MAKING THE POSITIVE IMPACT OF ORGANIC AGRICULTURE VISIBLE

Existing evidence, why major positive impacts are being underplayed, and what needs to change in reporting frameworks

January 2025

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Contents

This report was prepared for the Robin Food Coalition and with the support of Provincie Noord Holland

Provincie Noord-Holland

Executive summary

This paper aims to identify why the major positive impacts of organic agriculture are often underplayed in the results of food sustainability assessments. It reviews the evidence on these positive impacts and the research on what needs to be added to mainstream sustainability reporting instruments for these benefits to be fully reflected.

All existing meta-analyses about biodiversity of organic farming systems agree that these perform better compared to conventional ones. This means significantly higher species richness and greater diversity of pollinators, farmland birds and crop varieties[1]. Organic systems create conditions that support a more varied ecosystem, which is crucial to meet targets to halt and reverse biodiversity decline globally.

Multiple meta-analyses indicate that organic farming systems also often produce fewer greenhouse gas (GHG) emissions compared to conventional ones[2]. Primarily because they avoid synthetic inputs such as fertilizers and pesticides. Also, depending on the choice of metrics (per kg product or per hectare farmed) some meta-analyses have found contrasting results, showing similar impacts, or better impacts for conventional agriculture[3], depending on yields. Researchers agree that organic farming practices like cover cropping, composting and extended crop rotations lead to a significant increase in soil carbon, which contributes to mitigating climate change, even though mostly not considered in GHG footprints.

Organic soils are found not only to store more carbon, but to be healthier, too: better structure and microbial activity strengthen resilience against droughts and extreme rainfall, natural resistance to pests and diseases, and nutrient cycling.

Organic farming also leads to better water quality, by eliminating pesticide leaching and reducing nitrate pollution.

Next to environmental benefits, organic food also is found to have higher nutrient concentration[4]. Observational studies report that diets high in organic food consumption are associated with lower risks of chronic diseases such as type 2 diabetes and certain cancers. Organic food is also noted for reduced harmful substances such as pesticide residues and nitrates[5]. Although more research is needed to fully confirm these findings, the current scientific evidence strongly supports the health benefits of increasing organic food in diets.

Why are positive impacts of organic food systems being underplayed in today's sustainable food system discourse, notwithstanding extensive evidence?

The first reason is the excessive focus on product-level efficiency metrics, and in particularly two sustainability metrics (GHG emissions per kg and land use per kg), which most often favour conventional agriculture over organic. These metrics take a limited perspective, ignoring the necessity of shifting diets and the protein transition in order to meet sustainability targets. *Diet-level metrics, product-mix level metrics, and scenarios including the protein transition, should also be used by policy and business sustainability assessments of the food system.*

Additionally, comparing impacts only per unit of product (i.e. per kg) entirely ignore the fact that similar products can have different nutritional content and health value.

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[1] Pfiffner & Stöckli, 2023, Tuck et al., 2014, Sanders et al., 2022

[2] Chiriacò et al., 2022, Michalke et al. 2023, Scialabba et al., 2010; Skinner et al.,2019

[3] Hashemi et al. 2024

[4] Crinnion, 2010, Rembialkowska,E., 2007

[5] Lairon 2010

Product-level efficiency metrics also ignore the link between natural capital protection and agriculture: land use for food production should not be minimized but optimized. Biodiversity and ecosystem services are also products of agricultural land. In many places, farms do not only produce food, but also safeguard soil fertility, rainwater buffers, habitats for wild species, nature viability in the surroundings, carbon sequestration, and other ecosystem services. *The fact that farmland have multiple outputs next to food can be better integrated in assessments at the product level*.

However, a product-level lens can never show the actual impact on people, the environment and the climate. The impact of agriculture must be assessed at the hectare, farm or landscape level as well. There is ample evidence of the benefits of organic agriculture at the area level, on biodiversity, contamination of water, air and soil[6]. Therefore, many government policies favour organic agriculture, while product-level studies do not capture this benefit, as much as the water footprint of a product does not capture the total freshwater withdrawal from irrigation in a specific region. *Food sustainability assessment need to include area-based metrics and metrics that reflect farm-level sustainability, next to product-level impacts*.

Academics have also raised the issue that Life Cycle Assessment (LCA) models, the dominant method for evaluating sustainability of products, are biased in favor of conventional systems, because organic farming benefits such as nutritional value, soil health, and nutrient fluxes are not commonly well captured in LCA studies. Also, biodiversity characterisation factors for agricultural land are not able to capture the difference between farming practices, and pesticide impact models are partial and often outdated. *Improvements to datasets and models on pesticides, biodiversity and soil health are required for organic agriculture's benefits to show up in LCA studies*.

Mainstream sustainability assessment and reporting frameworks have large room for improvement when it comes to capturing the benefits of organic agriculture, and some recommendations are presented. There should be sector-specific standards about reporting metrics for agrifood businesses in the Corporate Sustainability Reporting Directive (CSRD), especially on biodiversity and soil degradation and complementing product-level metrics with area- or farm-level ones. In GHG accounting, models and data that are more tailored to organic farming practices are needed, and more focus is required on Scope 3 emissions for the food sector, to avoid an underestimation of the environmental impact of fertiliser use and imported feed. The Science-Based-Target Network (SBTN) standard on land should consider biodiversity on agricultural land, and more attention should be given to whether companies are already operating near sustainable thresholds, for example with low input use, moving away from an exclusive focus on reductions over time. The Product Environmental Footprint (PEF) methodology should be improved to better include biodiversity loss due to farming practices, land degradation and pesticide effects. More collaboration is required to identify and promote changes to said frameworks.

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[6] van der Werf et al 2020

Introduction

The assessment of food sustainability today largely revolves around a narrow set of metrics, particularly land use and greenhouse gas (GHG) emissions per kilogram of product. This limited focus often fails to capture the full scope of environmental impacts, leading to conclusions that overlook the environmental benefits and increased resilience that organic farming offers. While organic agriculture has been shown to support biodiversity, enhance soil health, conserve water, and contribute to resilience to climate extremes, these advantages are frequently undervalued in mainstream sustainability assessments. Organic practices are often dismissed as less efficient due to higher land use, and for some products higher GHG emissions per unit of product, without recognising the substantial societal benefits and long-term sustainability gains they provide.

This paper aims to illustrate, in Part 1, the scientific evidence that is overlooked by conventional sustainability frameworks, leading to an incomplete and potentially misleading comparison between organic and conventional systems. With this, we aim to give a broader view of what should be considered in assessing agricultural sustainability.

This shows the urgent need for the organic sector to advocate for a more realistic assessment approach to be taken up in the existing sustainability framework. Part 2 of this paper illustrates the reasons why the major positive impacts of organic agriculture are currently not captured by sustainability assessment. It draws from insights from science and the practice of impact measurement. Part 3 addresses how existing reporting frameworks could better capture the benefits of organic agriculture, ensuring that organic practices receive fair evaluation and support within the evolving landscape of sustainability reporting standards. This includes the need for additional product-level KPIs, the need to go beyond product-level assessments, and the need to include a more holistic view of agriculture sustainability in mandatory disclosure requirements such as the Corporate Sustainability Reporting Directive (CSRD) and voluntary frameworks like the Science-Based-Targets Initiative (SBTi) for climate change and Science-Based Targets Network (SBTN) for nature.

Section 1: Evidence of organic agriculture's better impact on people and the planet

1.1 Climate Change Mitigation and Carbon Sequestration

- **Greenhouse Gas (GHG) Emissions reduction:** A recent meta-analysis showed that organic farming has a smaller climate footprint than conventional farming, with a 43% reduction in GHG emissions per unit of land and a 12% reduction per unit of product (Chiriacò et al., 2022). However, other studies have found that GHG emissions per unit of product are higher for organic farming than for conventional. Hashemi et al. (2024) found that the choice of functional unit (mass-based vs. area-based) significantly affects outcomes. While mass-based comparisons showed similar energy use and climate impact between conventional and organic farming, area-based analyses favoured organic farming for reduced global warming potential and energy use. This discrepancy likely relates to differences in yields between the two systems, with organic farming typically producing lower yields per area. Michalke et al. (2023) confirmed the environmental benefits of organic products in a True Cost accounting study but noted that even after internalising costs, organic prices remain higher than conventional ones. Section 2 delves further into these efficiency-related complexities and their implications for sustainability assessments. In general, organic farming does not make use of energy-intensive synthetic fertilisers or pesticides, leading to reduced GHG emissions in the upstream value chain, making it a key lever in mitigating agriculture's contribution to climate change (Borron, S., 2006; IFOAM, 2022; Niggli et al., 2009; Scialabba & Müller-Lindenlauf, 2010). By comparison, conventional agriculture, reliant on these inputs, is associated with higher GHG emissions and greater contributions to climate change (Scialabba et al., 2010; Skinner et al., 2019). In a scenario where all farmlands were converted to organic, global GHG emissions from farming are estimated to decrease by 20% due to lower energy demand and reduced nitrous oxide (N2O) emissions (Scialabba et al., 2010). Skinner et al. (2019) report that organic systems produce 40% less N2O emissions per hectare.

- **Soil carbon storage:** Key practices in organic agriculture, such as composting, crop rotation, and cover cropping, increase soil carbon content, transforming soils into effective carbon sinks that capture and store atmospheric carbon, thereby mitigating climate change (Kotschi and Müller-Samann, 2004; Müller, 2009). By improving soil structure and supporting long-term carbon storage, these practices further solidify organic agriculture's position as a sustainable and climate-resilient farming approach (IFOAM, 2022; Müller et al., 2016). Research on organically managed soil in temperate climates has shown an average carbon sequestration rate of 256 kg of carbon per hectare annually (Sanders, J., & Heß, J., 2019).

1.2 Biodiversity

Organic farming enhances ecosystem diversity and stability by promoting a rich variety of plants, insects, animals, and soil organisms (Pfiffner & Stöckli, 2023) (see *Appendix*, *Figures 3,4,* and *5*). A global meta-analysis comprising 94 studies across multiple countries and crop types, found that organic farming increases biodiversity, measured as species richness, by approximately 34% compared to conventional methods (Tuck et al., 2014) (see *Appendix, Figure 4*). A more recent study revealed that organic farming results in 95% more species on arable land, with 61% higher diversity in the seed bank, 23-26% more flower-visiting insects, and 35% more species of farmland birds (Sanders et al., 2022). This substantial increase suggests a robust impact that could help reverse biodiversity declines among previously common species in developed nations (Müller et al., 2016). By avoiding synthetic pesticides and fertilisers, organic systems attract pollinators, beneficial insects, and wildlife, fostering a balanced and resilient agricultural environment (IFOAM, 2022).

1.3 Soil Health

- **Soil structure and fertility:** Organic farming promotes soil health and reduces soil erosion by 22% (IFOAM, 2022). Common organic farming practices promote soil quality and contribute to carbon sequestration in soils (see *Appendix, Figure 2*). Organic soils store up to 3.5 t/ha more soil organic carbon than conventionally managed soils (IFOAM, 2022). By investing in soil health, organic agriculture builds long-term agricultural sustainability and resilience (Gamage et al., 2023; Williams et al., 2017).
- **Nutrient cycling and soil microbial health:** In soil, the absence of synthetic chemicals allows diverse microbes, fungi, and other organisms essential for nutrient cycling and plant health to flourish, which strengthens ecosystem stability against pests, diseases, and stressors—ultimately benefiting both farm productivity and environmental health (Gong et al., 2022; Parizad & Bera, 2023; Tuck et al., 2014). The use of longer rotations, nitrogen-fixing crops and cover crops also contributes to this. Research shows that organic systems increase microbial biomass carbon and microbial biomass nitrogen by 32% to 84% compared to conventional systems, supporting a more active soil microbial community that drives natural nutrient cycling and sustains crop productivity without depleting soil resources (Lori et al., 2017).

1.4 Water

- **Water retention and increased resilience to droughts and heavy rainfall:** Organic farming systems exhibit enhanced resilience to climate extremes, largely due to greater soil water dynamics and structure. Organically managed soils demonstrate 15-20% greater water movement down to groundwater levels, resulting in improved groundwater recharge (Müller et al., 2016). Additionally, organic soils can capture and retain up to 100% more water than conventionally managed soils, effectively storing rainfall for gradual release during dry periods, which is critical for withstanding droughts. Organic practices, especially the use of green and animal manures, also improve soil structure by increasing aggregate stability; studies show that organic systems can have up to a 50% increase in the mean weight diameter of water-stable aggregates in the top 15 cm of soil (Williams et al., 2017). This enhanced stability promotes better water infiltration and boosts water retention, supporting organic systems' resilience against frequent droughts and heavy rainfall events (Lotter, 2003; Parizad & Bera, 2023; Müller et al., 2016).

- **Water quality (lower nitrogen and phosphorus leaching):** Pesticide and fertiliser use in conventional agriculture can contaminate groundwater and surface waters through leaching and runoff, increasing the nutrient density of the water. The resulting higher levels of nitrogen and phosphorus stimulates algal blooms, depleting oxygen levels in aquatic ecosystems and causing ecosystem disruption and loss of biodiversity (Rad et al., 2022; Tang et al., 2021). Organic farming protects water bodies by reducing nitrate leaching by 20-39% (IFOAM, 2022) and increases its reusability (Parizad & Bera, 2023). In long-term field studies, organic practices have shown a significant reduction in nitrogen leaching, cutting nitrate runoff by more than 50% compared to conventional methods (Haas et al., 2002). By avoiding synthetic fertilisers and pesticides, organic systems further decrease the risk of water pollution, protecting local ecosystems and supporting healthier aquatic life (Han et al., 2021; Müller et al., 2016; Parizad & Bera, 2023).

1.5 Human Health: Highly nutritious organic food and potential impacts on human health

Consumers often believe organic food is healthier, a view supported by emerging evidence. Kesse et al. (2020) reported a 35% reduction in the risk of type 2 diabetes for individuals with the highest organic food consumption, alongside a 3% decrease in risk for every additional 5% increase in organic food in the diet. Similarly, Baudry et al. (2018) observed a 25% overall reduction in cancer risk, including significant decreases in postmenopausal breast cancer (-33%), lymphoma (-76%), and particularly non-Hodgkin lymphoma (-86%) among high organic consumers. Organic food has also been found to contain higher levels of certain nutrients and vitamins (Crinnion, 2010) (see *Appendix, Figure 2*). For example, organic foods have 21% more iron and 29% more magnesium than their conventional counterparts (Rembialkowska,E., 2007). Furthermore, 94-100% of organic food contains no pesticide residue, and 50% less nitrates compared to conventional foods (Lairon 2010). These findings are especially relevant given the significant negative health impacts of pesticides, a major source of endocrine-disrupting chemicals (EDCs). Dietary intake accounts for over 90% of total chemical exposure (Yilmaz et al., 2020).

Animal studies provide further insights. A feeding experiment comparing chickens fed organic versus conventional diets found that although both groups remained healthy, organically fed chickens exhibited stronger immune responses and resilience when challenged (Huber et al., 2010). These findings suggest that organic food may contribute to enhanced immune function and overall health.

Although more research is needed to fully confirm these findings, the current scientific evidence strongly supports the health benefits of organic food, making it a sensible choice for improving diet quality and reducing chemical exposure.

Section 2: Why major positive impacts of organic food systems are being underplayed today

2.1 Carbon footprint and land footprint, the two most used indicators, favour conventional agriculture over organic

A large part of the sustainable food debate is focusing on GHG emissions per kg of product, and land use per kg of product. While many metrics show the environmental advantages of organic agriculture, these two specific metrics are often favouring conventional agriculture.

Organic farming typically produces lower yields compared to conventional systems. Studies show that crop yields in organic farming can be 5% to 34% lower, depending on specific systems and site conditions (de Ponti et al., 2012; Seufert et al., 2012). As a result, organic farming generally requires more land to produce the same quantity of food as conventional farming. Consequently, the environmental advantages of organic practices per unit of product may be diminished when looking at this metric in isolation. In a comprehensive meta-analysis, Tuomisto et al. (2012) find that a higher land requirement per unit of product is counter-balanced by better environmental impacts per unit of area in organic farming compared to conventional.

Comparative studies of greenhouse gas (GHG) emissions in conventional and organic farming have yielded diverse results. Some research suggests organic methods reduce climate emissions (Chiaracho et al., 2022; Michalke et al., 2023; Scialabba et al., 2010), while others indicate little to no difference (Hashemi et al., 2024) (see *Appendix, Figure 9*). A crucial variable in these assessments is whether the analysis is conducted per unit of product or unit of land, leading to significantly different, sometimes contradictory conclusions about sustainability (Meier et al., 2015; Hashemi et al., 2024). For example, Zhu et al. (2018) found that organic apple production results in 45% lower GHG emissions per unit of land and 5% lower emissions per unit of product compared to conventional farming. Similarly, Michos et al. (2012) reported that organic peach farming reduced emissions per unit of land by 64% but showed a slight increase in emissions per unit of product (+3%). In contrast, Abeliotis et al. (2013) observed significantly higher emissions for organic bean farming, with 39% more emissions per unit of land and 23% more per unit of product. Aguilera et al. (2015) identified a similar pattern in rice cultivation, where organic systems had 9% higher emissions per unit of land and 59% higher emissions per unit of product. However, in wheat farming, Chiriacò et al. (2017) found that organic systems reduced GHG emissions by 60% per unit of land but increased emissions by 30% per unit of product compared to conventional systems.

This variability underscores the challenges of relying solely on land use and GHG emissions per unit of product to assess the sustainability of food. Section 2.2 discusses the limitations of product-level metrics. Section 2.3 talks about the need for a broader set of metrics.

2.2 Environmental impacts cannot only be assessed at the product level

- **A product-level lens ignores the sustainability opportunities of changing diets**. Focusing only on product-level impact overlooks broader sustainability opportunities that arise from adjusting consumption patterns. Measuring and optimising only at the product level implicitly assumes that current product consumption mixes should remain unchanged. However, researchers (and increasingly policy makers) agree that today's sustainability challenges in the food system need to be addressed also by shifting diets. Decisions on sustainability policy for the food system need to consider an ecological perspective as well. For example, reducing animal product consumption, especially red meat and dairy, in industrialised countries, has major potential for reducing the land footprint of human agriculture, relativising the importance of high crop yields.
- **A product-level lens ignores the link between natural capital protection and agriculture**. Product-level assessment take the perspective of looking at a farm as something with only one yield: the studied product. In practice, however, farmland supplies ecosystem services and has broader societal functions. Farmers are also active in activities that could be seen as natural capital management: safeguarding soil fertility, the water cycle, habitats for biodiversity, nature viability in the surroundings, carbon sequestration and other ecosystem services. These effects cannot be optimised at the scale of one single product (van der Werf et al., 2020).
- **A product-level lens does not show the actual impact on local communities, nature and ecosystems.** The impact of agriculture must be assessed at the hectare, farm or landscape level as well. There is ample evidence of the benefits of organic agriculture at the hectare level, on biodiversity, contamination of soil, water, air and food, and animal welfare (van der Werf et al

2020). Therefore, many government policies favour organic agriculture. However, product-level studies such as LCAs do not fully capture this benefit. Looking at the impact of a single product makes sense when looking at the impact of consumption, but it does not say much about the quality of the environment in the landscape where this product comes from. For example, two agricultural systems that have the same nitrogen surplus per unit of product will have a very different nitrogen surplus at the hectare or farm level, if one has a much higher yield. Nitrogen surplus influences air, water and ecosystem quality, so a similarity per unit of product can hide large differences in the health of local communities, local nature areas and local water bodies: one farm could be deteriorating the environment, and the other one preserving it. Or, if a pest management improvement allows an increase in yield using the same resources, for example, the same amount of water, the water footprint at the product level decreases thanks to the larger output. However, at the local level, the same amount of water is used, so there has been no improvement in water availability to local communities[7].

Recommendation:

- Look at impacts per hectare or other area-based level. Impact of farms, not only of products.
- Look at the impact of the diet or the consumption mix levels.
- Define metrics of ecosystem quality to be assessed at location level.

2.3 The need for dietary shifts over productivity comparison

Too often, criticisms of organic agriculture argue that such a system cannot sustain a growing global population under current productivity parameters (Connor, D. J. 2008). However, this perspective misses a crucial point: the potential for transformative environmental impact lies not solely in comparing farming systems but in rethinking diet composition. Reducing the environmental footprint of individual products, particularly animal-based ones, poses significant challenges due to the inherent inefficiencies and high emissions associated with livestock production. In contrast, transitioning diets towards plant-based alternatives represents a more feasible and impactful solution. This shift not only addresses environmental concerns but also promotes food efficiency by optimising resource use, as plant-based proteins generally require fewer inputs - such as water, land, and energy - while generating lower greenhouse gas emissions compared to animal-based proteins (Candy et al. 2019; Fehér et al., 2020). Retailers are uniquely positioned to drive this change by prioritising plant-based products in their offerings. Such a shift enables them to achieve faster and more substantial emissions reductions across supply chains, bypassing the slower and often less effective process of incremental improvements to animal-based systems. Embracing plant-based diets is not merely an opportunity for environmental progress but a pressing necessity for aligning food systems with sustainability goals and mitigating climate change impacts.

2.4 Major impacts of the food system on people and the planet are still unmeasured, under-measured, or wrongly measured

Life Cycle Assessment (LCA) studies are the standard method for quantifying the environmental sustainability of products, including food. However, they rarely capture the full scope of organic agriculture's benefits at the landscape level (van der Werf et al., 2020).

- **Land degradation is a major global problem, but soil health aspects are rarely considered**. While ecosystem services assessments take land as the starting point, LCA treats land as a resource input in a production process, equivalent to energy or materials. For example, the current pesticide impact model in LCA considers soil as part of the economy, not part of nature (van der

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[7] The same logic is clear for social impacts: for spotting trends in unethical labour practices in an industry, you would not only measure these impacts per unit of product, but at the employee-, workforce- and/or sector level.

Werf 2020). Aspects such as soil microbiology, water retention capacity, and soil structure do not or very rarely make their way into LCA studies comparing conventional and organic farming.

- **The impacts of pesticides are not well captured by LCA.** Avoidance of pesticide use is the main feature of organic agriculture. Human health impacts of pesticides on the agricultural workforce are often left out of scope in LCAs and the toxicological models are partial, often excluded, highly uncertain, and often outdated. New pesticides are introduced regularly. The health effects of novel pesticides are only understood a decade or more after their introduction, let alone translated into LCA models, which requires additional years of academic research. The same holds for ecological health impacts of pesticide use (van der Werf 2020). Overwhelming evidence of the decline in biodiversity and insect populations, as well as increasing concentrations of pesticides in water bodies, is not fully captured by food LCAs. While policy recognizes the importance of a precautionary principle, environmental impact assessments of food don't take this into account.
- **Life cycle assessment does not model nitrogen fluxes in agriculture properly**. It is usually estimated through models based on conventional agriculture, that do not reflect correctly the actual amount of Nitrogen left in the system. This reduces the reliability of results for impact categories such as climate change, acidification, eutrophication and particulate matter formation (Meier et al, 2015).
- **Comparisons between organic and non-organic products do not capture differences in product quality** that consumers perceive and that are found by researchers. Comparisons at the product level implicitly assume a conventional and organic product to have the same value to the consumer.
- **Provision of ecosystem services is very rarely measured in comparison studies**. The higher environmental value of organic agriculture has positive externalities for the surroundings, which are not captured in LCA. In organic systems, improved presence of pollinators, natural crop protection, habitat services, and climate regulation also have benefits beyond the boundaries of the farm. Water retention helps mitigate the impact of floods and droughts, as better soil can hold much more water.
- Metrics to measure these important side-benefits of agricultural land management are underdeveloped, and not customary for impact assessment of food. These aspects, however, are crucial for the viability of food production in the long term, as well as societal well-being.

Recommendations:

- Do not base environmental decisions only on a limited set of widely studied indicators such as land use and GHG emissions. Include soil quality and biodiversity metrics.
- Improve soil quality, pesticides and nitrogen models for LCA.
- Apply precautionary principles in line with policy goals, in lack of sufficiently good models.

Section 3. What needs to change in major reporting frameworks to impartially reflect the environmental benefits of organic agriculture

3.1 GHG reporting in the food industry

- **In the agricultural sector, the insufficient focus on Scope 3 emissions reporting leads to a significant underestimation of the overall environmental impact of farming practices, by focusing less on fertiliser production and feed production.** Scope 3 emissions encompass all indirect greenhouse gas emissions occurring within an organisation's value chain, including upstream activities such as the production of inputs and downstream activities like packaging and distribution (Carbon Trust, *n.d*). These emissions are typically more challenging to assess and quantify, requiring extensive stakeholder engagement and data access. Despite these difficulties, Scope 3 emissions often represent the largest proportion of an organisation's carbon footprint, accounting for 70-90% of total emissions across both private and public sectors (Carbon Trust, *n.d*). In agriculture specifically, Scope 3 emissions include the production of chemical fertilisers and pesticides, as well as the cultivation of feed inputs, which significantly influence the climate impact of agricultural activities (WBCSD, 2024). Organic farming systems, which tend to be more circular and less dependent on chemical inputs, thus demonstrate substantial environmental benefits in terms of Scope 3 emissions. However, these advantages are frequently overlooked in analyses that focus solely on Scope 1 and 2 emissions. Consequently, intensive farming practices may appear to perform better in such limited assessments due to their high efficiency and yields. This oversight in emission accounting can lead to an incomplete and potentially misleading representation of the true environmental impact of different farming systems.

- **GHG models for farming are based on conventional agriculture and do not represent organic practices well.** There is a significant gap in the availability of farm-level greenhouse gas calculations that effective model organic farming practices. Most current GHG emission models are designed to evaluate conventional agricultural inputs and outputs, leading to an incomplete understanding of the climate impacts associated with organic management practices, such as crop rotation, cover cropping, and reduced reliance on synthetic inputs. Organic practices often involve complex interactions between soil systems, plants and management techniques which pose a challenge for accurate modelling. As a result, our knowledge regarding the comparative climate performance of organic versus conventional farming remains limited. Furthermore, the lack of appropriate tools for organic farmers hinders their ability to assess and compare various strategies and interventions effectively and restricts their capacity to demonstrate the benefits of organic practices to consumers, policymakers, and other key stakeholders.
- **In retail, low granularity data on carbon footprint misused to compare certified and not-certified food.** While GHG emissions per unit of product of organic and conventional food can show contrasting results, retailers are underestimating the uncertainty of these data and using them for the wrong purpose. The variability that we have reviewed in this section shows that secondary data can be inadequate for comparing the environmental impact of specific suppliers or differentiating between certified organic and non-certified products. While such data may serve as a useful starting point for estimating total Scope 3 emissions, or category-level impacts (e.g., meat versus vegetables), their uncertainty ranges can be too high for more specific comparisons. Point estimates in these databases often fail to capture the nuances of production systems due to small sample sizes, limited geographic and temporal relevance, and reliance on a handful of studies. This can result in organic products being unfairly penalised in retailers' attempts to reduce Scope 3 emissions, particularly when generalised estimates are used without accounting for the actual GHG emissions of a specific value chain.

Recommendations

- Develop frameworks that encourage and facilitate Scope 3 emissions reporting amongst farmers and agrifood businesses. This could include providing training, simplifying reporting processes, and establishing incentives for emissions disclosures.
- Develop sub-sector averages for emission factors for organic and conventional food that are sufficiently robust to allow for a comparison, so that the GHG emission-reduction benefit of organic is taken into account.
- Develop tools designed specifically for organic farming practices, enabling farmers to accurately calculate their greenhouse gas emissions based on detailed input data. These tools could be similar to existing models such as the Cool Farm Tool, Farm Carbon Calculator, and Agrelac.

3.2 Corporate Sustainability Reporting Directive (CSRD)

Organic farming practices are relevant across various disclosure requirements of the CSRD, particularly regarding impacts, risks, and opportunities. These practices align with the CSRD's emphasis on sustainability by reducing negative impacts or even creating positive ones (*e.g.,* water retention) and offering financial opportunities. Furthermore, transitioning to or practising organic farming can constitute relevant policies and actions adopted by companies for key topics such as biodiversity and greenhouse gas emissions. These elements can be effectively showcased when reporting under the CSRD. The flexibility in reporting formats enables organic systems to utilise area-based metrics, providing a holistic view of environmental impacts across larger land areas. However, the diversity in reporting metrics, coupled with the absence of sector-specific reporting standards, can complicate efforts to accurately capture and compare the benefits of organic practices, potentially leading to confusion among stakeholders. This confusion highlights the need for tailored metrics suited to the food sector. Additionally, the increased land use associated with organic farming raises concerns about deforestation and habitat loss, adding to the doubts to which extent companies can report positive impacts in areas where there are also negative impacts. This emphasises the importance of presenting organic farming as a proactive action to mitigate risks and improve sustainability performance.

Another significant opportunity for organic farming lies in the CSRD's requirement to report on Scope 1, Scope 2, and Scope 3 emissions. This comprehensive approach allows organic operations to highlight their reduced emissions resulting from a lower reliance on synthetic inputs and a more circular recycling of nutrients. However, the CSRD also emphasises robust data collection across the entire value chain, placing scrutiny on companies to substantiate their sustainability claims. A critical risk is the need to provide compelling evidence for the impacts of interventions such as carbon sequestration, crop rotation, and biodiversity enhancement. Without sufficient data, companies may struggle to validate their sustainability efforts. The current lack of clarity around organic farming's broader impacts on biodiversity, nitrogen emissions, animal welfare, and health presents a challenge. Governments can play a vital role here by funding research into these areas and developing standardised frameworks to enhance transparency and comparability in CSRD reporting.

The financial sector also presents an opportunity. As investors increasingly prioritise sustainability, clearer evidence of organic farming's positive impacts could encourage investment. By addressing perceived risks, companies adopting organic practices can strengthen their position within sustainability-conscious markets (Verburg & Thelen, 2024).

3.3 The Science-Based Targets for Nature (SBTn) framework

The SBTn framework is a global benchmark for biodiversity ambition, but it has significant limitations in assessing organic agriculture. Organic companies face challenges because their framework fails to account for their already minimal environmental impacts and long-term commitments. For instance, the SBTn's reduction requirements demand equal percentage reductions in inputs like phosphorus, regardless of the starting baseline. This penalises organic businesses, which are already operating near sustainable thresholds, making further reductions impractical and misaligned with their practices. Additionally, the SBTn's emphasis on reducing land footprint overlooks the inherently lower-intensity, land-reliant nature of organic farming. These gaps highlight the need for tailored adjustments to ensure organic agriculture is fairly assessed within biodiversity strategies.

Recommendations

- Apply different impact reduction requirements based on current performance
- Include measures of biodiversity in agricultural land

3.4 Product Environmental Footprint (PEF)

The Product Environmental Footprint (PEF) methodology developed by the European Commission, aims to harmonise environmental claims and improve the comparability of sustainability metrics across products and sectors. However, significant gaps are found in the current PEF framework, since no specific PEF exists for organic food products. Additionally, the existing methodology is described as incomplete, lacking transparency, and insufficiently adaptable. Key elements of sustainability, such as biodiversity conservation, soil protection, and animal welfare, are either absent or inadequately addressed within the framework. Dylla et al. (2022) emphasise that sustainable business practices encompass far more than what is captured by the Product Environmental Footprint alone.

Significant limitations of the PEF methodology are reported in the report by IFOAM (2022). These include failure to capture differences between production methods, inconsistent modelling by the life-cycle analysis of indirect effects, a too narrow perspective on functions of agricultural systems and a lack of operational indicators for some key environmental issues.

Recommendations

- Expand the scope of the baseline LCA used by the PEF methodology by using other methodologies that complement LCA.
- Include biodiversity loss, land degradation and pesticide effects.
- Include animal welfare.

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APPENDIX: Visuals and tables from literature

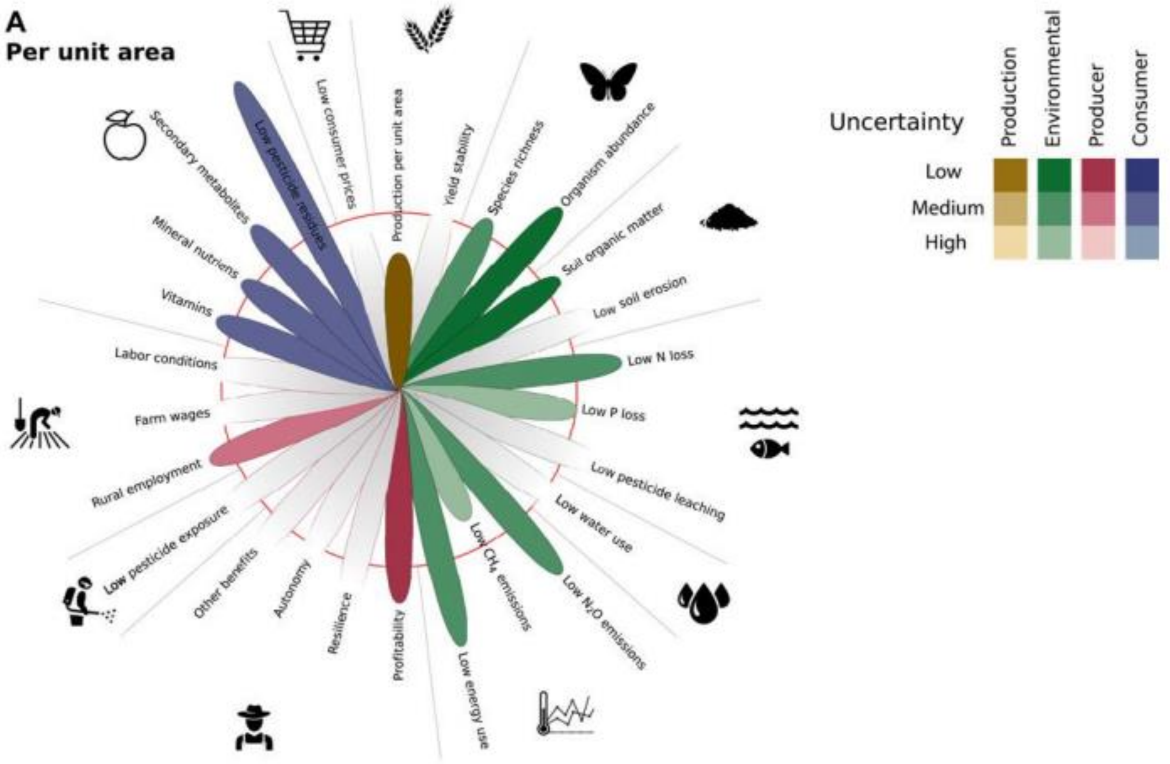


Figure 1 – This chart compares organic and conventional farming (indicated by the red circle). Larger petals represent superior organic performance, showing that organic farming performs better for the environment, biodiversity, and farmer well-being, while conventional farming is more focused on higher yields. ***Source****: IFOAM (2022). Organic agriculture and its benefits for climate and biodiversity.*

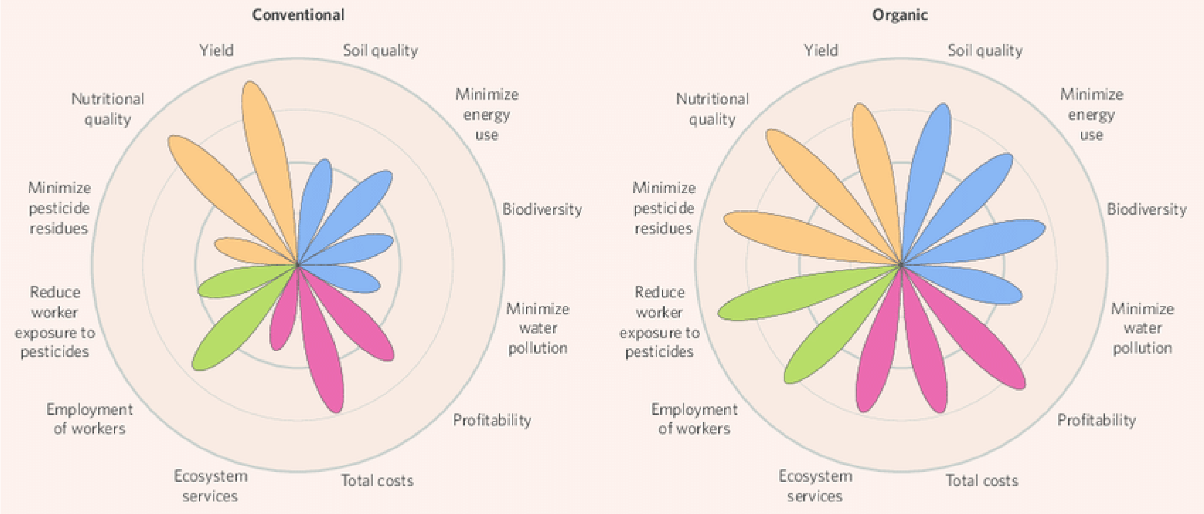


Figure 2 – This figure highlights how organic farming balances different aspects of sustainability – environment, profits and social benefits – more evenly than conventional farming. Lengths of the 12 flower petals are qualitatively based on the studies discussed in this Review and indicate the level of performance of specific sustainability metrics relative to the four circles representing 25, 50, 75 and 100%. Orange petals represent areas of production; blue petals represent areas of environmental sustainability; red petals represent areas of economic sustainability; green petals represent areas of wellbeing. The lengths of the petals illustrate that organic farming systems better balance the four areas of

sustainability. ***Source****: Reganold, J. P., & Wachter, J. M. (2016). Organic agriculture in the twenty-first century. Nature plants, 2(2), 1-8.*

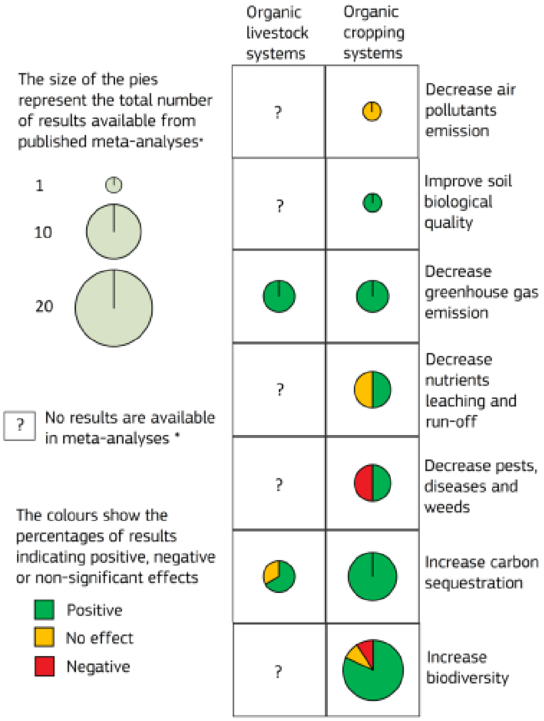


Figure 3 *– This figure shows the impacts of organic farming per ha on environmental and climate impacts (compared to conventional systems) based on the available scientific evidence (from published meta-analyses*).* ***Source:*** *European Commission, iMAP (Integrated Modelling platform for Agro-economic and resource Policy analysis),*

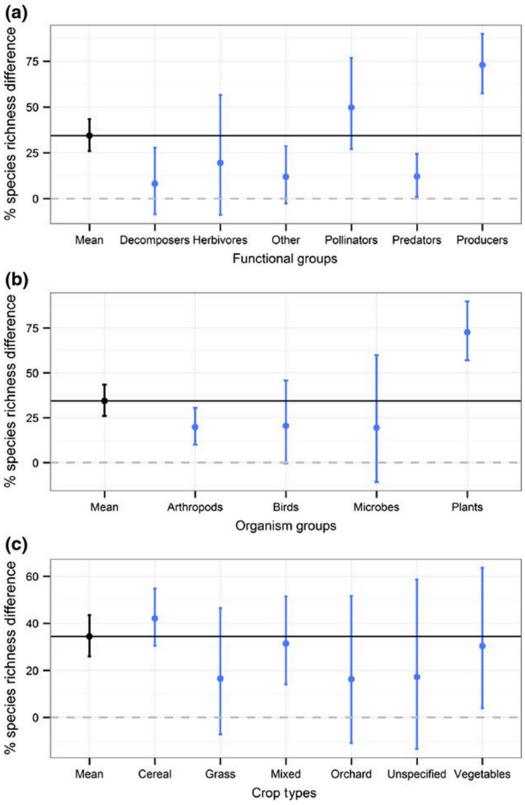


Figure 4 *– This figure shows how organic farming supports higher biodiversity compared to conventional farming. It highlights increases in species richness for different groups, like pollinators and plants, emphasising the environmental*

benefits of organic methods. The difference in species richness (%) on organic farms, relative to conventional, classified: (a) by functional group (n: decomposers = 19, herbivores = 6, other = 27, pollinators = 21, predators = 49, producers = 62), (b) by organism group (n: arthropods = 89, birds = 17, microbes = 6, plants = 62) and (c) by crop types (n: cereals = 100, grasses = 13, mixed = 40, orchard = 9, unspecified = 6, vegetables = 16). The grand mean is shown in black, accompanied by the black line. The dashed lines show the zero line. 95% credible intervals are calculated from posterior standard errors. ***Source****: Tuck, S. L., Winqvist, C., Mota, F., Ahnström, J., Turnbull, L. A., & Bengtsson, J. (2014). Land-use intensity and the effects of organic farming on biodiversity: a hierarchical meta-analysis. Journal of applied ecology, 51(3).*

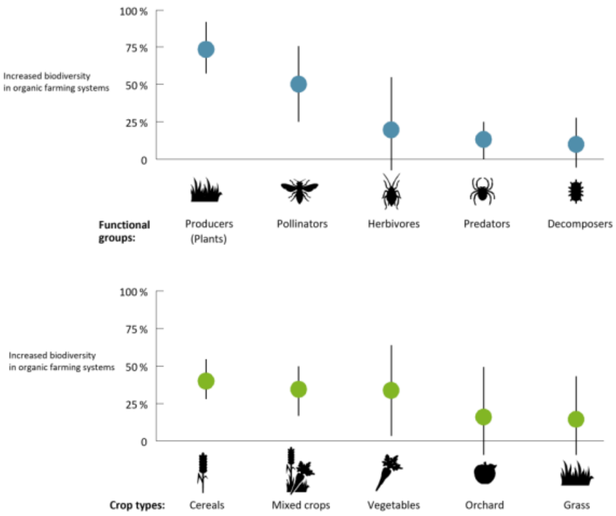


Figure 5 *- This Figure illustrates the differences in biodiversity in organic systems compared to conventional farms. It shows that organic farming systems consistently enhance biodiversity across various species, particularly for insects, birds, and plants, compared to conventional farms* ***Source****: IFOAM (2022). Organic agriculture and its benefits for climate and biodiversity*

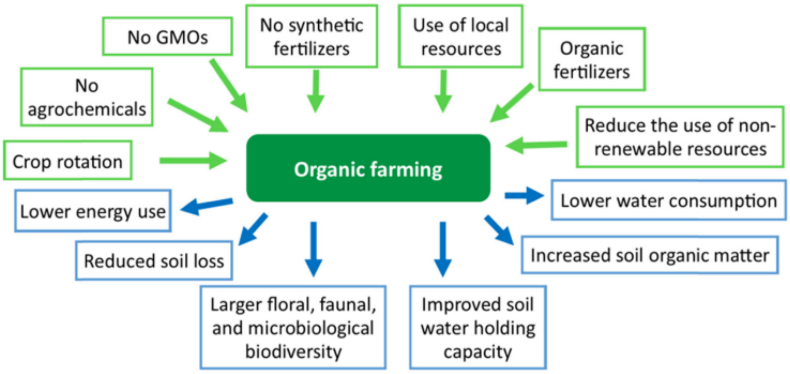


Figure 6 *– This Figure shows the main practices and effects of organic farming.* ***Source****: Gamage, A., Gangahagedara, R., Gamage, J., Jayasinghe, N., Kodikara, N., Suraweera, P., & Merah, O. (2023). Role of organic farming for achieving sustainability in agriculture. Farming System, 1(1), 100005.*

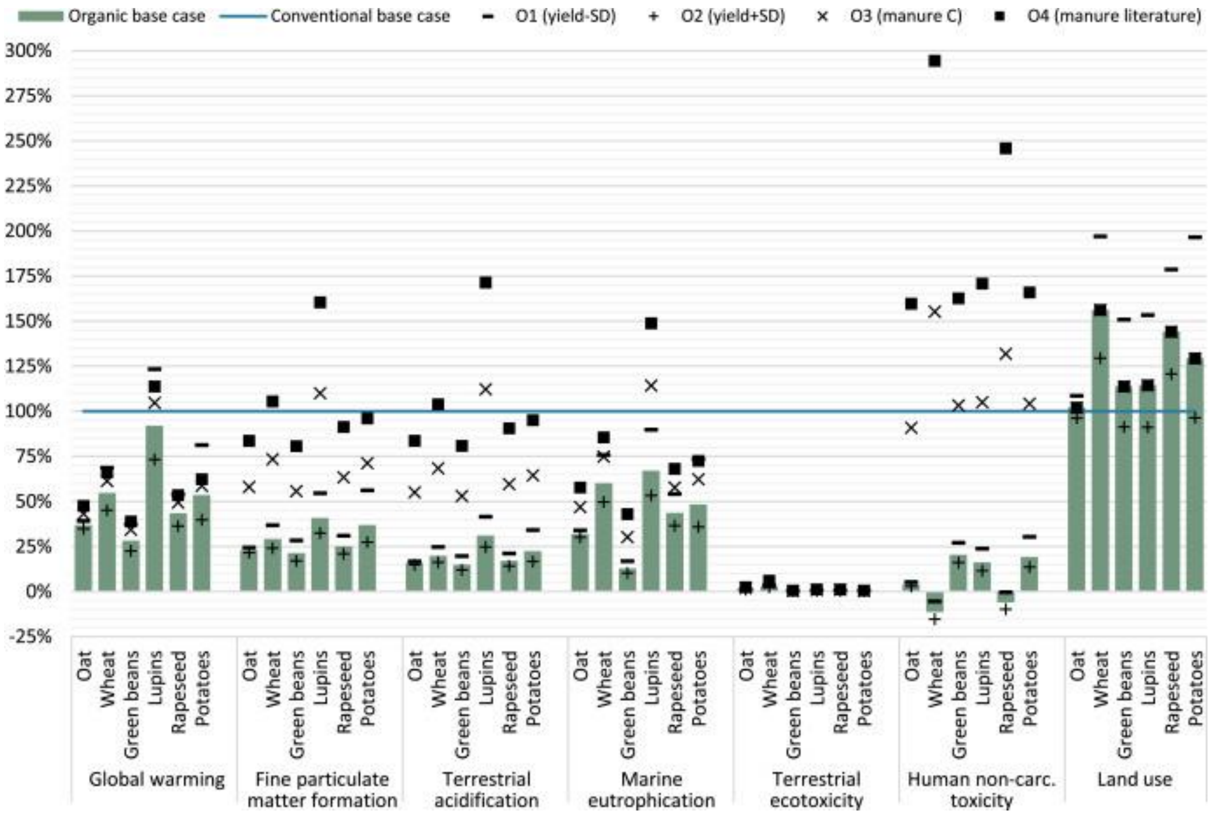


Figure 7** – This Figure shows the Life Cycle Impact Assessment of organic (O) scenarios focusing on the impact of yield and manure differences compared to the conventional base case (C) as assessed with ReCiPe 2016 for different plant-based products and how these results vary for scenarios O1-O4. The blue line represents the conventional farming system, while the green columns represent the organic base scenario. The ranges of results vary between products due to the varying yield gaps found in the literature.* ***Source: *Michalke, A., Köhler, S., Messmann, L., Thorenz, A., Tuma, A., & Gaugler, T. (2023). True cost accounting of organic and conventional food production. Journal of Cleaner Production, 408, 137134.*

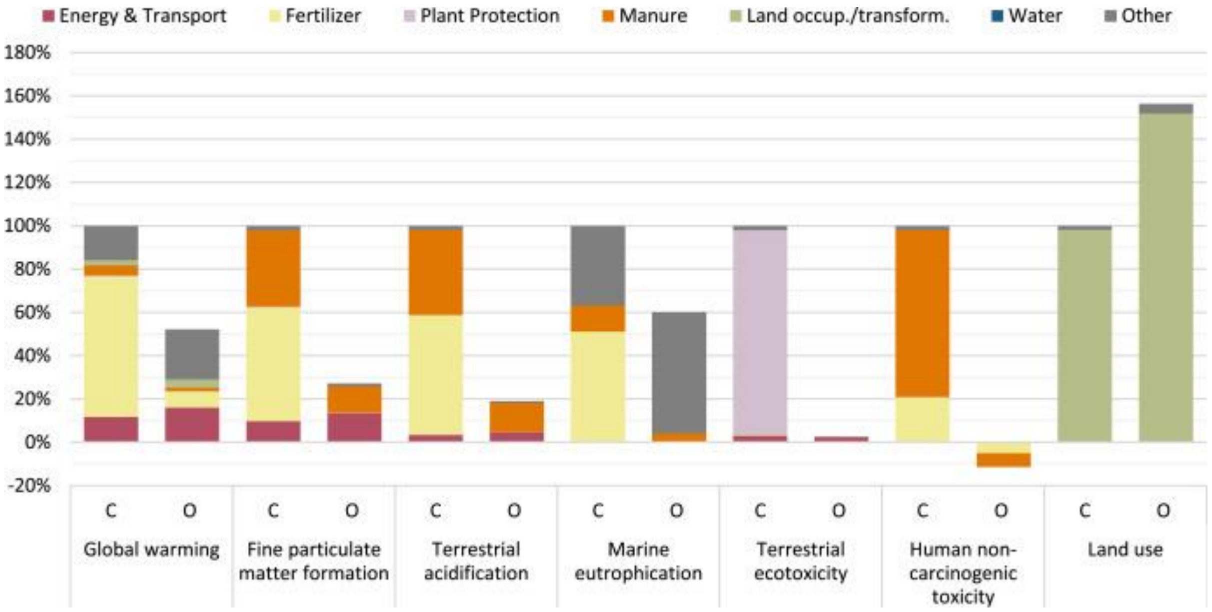
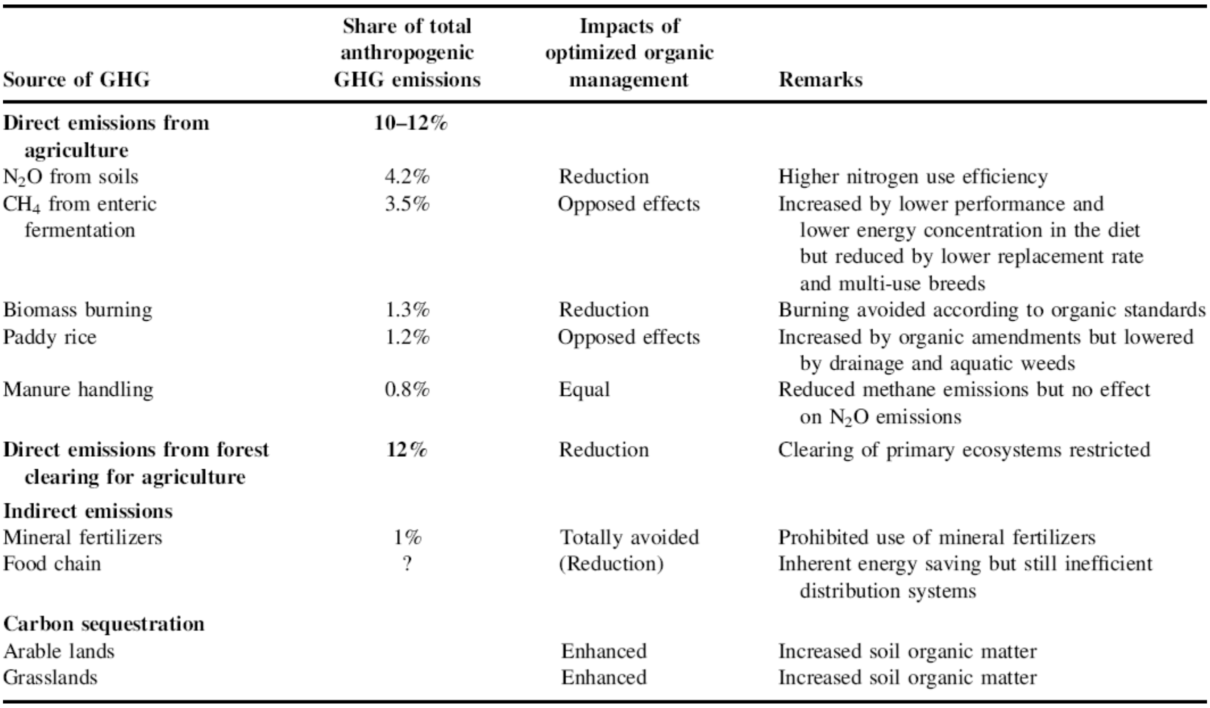


***Figure 8** – This Figure shows the process contributions for conventional (C) and organic (O) wheat production, representing the category of cereals, as assessed with ReCiPe 2016. Processes included in "Energy & Transport" are inputs of diesel fuel on the farm site (including associated transports of said fuel), and electricity used in stables. The category "Other" comprises crop residue emissions and the production of seeds and capital goods. Key process*

contributions are quite heterogeneous across midpoints in wheat. Significant difference is found in the impacts of terrestrial ecotoxicity, primarily driven by plant protection like herbicides, pesticides or fungicides. Since neither is allowed in organic farming, the impact is almost zero for all organic products. ***Source:*** *Michalke, A., Köhler, S., Messmann, L., Thorenz, A., Tuma, A., & Gaugler, T. (2023). True cost accounting of organic and conventional food production. Journal of Cleaner Production, 408, 137134.*



Source of GHG	Share of total anthropogenic GHG emissions	Impacts of optimized organic management	Remarks
Direct emissions from agriculture	**10–12%**		
N_2O from soils	4.2%	Reduction	Higher nitrogen use efficiency
CH_4 from enteric fermentation	3.5%	Opposed effects	Increased by lower performance and lower energy concentration in the diet but reduced by lower replacement rate and multi-use breeds
Biomass burning	1.3%	Reduction	Burning avoided according to organic standards
Paddy rice	1.2%	Opposed effects	Increased by organic amendments but lowered by drainage and aquatic weeds
Manure handling	0.8%	Equal	Reduced methane emissions but no effect on N_2O emissions
Direct emissions from forest clearing for agriculture	**12%**	Reduction	Clearing of primary ecosystems restricted
Indirect emissions			
Mineral fertilizers	1%	Totally avoided	Prohibited use of mineral fertilizers
Food chain	?	(Reduction)	Inherent energy saving but still inefficient distribution systems
Carbon sequestration			
Arable lands		Enhanced	Increased soil organic matter
Grasslands		Enhanced	Increased soil organic matter

Figure 9 *– This figure shows how organic agricultural systems have an inherent potential to both reduce GHG emissions and enhance carbon sequestration in the soil. An optimised organic management is proven to reduce nitrous oxide emissions from soils, and direct emissions from forest clearing for agriculture too. Opposed effects are instead found for methane emissions from enteric fermentation.* ***Source****: Scialabba, N. E. H., & Müller-Lindenlauf, M. (2010). Organic agriculture and climate change. Renewable agriculture and food systems, 25(2), 158-169.*