2.7. Towards a comprehensive assessment of agriculture's sustainability performance: Insights from organic farming

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Key messages

- To comprehensively measure both the economic and environmental sustainability performance of agricultural practices, it is essential to assess output in human edible calories and protein from whole landscapes over extended periods of time, rather than narrow short-term single crop indicators.
- Adopting a broader food systems perspective that extends beyond assessing production processes to consider food loss and waste, as well as dietary patterns, can open new avenues in measuring the economic and environmental sustainability performance of agricultural production.

Sustainable productivity as a framework to measure the performance of production systems offers a good opportunity to consistently address issues related to sustainable agriculture. On a narrower level, traditional total factor productivity (TFP) can address yields, traditionally seen as the main performance metric for agriculture, in conjunction with the use of other inputs and the production of other outputs in agriculture. Expanding the TFP framework would allow for a deeper analysis of positive co-benefits (e.g. improved soil fertility, biodiversity support) and negative impacts (e.g. various emissions, soil degradation, biodiversity loss).

In general, this measurement strategy is thus well suited to assess outputs from a broad range of approaches (e.g. agroecology, regenerative agriculture, organic agriculture) that aim to improve environmental outcomes. These approaches all emphasise the importance of achieving decent yields, while also giving due weight to other beneficial and damaging outputs on the environment. The goal is to provide a bundle of positive outputs per unit of inputs. Crop production is but one factor (albeit a central one) amongst others, and negative outputs and the use of other inputs need to be kept to a minimum.

Organic agriculture provides beneficial environmental performance on the landscape (Seufert and Ramankutty, 2017[49]). However, a central challenge is overcoming its low-yield performance compared to conventional agriculture. At present, organic yields are on average around 20% lower than conventional yields, although some highly performing organic systems building on high diversity in cropping patterns show differences of around 10% (Ponisio et al., 2015[50]). Hence, efforts are undertaken to increase organic yields, to ensure high yields also in this sustainable production system. It is clear nonetheless that organic yields will most likely not attain the yields of conventional intensive industrialised agriculture, which has a primary focus on obtaining high yields generally accompanied by low awareness of reducing its negative impacts and supporting positive side-effects. A current EU-funded project led by the Research Institute of Organic Agricuture (FiBL) is attempting to identify the main determinants of organic yields and how higher yields can be achieved (OYUP, 2024[51]).

Increased diversity in crop rotations and the breeding of organic crop varieties are promising strategies. As such, there is a focus on specific organic breeding strategies to develop varieties that are optimally adapted to organic production contexts with lower nutrient inputs and biological plant protection strategies. Yet organic production continues to depend on conventionally-bred varieties that are not optimally designed for organic contexts.

Organic agriculture also focuses on soil fertility, soil health, and biodiversity. Some argue in view of this that organic yields may not increase to equalise conventional yields in the future but rather sustain current yields by maintaining production means, most importantly in comparison to decreasing yields in conventional agriculture. The argument is that organic production focuses on sustaining the production means, particularly healthy and fertile soils, as opposed to conventional agriculture which often results in a degradation of soils and loss in soil fertility, leading in turn to lower yields. In this context, a shift of the narrative is warranted by stating that "organic agriculture does not have too low yields for ensuring food security, but conventional agriculture has too high yields for ensuring sustainability".

From a food systems perspective, a broader approach to productivity is needed beyond the focus on yields. Ultimately, what counts is the quantity of food ending up on peoples' plates which is actually eaten. Thus, food waste and loss must be taken into account when addressing yields in agricultural production systems. In organic agriculture, in addition to yield improvements, reduction in storage losses are required. What is of greater long-term benefit: efforts to increase yields or efforts to reduce losses? This question applies not only to organic and other agroecological production systems, but to agriculture of any kind; reducing storage losses and food waste is one strategy to increase supply without yield increases. There not only losses due to pests are relevant, but also waste due to regulations and industrial norms (e.g. related to expiry dates), the homogeneity of the product for easy processing or specific requirements regarding composition for industrial processing (e.g. high protein contents in wheat to ensure high "baking quality"), or market and consumer expectations (e.g. aesthetic aspects such as spotless fruit peels or equal size and form of vegetables).

TFP metrics play an important role is assessing the performance of agriculture but it should account for systemic aspects such as food waste. Improved sustainable productivity growth (SPG) indicators would include the output bundle that finally reaches those that use the outputs, rather than just those produced on the field. A focus on a new narrative could be helpful: "What is the most sustainable product? One that is not produced. And which products do we not need to produce? Those that are lost or wasted." Avoiding these lost products directly saves inputs for their production and on related emissions, thereby reducing the zero productivity parts in the equations that stem from such losses.

For a truly systemic approach to productivity, further steps need to be taken both centrally linked to organic production systems and their role and performance in food systems. First, we need to go beyond single crop yields when defining the main output for assessing the productivity of organic agriculture. The focus should be on the quantity of food obtained over several years (e.g. over a whole crop rotation) from a whole landscape, including the products derived from animals fed on feed crops produced in the landscape. This quantity can be measured through a number of indicators, where the classical yields as physical quantity is less relevant than, for example, total calories or proteins for human consumption.

Second, we need to address the use of the crops produced. In many countries, predominantly in industrialised ones, the productivity of croplands for producing human edible calories and protein is determined by the share of croplands used for feed production. Shifting towards more direct food production on these croplands would improve the level of productivity of agricultural production systems, although this works only if consumption patterns change accordingly towards reduced shares of animal-source food. As with avoiding food waste, such a focus on increased plant-based consumption patterns requires that any debate on sustainable agricultural productivity is addressed with a whole food system perspective, including consumption.

Reducing waste and loss, as well as feed production on croplands, reduces the pressure to produce high yields to achieve a certain calorie and protein supply, thus ensuring food security with relatively lower yields from organic and other agroecological production systems that also deliver other beneficial outputs (Muller et al., 2017[52]). This is partly captured by approaches such as TFP, but only if the main output is defined broadly enough; namely, as "quantity of human edible protein produced from a whole landscape over several years", rather than "biomass yield of a single crop".

Conclusion

TFP approaches to measure performance fit well to agroecological production systems such as organic agriculture. Given the yield gap in organic agriculture and the importance of yields in TFP, improving them is an important task in current agroecological research. However, it is important to adopt a truly systemic and comprehensive TFP approach to assess SPG, going beyond single crop yields as the relevant output measure, and focusing on the output in human edible calories and protein from whole landscapes over an extended period of time. As such, the productivity of agricultural systems cannot be addressed without addressing consumption, including food waste and loss, as well as dietary patterns, in particular as shares of animal-source food and cropland-based feed production become central for encompassing TFP assessments. It is important to be aware of these systemic aspects and to correspondingly adopt a whole food system level approach when addressing productivity in sustainable agriculture, as otherwise, a narrow focus on TFP may again overly focus on increasing single crop yields, c.f. the focus emphasized in OECD (2022, p. 30[53]): “The takeaway message is that we can only continue to feed the world and improve people’s well-being if agricultural TFP continues to grow”.

Data requirements for unbiased SPG assessments are high and it is important to adopt a pragmatic approach on what is covered to avoid overly demanding data collection. Overly simplistic proxies for relevant variables also need to be avoided to ensure unbiased and correct assessments. As OECD (2022, p. 17[53]) states: “Typically, there are three types of obstacles to TFP measurement: obtaining appropriate measures of the outputs and the inputs that are used, especially primary inputs; capturing changes in quality of outputs and inputs over time (or differences across regions in cross section comparisons); and finding appropriate weights on inputs and outputs. These three issues are of particular concern in agriculture.”

Finally, TFP is a relative measure relating outputs to inputs, but it does not account for total production and pollution levels. A central drawback is the landscape-related impacts of most environmental pollutants (except greenhouse gas emissions) that have to be assessed within local ecosystem carrying capacities. Agriculture in a certain landscape can be highly productive measured in high TFP values, but may nevertheless damage the environment and degrade production factors, in case the total emissions transgress the local carrying capacities. Awareness of absolute emissions in a context of local ecosystem boundaries needs to complement a relative performance measure such as TFP.