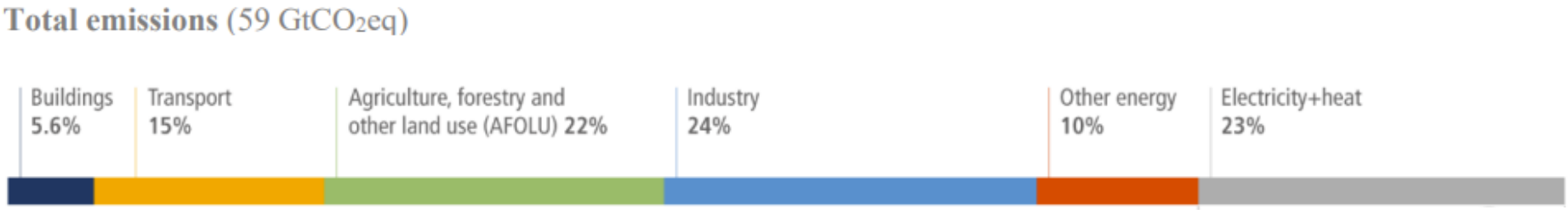
Organic versus conventional food emissions under different carbon footprint metrics
Maria Vincenza Chiriacò

EGU22-2713 - Session SSS9.4 Organic farming and Soil management, with a special emphasis on P biogeochemistry

GHG emissions from the Food System: IPCC AR6 (2022)



- 23-42% of global GHG emissions are associated with food systems

Making food consumption and agricultural production and processing more sustainable is an imperative target to control and address the climate crisis.

Organic farming is widely recognized as a sustainable agriculture:

- ✓ Healthy food with lower environmental impacts and a plethora of co-benefits (biodiversity protection, reduced GHG emissions, increase of soil organic carbon stock, resilience and adaptive capacity);
- ✓ Supported by EU and global policies: CAP, Green Deal in its Farm to Fork Strategy.

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A DEBATE on organic farming exists in the scientific community on its effective sustainability in terms of GHG emissions:

- FROM ONE SIDE: lower inputs and emissions than conventional farming, representing a possible pathway to sustainably feed the global population;
- FROM THE OTHER SIDE: yields are on average lower than conventional farming and to produce the same amount of food more cultivated land would be needed.

Clear **INDICATORS OF GHG EMISSIONS** are crucial to solve the existing debate:

The environmental sustainability of the agrifood system is usually quantified through the Life Cycle Assessment (LCA) and its indicator of **Carbon Footprint (CF)** → measures the GHG emissions (in CO_2eq) generated to produce a good along its entire life cycle, assessed per **FUNCTIONAL UNITS:**

- **PER UNIT OF PRODUCT (kg CO_2eq / kg of product)**
- **PER UNIT OF CULTIVATED LAND (Mg CO_2eq / ha / year)**

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The **two CF METRICS** (*per **land unit*** or ***product unit***) when applied to food can lead to very **DIVERSE RESULTS, EVEN OPPOSITE,** especially when ***conventional*** vs ***organic*** food is compared.

The contribution to climate change of different agricultural systems can be very diverse:

- Organic food production usually generate lower GHG emissions in absolute terms compared to conventional farming

  → ***expected lower CF per unit of land***

- Since organic yields are on average lower than conventional, total GHG emissions, although lower in absolute terms, are spread over less product units

  → ***predictable higher CF per unit of product***

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To provide evidence on the applicability of the ***2 CF metrics*** and to contribute to a more informed debate on the actual sustainability of the ***organic vs conventional food systems***:

→ we explored (search and analysis) existing peer-reviewed studies that allow to compare the CF of ***organic vs conventional*** food, expressed both per ***unit of product*** and ***per unit of land.***

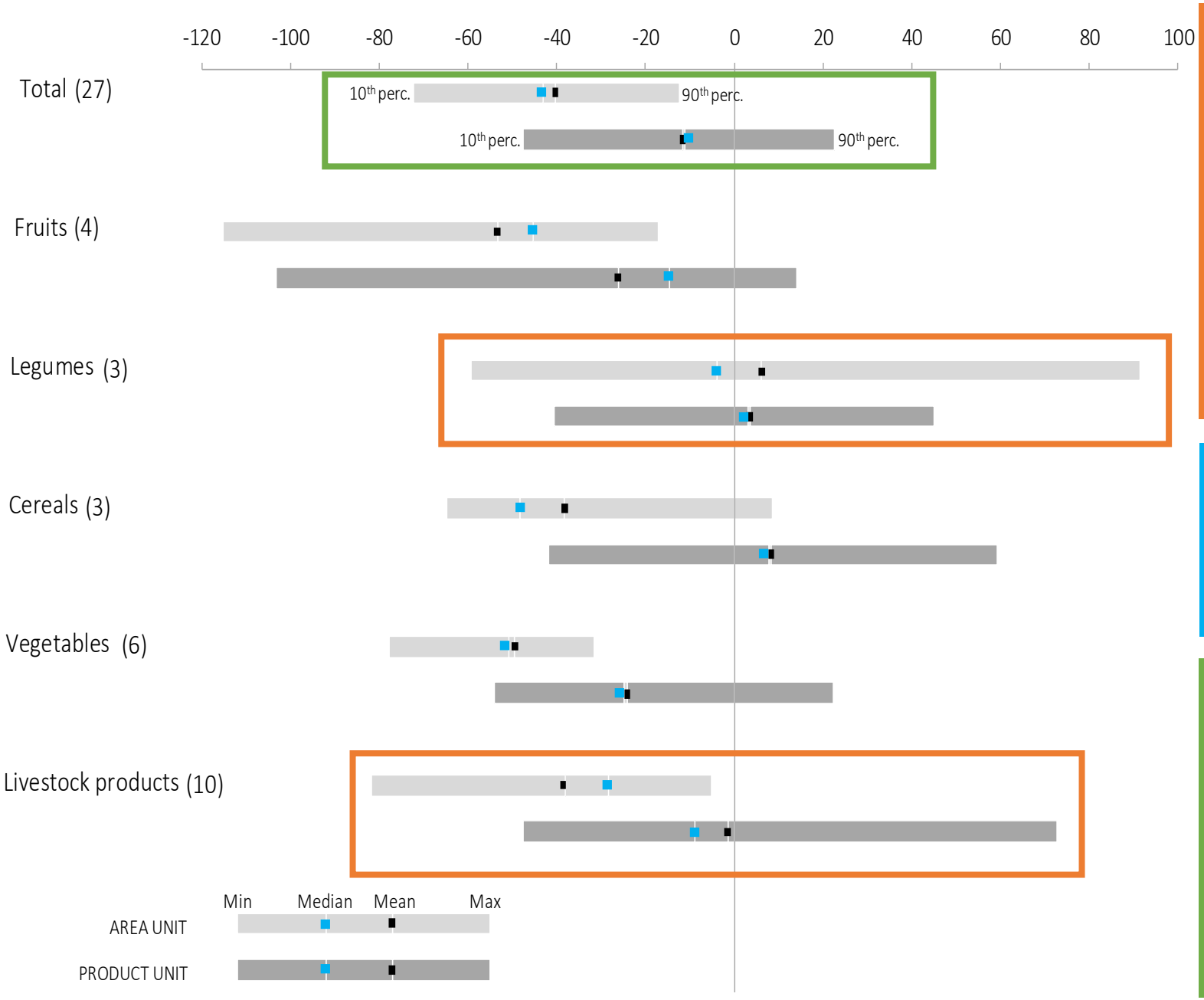
- 27 papers report for both **organic and conventional food**, the **CF per area** (Mg CO_2eq ha^{-1} per year) and **per product** (kg CO_2eq kg^{-1}) or provide the information needed (e.g. yields or land used) to derive both the CF metrics when only one of them was reported.

- 41 items of organic and conventional food products

  → grouped into 5 main food categories:

  Fruits, Legumes, Cereals, Vegetables, Livestock products

RELATIVE % DIFFERENCE OF GHG EMISSIONS OF ORGANIC VS CONVENTIONAL FOOD: NEG values represent an advantage of organic food, zero line represent equal impact, POS values represent an advantage of conventional food



Great variability among food categories and between the 2 CF metrics for the same category:

- legumes show a wide range for CF per land unit, from -59% to +91%, meaning that GHG of organic legumes can be either lower or higher than conventional;
- Livestock product show CF per product unit from -48% to +73%, and CF per land unit always below zero.

Median values of the 2 CFs are always below zero – with the only exception for the product unit of legumes and cereals – ***suggesting a general advantage of organic farming systems***.

For almost all the 41 food items, organic food has always lower impact than conventional ***per land unit***, with an average -43% (median).

What is surprising is that most of the studies (28 food items out of 41) shows that organic food has lower impact than conventional ***per product unit***, with an average -12% (median).

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Global food system emissions form the land sector (Gt CO_2eq y^{-1})[a]	11.1
Global agricultural lands (M ha)	4800
Global organic croplands[c] (M ha)	71.5
Emission intensity of the current croplands[d] (Mg CO_2eq ha^{-1} yr^{-1})	2.3
Emission intensity of organic croplands[e] (Mg CO_2eq ha^{-1} yr^{-1})	1.3
Potential global emissions of an ideal full organic food system (Gt CO_2eq y^{-1})[a]	6

[a] GHG Emissions of global food system (land use change + agriculture) as reported in Table SPM1 of the IPCC 2019 Special report on Climate Change and Land - Summary for Policy Makers

[c] FiBL Statistics - Area https://statistics.fibl.org/world.html

[d] Considering 4.8 billion hectares of global agricultural lands with a global share of 1.5% organic croplands share (Source: FAOSTAT and FiBL Statistics - Area)

[e] Considering an average cut of -43% GHG emissions per ha

Thanks

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