FARMING PRACTICE
ORGANIC FARMING SYSTEMS

IMPACT: ENERGY USE (LCA)

Reference 11

Clark, M; Tilman, D. 2017 Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. ENVIRONMENTAL RESEARCH LETTERS 12 6 10.1088/1748-9326/aa6cd5

Background and objective

Understanding how alternative agricultural production systems, agricultural input efficiency, and food choice drive environmental degradation is necessary for reducing agriculture's environmental impacts. Recent increases in the number of published LCAs enables more complete analysis of the comparative impacts of organic and conventional systems across a range of environmental indicators and foods. This meta-analysis aims at comparing the impacts of agricultural production systems, agricultural input efficiency and food choice these comparisons for five environmental indicators: greenhouse gas emissions (GHGs), land use, fossil fuel energy use, eutrophication potential, and acidification potential. We focus here on energy use.

Search strategy and selection criteria

The search was conducted in Web of Knowledge, PubMed, AGRICOLA, and Google Scholar for food LCAs published before July 2015. The author's analyses include all relevant pre-farm and on-farm activities (fertilizer production and application, seed production, farm energy use, feed and fodder production, manure production (when used for fertilizer), manure management, infrastructure construction, etc) and their associated environmental impacts up until a food leaves the farm. Our analyses are thus of 'cradle-to-farm gate' activities; a paucity of data on post-farm gate impacts limited our ability to analyze them in a balanced manner, although a previous analysis showed that the vast majority of a food's greenhouse gas emissions stem from 'cradle-to-farm gate' activities. Several publications were excluded because a lack of defined system boundaries made direct comparisons with other LCAs impossible. In addition, some LCAs conducted by for-profit companies were excluded because of potential biases.

Data and analysis

The log ratio of impacts of different production systems by food item within each publication was calculated. These log ratios were then aggregated foods into groups of similar food types (cereals; fruits; vegetables; pulses, nuts and oil crops; dairy and eggs; and meats) to improve the power of statistical tests. The significance of differences between alternative production systems was tested using t-tests on the response ratio.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
164	LCA studies assessing the performance of organic systems in comparison to conventional systems. Emissions are accounted for all 'cradle-to-farm gate' activities.	Organic Cereals, Organic pulses and oil crops, Organic fruits, Organic Vegetables, Organic meats, Organic dairy products and eggs	Conventional systems	Metric: Energy use per unit of product; Effect size: Ratio of the considered metrics in the intervention to the considered metrics in the control	62.5

Results

- Organic systems, as average, use 15% less energy per unit of product ($p = .0452$; $n = 33$), than conventional systems.
- Significantly lower energy use for dairy products, cereals, oil crops and pulses.
- Significantly higher energy use for vegetables.
- No significant effect for meats and fruits.
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Organic systems use 15% less ($p = .0452$; $n = 33$) energy per unit of product, than conventional systems. Significantly lower energy use for dairy products, cereals, oil crops and pulses. Significantly higher energy use for vegetables. No significant effect for meats and fruits.