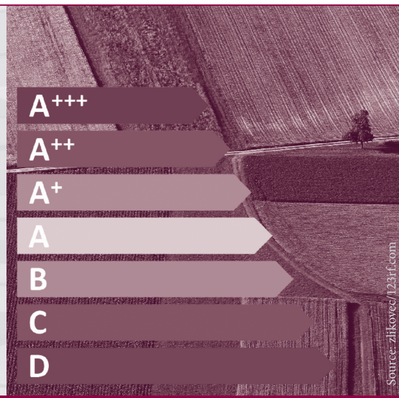
OFFICE OF TECHNOLOGY ASSESSMENT
AT THE GERMAN BUNDESTAG

Paving the way to a sustainability assessment of farming systems



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Summary

- Sustainability assessments in the field of agriculture have focused on individual farms on the one hand and on the agricultural sector as a whole on the other hand. Aggregation levels in between have hardly been examined so far.
- Comparisons of organic and conventional farming and their scientific evaluations provide reliable statements on fundamental differences for a limited number of sustainability indicators.
- It is not possible, however, to differentiate with regard to significant natural landscapes and economic conditions of the farms and to map temporal developments of the sustainability performance of organic and conventional farming.
- A comparative sustainability assessment of farming systems below the level of the agricultural sector as a whole offers the opportunity to generate more differentiated information on agricultural sustainability. However, the (further) development of such sustainability assessment systems is still associated with an extensive need for development and action.

What is involved

For years already, there has been a broad and controversial debate in Germany and other countries about which type of farming most likely corresponds to sustainable farming and how progress can be made towards sustainability. This is why sustainability assessment in the field of agriculture is of major importance.

So far, approaches to sustainability assessment have focused on individual farms, selected value-added chains or products (e. g. palm oil, soy), or the agricultural sector as a whole. Aggregation levels between individual farms and agriculture as a whole, however, have hardly been examined so far in terms of their sustainability performance. In recent years, numerous publications on comparisons between organic and conventional production methods appeared in which various sustainability aspects have been examined. These comparisons are of interest not only due to the data available, but also are of particular importance for the agricultural policy debate.

A review of the state of knowledge on a comparison of conventional and organic farming with regard to their sustainability impacts and a presentation of still existing gaps and methodological flaws allow to identify which approaches for a sustainability assessment of farming systems appear to be appropriate to serve as a framework of orientation for an economically viable as well as socially and environmentally sustainable shaping of agricultural and environmental policy.

Sustainability of conventional and organic agriculture

To date, the economic, social, and environmental dimensions of sustainability have been examined in comparisons of conventional and organic farming to a largely varying extent. The results of those comparisons can be based on individual studies, reviews (qualitative evaluation of existing publications), and meta-analyses (joint quantitative and statistical evaluation of data from studies) and thus are based on a varying degree of scientific evidence.

For economic sustainability, the range of average crop yield differences is well substantiated. On average, yields are

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20 to 25 % lower for organic farming than for conventional farming. The average profit per worker of organically managed farms is approx. 20 % higher than that of conventional farms. Here, however, the data base with a meta-analysis and the results of comparable farms from the test farm network of the German Federal Ministry of Food and Agriculture (BMEL) is weaker. In the last 20 years in Germany, the profit of organic farms has been higher than that of conventional farms in most, but not all, years, with the share of transfer payments in the income of organic farms being somewhat higher than that for conventional farms.

For two other indicators, it is possible to make directional statements without an exact dimension, since only few studies are available. This applies to both the lower external costs of agriculture in case of organic farming and the increase in average household expenditures in case of a complete switch to organic food and an unchanged shopping cart. Moreover, there are systemic interrelations that have to be considered here, as changing dietary behaviour observed among many intensive users of organic food affects food expenditures. This makes it difficult to estimate the effects here. No comparative studies could be found on two other aspects of economic sustainability – the ability of farms to develop (liquidity and stability or future viability of farms) and effects on the regional economy (e. g. regional marketing and regional value added) – and therefore no statements can be made.

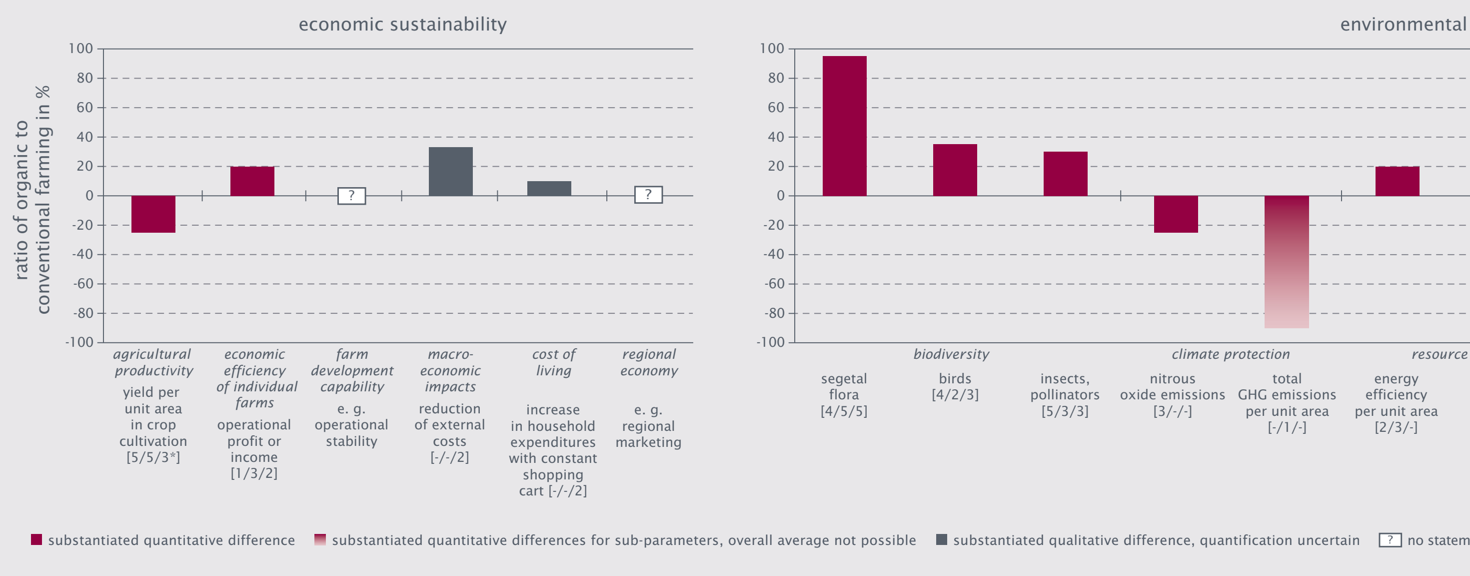
Social sustainability encompasses, on the one hand, social conditions on farms and, on the other hand, social impacts of agriculture. Comparative studies on social indicators such as labor input, working conditions, social situation and social commitment of farms are hardly or not at all available, so that no statements can be made on differences between conventional and organic farming for these indicators of social sustainability.

However, the situation is different for comparisons of food quality as a part of the social impacts of agriculture. Most meta-analyses have been carried out with regard to that issue. According to this, the levels of some nutritionally relevant ingredients are higher in organically produced food. Since different foods or food groups as well as a large number of food ingredients are considered, the differences show a high degree of heterogeneity that cannot be simply summarised in a single quantified indicator of the differences involved.

Indicators of **environmental sustainability** have been examined in the most differentiated way. With regard to a number of environmental indicators, it is scientifically proven that organic farming performs significantly better. Significant benefits of organic farming have been documented for organic carbon content of soils, soil biology (soil microorganisms, earthworms), and overall soil fertility. Similarly, benefits of organic farming have been demonstrated with regard to protecting the groundwater and surface waters against nitrogen inputs. Positive effects of organic farming on overall biodiversity and important groups of species (e. g. segetal flora, pollinating insects) have been confirmed, although there is a high degree of heterogeneity among available comparative studies and many studies show methodological deficits.

For direct agricultural greenhouse gas (GHG) emissions, the state of knowledge is relatively good with regard to carbon storage in organically and conventionally managed soils, rather limited with regard to nitrous oxide emissions due to

Dimension of differences in sustainability impacts of organic and conventional farming

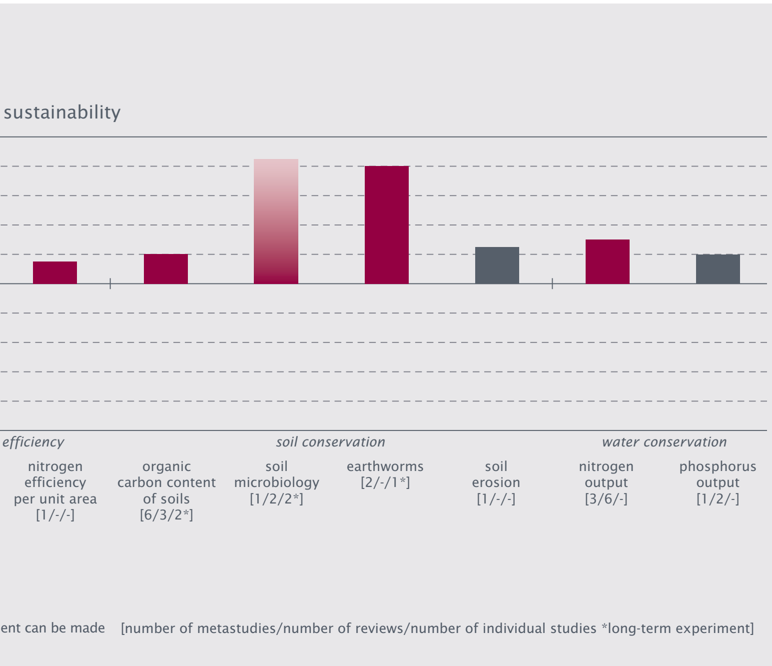


fewer experimental studies being available, and insufficient with regard to methane emissions. Meanwhile, numerous studies are available dealing with the carbon footprint of agricultural products using life cycle assessment (LCA). Generally, GHG emissions per unit area are lower for organic farming than for conventional farming, while both higher and lower emissions per product unit have been calculated. Altogether, the LCA results are very inconsistent, partly due to methodological flaws. As a result, the state of knowledge here is not satisfactory. Finally, organic farming tends to perform better in terms of energy and nitrogen efficiency.

The current state of knowledge only allows statements on **fundamental differences between organic and conventional farming**. Average differences in sustainability performance mean that – to a varying degree – individual farms or groups of farms can also show contrary characteristics. At present, differentiations of the comparative results with regard to significant natural landscapes and economic conditions of the farms – such as farm types as well as locations, regions and federal states – cannot be made. Similarly, it is impossible to map temporal developments of the sustainability performance of organic and conventional farming – with just a few exceptions.

Challenges

From the analysis of the available comparisons of conventional and organic farming, important challenges of a comparative sustainability assessment of farming systems have been derived, which are relevant both for one-time, fundamental comparisons and for periodic surveys of the sustainability of farming systems:



- **System definition**: It is necessary to select comparative systems relevant for agricultural policy below the agricultural sector as a whole and to determine their systemic interrelations beyond agriculture.
- **Objective**: The objective of comparative sustainability assessments (e. g., development of fundamental statements or monitoring of sustainability performance over time) has to be clearly defined.
- **System differentiation**: Sufficient coverage of variations within the systems needs to be ensured in order to map important differentiations within the two farming systems in addition to average sustainability effects.
- **Dimensions and indicators of sustainability**: Further development of the indicator systems is necessary in order to be able to map sustainability comprehensively and with equal weighting. For this, existing sustainability assessment systems in the field of agriculture should be used and further developed.
- **Target values**: As far as possible, uniform target values should be developed for different aggregation levels and supported by a broad consensus of the social groups concerned.
- **Interactions and conflicting objectives**: Sustainability assessments should provide transparency with regard to interactions and potentially resulting conflicts of objectives.
- **Data availability and sources**: Both the use of existing data sources – such as agricultural statistics, test or model farms, environmental monitoring and scientific comparative studies – and the development of new data sources or surveys are necessary. Compatibility of different data sources should be ensured.
- **Representativeness and comparability**: The mapping of real agricultural conditions in field trials or for the selection of farms in comparative studies is a central prerequisite for being able to generalise results from comparative studies or surveys and to enable meaningful comparisons.
- **Spatial system boundaries**: A comparative sustainability assessment should refer to Germany, but take into account the interrelation with national and international upstream and downstream value-added chains.
- **Temporal system boundaries**: For comparative surveys included in sustainability assessments, minimum standards should be met with regard to the survey duration and the time since having switched to organic farming.
- **Interpretability**: An appropriate reference unit, i. e. the reference area or product, must be determined for each indicator.

Next steps

A comparative sustainability assessment of farming systems below the level of the agricultural sector as a whole offers the opportunity to get a differentiated overview of agricultural sustainability. This issue was investigated using the comparison of conventional and organic farming as an example. However, the (further) development of such sustainability assessment systems is still associated with an extensive need for development and action. For this, **three core elements** have been identified.

In politics, society and science, there are different ideas on how to shape the sustainable development of agriculture. Moreover, the need for action, objectives and instruments are controversial. These different perspectives influence the design of sustainability assessment systems. A **dialogue process on the understanding and on fundamental conceptual issues of sustainability** – involving a broad range of stakeholders – would be an important basis for the further development of sustainability assessments of German agriculture. At the same time, such a dialogue might help to further develop sustainability policy in the field of agriculture.

Comparing conventional and organic farming is an important way to conduct a sustainability assessment below the level of the agricultural sector as a whole. On the one hand, considerable preliminary work has been carried out in this regard – but on the other hand, in some areas, relevant deficits still exist. If the comparative assessment of farming systems is to be developed further, further **research activities** would have to be initiated on the basis of the existing research deficits. This includes:

- closing indicator gaps in economic sustainability,
- developing indicators for a comprehensive mapping of social sustainability,
- more closely linking farming practices and the recording of environmental impacts in environmental sustainability,
- developing standards for life-cycle assessment of agricultural value-added chains,
- conducting long-term experiments for systemic comparison,
- developing approaches for the mapping of cross-sectoral, systemic interrelations, and
- examining options for linking sustainability assessments at the farm, value-added chain, farming system, and sector levels.

TAB report no. 188

Nachhaltigkeitsbewertung landwirtschaftlicher Systeme – Herausforderungen und Perspektiven

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unter Mitarbeit von Arnold Sauter

Website of the project

www.tab-beim-bundestag.de/en/research/u30400.html

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A bioeconomy monitoring system is currently being set up in order to monitor, measure and evaluate the transformation process towards a bio-based economy. **Monitoring the sustainability of farming systems** might complement this, but would have to take a different approach than bioeconomy monitoring, which has so far been geared to material flows or value-added chains, since the focus is on impacts in the various sustainability dimensions with regard to land uses or farms. Moreover, it would be useful to consider several levels – from the individual farm to typical regions, farm types, legal forms and the production system at the level of the agricultural sector.

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