to ecosystem function. Experiments that separately manipulate richness from evenness, and vice versa, could provide a particularly powerful way to uncover the contribution of each biodiversity facet to ecosystem health and food-web interactions.
- Direct relationships between soil microbial biomass -C and nutrient-cycling dynamics, microbial diversity and functionality are still unclear. Further studies are needed to develop strategies to maximize beneficial effects of microbial communities on soil fertility and crop productivity.
- In studies of farmland biodiversity, the farmers themselves are often ignored. The attitude of individual farmers, rather than which farming system is used, is probably the most important factor determining biodiversity at the farm level.

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")
Search dates	No time restrictions
Databases	Web of Science and Scopus, run on 20 July 2020
Selection criteria	Three 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 is neither a meta-analysis nor a systematic review. Synthesis papers that passed the relevance criteria were subject to critical appraisal carried out on paper by paper basis. From an initial number of 122 synthesis papers, we finally selected 13 meta-analyses or systematic reviews.