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The multidimensional performance of agroecology: what we know and what we are yet to learn

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1 Introduction

Agroecology has been hailed as 'the ultimate and most comprehensive solution to the many challenges of the agricultural and food system' (Ewert et al., 2023, p. 351). Yet, limited evidence for the actual contribution of agroecology to achieving societal goals particulalry economic benefits for farmers has often been referred to as a critical barrier for its wider adoption as well as for large-scale financial and institutional support (e.g. Ahmad and Köpke, 2024; Fischer et al., 2025; Mugwanya, 2019; Oteros-Rozas et al., 2019; van der Ploeg et al., 2019).

A growing number of countries across the world are adopting public policies on agroecology or to scale agroecological practices (e.g. France in 2014, Benin in 2022, Tanzania in 2023, Kenya and Vietnam in 2024, Cuba in 2025). In this light there is an urgent need to develop appropriate methodologies to collect evidence on how the implementation of national strategies or policies shape food system transformation and how they affect the achievement of societal goals and national priorities. In a bibliometric analysis of scientific production at the interface of public policies and agroecology, Gervazio et al. (2025) found that while there has been a significant growth in related publications yet they largely focus on the agronomic and environmental aspects of agroecology with socio-economic research being limited.

This notwithstanding, in this opinion article we argue that due to a number of recent publications there is no longer a lack of evidence on the performance of agroecology *per se* but that critical knowledge gaps persist that require concerted efforts by the scientific community to support evidence-based agroecological transitions.

2 What we know about the multidimensional performance of agroecological practices

Before the publication of the 10 Elements and 13 Principles, agroecology has been variously defined as a science, a movement, and a set of agricultural practices (Wezel et al., 2009). Agroecological farming practices and their combinations include crop rotation, intercropping, mulching, composting, cover cropping, and the integration of trees and livestock in cropping systems among many others (Wezel et al., 2014). The adoption of a greater number of agroecological practices by agroecological farmers has been positively associated with the provision of a wider range of ecosystem services within farming systems, compared to conventional farmers, who often rely more on a narrower set of practices, approaches, and tools (Palomo-Campesino et al., 2022). While the suitability and performance of such practices are highly context-specific, recent studies, reviews and meta-analyses demonstrate that individual agroecological practices and particularly combinations of them result in positive socio-economic as well as environmental outcomes (Figure 1).

Faure et al. (2024) summarize the growing body of reviews and meta studies that assess the contribution of agroecological practices to food security and ecosystem service provision. Thus, Bezner Kerr et al. (2021) highlight that 78% of the 56 reviewed studies showed positive food security and nutrition outcomes from agroecological practices. Dittmer et al. (2023) in a review of 50 articles found that agroecological practices support climate change adaptation without compromising productivity, with crop yields being higher in 63% of agroecological treatments compared with conventional practices as baseline. Mouratiadou et al. (2024), based on a review of 80 articles, found that in 53% of cases agroecological practices are associated with positive socio-economic outcomes, mainly for income, revenue, income stability, and decreased production costs, compared to 30% cases with negative outcomes (which were mainly on labour costs and labour availability). Additional sources summarized by Faure et al. (2024) provide large-scale evidence on the productivity and environmental performance of individual practices, such as agroforestry, legume intercropping, crop rotation, and biochar application. Moreover, agroecology can make a significant contribution to climate change mitigation. In a recent global review, based on 138 articles with evidence, it was found that use of multiple agroecological practices outperformed conventional farming both in sequestering carbon in the soil (outperformed very strongly) and in reducing greenhouse gas emissions (for most gases, although many comparisons were neutral or inconclusive) (Wezel et al., 2025a). Similar findings are stated by Blaix et al. (2026) in a meta-analysis of agroecology's impact on biodiversity and climate change mitigation with a focus on Europe. They found that soil C storage and N_2O mitigation increase, but not CH_4 and CO_2 mitigation. Moreover, agroecological interventions increased biodiversity of all studied functional groups.

Madsen et al. (2025) specifically focused on the African continent in their review of scientific literature available on the contribution of agroecological practices to the achievement of the Sustainable Development Goals (SDGs). Their review concluded that 79% of the 104 articles analyzed, provided evidence for agroecological practices positively impacting on a minimum of two SDGs. Focusing on India, Berger et al. (2025) assessed the multidimensional performance of the 'largest agroecological transition globally' concluding that the Zero Budget Natural Farming (ZBNF) programme succeeded in increasing farming households' profits by more than two-fold while creating significant

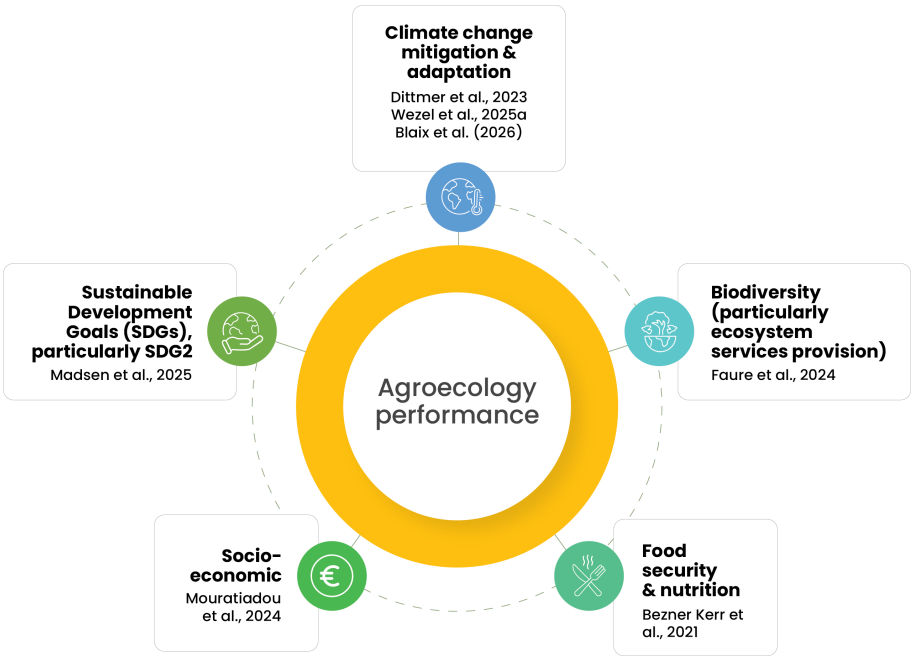

FIGURE 1
Recent reviews and meta-analyses on agroecology performance.

environmental benefits aligned with the Global Biodiversity Framework (GBF).

3 What we know about the performance of agroecology as a holistic food system approach

Since the seminal FAO (2018) and HLPE (2019) publications, agroecology is generally defined as a transformative food system approach guided by 10 Elements and 13 Principles (Wezel et al., 2020). The Elements and Principles go beyond farming practices and capture the economic, environmental, political, and socio-cultural dimensions of agroecology in addition to its agronomic aspects. This has important implications for the assessments of the multidimensional performance of agroecology. While agroecological practices alone may provide numerous economic, environmental and social benefits to farming communities and the wider society, arguably agroecology only develops its full transformative potential and demonstrates it true impact when defined by the 10 Elements or 13 Principles. Over the course of the past few years a multitude of tools and frameworks have been developed and applied that allow for the assessment of the performance of agroecology based on a more holistic definition, as reviewed by Geck et al. (2023).

The most widely used of these tools so far is FAO's Tool for Agroecology Performance Evaluation (TAPE) (Mottet et al., 2020). While the high diversity of application approaches and contexts of TAPE do not yet allow for a robust systematic analysis of the results derived from its application with over 10'000 households across the world, a growing number of TAPE studies are being published. To date, the most comprehensive TAPE study is Adoyo et al. (2025) application of the tool with 839 households in Benin, Ethiopia, Kenya and Madagascar. Their study shows a significant positive correlation between the integration of the 10 Elements of Agroecology and performance parameters including i) household food security and dietary diversity; ii) overall farm productivity; iii) household income; iv) soil health; v) agrobiodiversity; and vi) farmers' exposure to pesticides. The study did not, however, identify any significant correlations between agroecology scores and value addition, women's and youth empowerment nor did the methodology allow for analyzing causality between agroecological integration and performance. These results are largely corroborated by another major TAPE study with 619 farming households in Ethiopia (Wordofa et al., 2024). In this study, agroecology scores correlated positively with nearly all performance criteria assessed by TAPE. Several other TAPE studies find positive correlations between agroecological integration and a range of economic, environmental and social performance criteria in highly diverse contexts (e.g. El Mujtar et al., 2023; Gharbi et al., 2025; Lucantoni et al., 2023; Savels et al., 2024; Suárez-Córdoba et al., 2025). Yet, all these studies also found that for certain performance criteria agroecology scores do not show positive correlations and in some instances also negative correlations. This highlights that agroecology is not a panacea and that effects of agroecological integration remain highly dependent on the respective context. Further, as to date there is no standardized methodology for analyzing TAPE and the thousands of TAPE datasets have never been synthesized, the cumulative evidence is not accessible in a useful format to decision makers at global level. FAO is currently addressing these issues through the TAPE+ project (FAO, 2025).

To complement evidence derived from TAPE, the CGIAR Agroecology Initiative has developed the Holistic Localized Performance Assessment (HOLPA) tool and applied it on an initial set of 1979 farming households in eight tropical and subtropical countries (Jones et al., 2024). Initial results from 204 dairy farms in Burkina Faso demonstrate that more agroecological farms, as assessed through the 13 HLPE Principles, are on average performing better across agronomic, economic, environmental, and social criteria (Orounladji et al., 2025).

Among the other tools available to assess specifically the performance of Agroecology, Agroecology Europe's Original Agroecological Survey and Indicator System (OASIS) and the handbook for the evaluation of agroecology developed by the French working group on agroecological transitions (GTAE) are particularly prominent. OASIS has been applied to organic and conventional farms in three European countries (Wezel et al., 2025b). It showed that when farms scored higher in implementation of agroecological practices, as well as in environment/biodiversity, social-political aspects and resilience dimensions, they also performed better in the economic viability dimension. In another study in Italy, Guglielmo et al. (2025) applied OASIS to rice farming under climate stress. Results from application of the GTAE methodology are not yet available but will certainly enrich our understanding of agroecology's contribution to holistic sustainability of agrifood systems.

4 Agroecology as a transdisciplinary sciences values co-creation of knowledge and multi-perspective evidence

As a transdisciplinary science, agroecology values the co-creation of knowledge and the integration of multiple perspectives and forms of evidence. It brings together scientific research, traditional and local knowledge, and experiential learning to design and manage sustainable food systems adapted to local contexts (FAO, 2018; Gliessman, 2018). This approach emphasizes participatory processes involving farmers, researchers, and communities, fostering collective innovation and context-specific solutions that strengthen ecological, economic, and social resilience (HLPE, 2019; Wezel et al., 2020). Central to agroecological transitions is co-creation of knowledge with diverse stakeholders and an eye-level dialogue of different knowledge systems (Brock et al., 2024; Méndez et al., 2012). In reflecting on the performance of agroecology, it is hence critical to not limit ourselves to peer-reviewed scientific evidence but to also consider empirical evidence grounded in local practice and knowledge (Fischer et al., 2025). For instance, the Agroecology Fund and Stats4SD (2024) rely on grassroots

evidence for agroecology to demonstrate positive economic, environmental, nutritional, and social outcomes of agroecology through case studies from Uganda, Mexico and Brazil assessed by local communities through participatory and reflective methodologies. Similarly, the Alliance Sufosec (2024), in partnership with around 300 civil society organizations and scientific support from ETH Zurich and the University of Bern, assessed food security and nutrition outcomes of practicing agroecology in around 10'000 households in 15 countries. Their results showed that households that apply at least three agroecological practices have a 34% reduced risk of hunger and a 20% reduction in malnutrition. Also, the Alliance for Food Sovereignty in Africa (AFSA, 2018) analyzed the contribution of agroecology to the SDGs based on 50 case studies and found that in all cases agroecology had a positive impact on SDG2 on ending hunger, in most cases positive effects were found on ten of the 17 SDGs, and in none of the cases was there any negative effect of agroecology on any of the SDGs. While in these publications the line is often blurry between evidence-based assessments and advocacy, the co-developed evidence on performance is highly meaningful for the communities and actors involved and allow them to adaptively manage their own context-specific agroecological transitions. The various participatory methodologies should ensure that peasant and local communities, and Indigenous Peoples are engaged as active co-creators in research processes, rather than being treated solely as input providers to siloed research frameworks.

5 Discussion: what we are yet to learn on the performance of agroecology

Current evidence shows that agroecology generates multiple environmental, social, economic, and nutritional benefits. However, major gaps persist in understanding and comparing its multidimensional performance across contexts (HLPE, 2019; Wezel et al., 2020). The lack of standardized metrics/indicators, long-term datasets, and causal/robust analyses limits insights into productivity, soil health, climate resilience, and socio-economic trade-offs (Bezner Kerr et al., 2021). Evidence on agroecology's impacts on nutrition, health, gender equity, and scaling dynamics remains particularly limited (IPES-Food, 2016; FAO, 2018). Addressing these gaps requires harmonized indicators, participatory and transdisciplinary research approaches, and enabling governance to capture and strengthen its transformative potential (Mouratiadou et al., 2024). Future research should therefore prioritize robust, multi-site assessments, comparative policy studies, and co-creation approaches that ensure equitable and context-sensitive outcomes.

Further, the existing evidence base remains scattered and in certain cases of questionable scientific robustness. With multiple tools available for assessing agroecology and its performance, there is a growing need for increasing data interoperability, harmonizing existing assessments, and presenting the information in coherent manners and formats that are meaningful for diverse stakeholders, including farmers, policymakers, and advisory services.

While the emerging evidence on the contribution of agroecology to food security, nutrition, economic development and environmental sustainability is compelling, there is scarce and sometimes negative evidence on agroecology's role in increasing farmers' and indigenous communities' agency as well as empowering women and youth. Dedicated methodologies and targeted studies are therefore crucial to assess whether agroecology delivers on its social and transformative promises and, if not, how concepts, practices, and implementation strategies may need to be modified to better address these critical dimensions (Behl et al., 2024; Fiore et al., 2024; Rietveld et al., 2025).

Further, while there is quite a robust evidence-base on the correlation between agroecological integration and multidimensional performance, most studies fall short of establishing causality. Therefore, it is not clear whether enhanced integration of agroecology results in improved performance or better performing farming households are in a better position to integrate agroecological practices, elements, and principles. Additionally, there is a dearth of evidence on exactly which aspects of agroecology correlate with which performance variables under which conditions (Andrieu et al., 2025). Generating such contextualized evidence is critical for enabling targeted advice for decision making and advisory services in line with the options by context approach (Sinclair and Coe, 2019; Pierre et al., 2025).

Finally, although several agroecology elements and principles largely become operational at a landscape, territorial or food system level, the majority of existing assessment approaches and therefore the lion's share of existing evidence is on farm or household level/scale (Fiore et al., 2024). This highlights an urgent need for dedicated methodologies to assess the performance of agroecology at a landscape or food system level. In light of growing policy support for agroecology, understanding its contribution to societal goals at territorial, regional,national, and global food system levels is increasingly critical (Tataridas and Freitas, 2024), particularly amid recurring and interconnected challenges, shocks, market disruptions, and extreme climate events.

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