DLG Expert Knowledge Series 369

Sustainable Arable Farming

Boosting efficiency, maintaining the image, conserving resources

Competence Center
Agriculture and Food Business

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Preface

Agricultural production in the 21st century faces the challenge of providing high quality and safe foods and raw materials efficiently. At the same time it must improve the competitiveness of the domestic agricultural and food sector and conserve resources for future generations. Alongside the enormous significance of international markets for domestic production, consumer interests in particular will have to be addressed even more strongly in future. This will move sustainability more into the focus of discussion as a guiding vision of modern agriculture in a process of change. The concept of sustainable development of agricultural production is poised at the interface between optimizing on-farm operations, efficient use of resources and the interest in communicating these features in the value chain.

To be able to evaluate farms and land use systems in this light, it must be possible to assess the diverse operating activities with regard to their sustainability. Model approaches and indicator systems developed in recent years to analyze and assess the sustainability of agricultural operating systems can do this.

The core task consists in making the systems accessible to farmers and advisors in order to be able to meet the new challenges adequately. The objective and benefit should primarily be to provide farm managers with an overview of the impacts of their production systems and to boost the efficiency of areas already managed. At the same time further penetration into sites that are only restrictedly suitable for production should be prevented. Priority must be given to conserving and increasing the performance capability of the more yield-rich agriculturally useful areas, as only in this way can a growing population be provided for sufficiently.

This leaflet aims to help provide comprehensive and objective information on the subject of sustainability in practical farming. The focus is on explaining the operational relevance and benefit of sustainability systems.

The authors

1. Sustainability and agriculture

"Making development viable for the future means that the present generation satisfies its own needs without jeopardizing the ability of future generations to satisfy their needs."

This definition of the term "sustainability" originates from the Brundtland report published in 1987. Since then the term sustainability has appeared in many different forms and was/is partly interpreted in different ways by politicians, the trade and interest groups depending on their needs. The word *sustainable* as such is located between the characteristics of *long-term, lasting, far-reaching* and originates from the forestry economics of the 18th century. Just as forest management has always been closely connected with agriculture, agriculture as such is defined by a sustainable – in other words long-term - development. The following examples illustrate this:

Cultivated landscape, which society wants and requires to be cared for, originated solely through the agricultural use of land. The controlled clearing and cultivation practiced over millennia still characterize our landscape, which with its changing forest, meadow, lake and field elements is unique.

With the development of crop cultivation came the need for more and better crops to feed an already then growing population. Starting with the import of cereals from Central Asia and the Middle East (wheat and barley) and cultivation of the potato and maize from America, it was above all breeding progress within these and other crops that led to the existence not only of a broad spectrum of field crops, but also a large number of food and feed plants for versatile and healthy diets. This development also occurred over millennia and is still ongoing today. Only long-term – in other words sustainable – ideas and activities by farmers and their attendants could make this possible.

There are many other examples of far-reaching and long-term developments in agriculture. They include, for example, the farms managed over many generations, functioning irrigation and drainage infrastructure, tracks and bridges, as well as agricultural machinery and equipment adapted to new conditions and knowledge. All these are ideal examples showing that there has always been sustainable agriculture.

So why this great and protracted discussion about "sustainability in agriculture"?

2. New challenges to agriculture

Europe's farming sector faces great challenges. The demand for food is growing steadily, together with demands made of product quality. In the same breath, society is also calling for renewable raw materials to be provided for energy and industrial use. Cultivation of both – foods and raw materials – requires the same resources, i.e. soil, water, nutrients, labour, etc.

Environmental impacts of agricultural production have long been the focus of public consideration.

The extent and the structure of production and use of resources differ depending on region and product. Existing agricultural structures, whether the availability of land, market access or specialization in animal improvement operations, greatly influence the extent and intensity of plant production. If we are to cater to the demand for foods and renewable raw materials there are only a few options with regard to our global future:

- expanding the area cultivated,
- increasing yields,
- multiple use of land,
- replacing low-yield crops with high-yield varieties,
- reducing post-harvest losses, and
- refraining from or limiting animal improvement.

The very question of the feasibility of these measures makes it clear that there is no simple answer to the challenges listed. On the contrary, through its many facets, the interactions between the individual farm sectors, and above all through natural constraints, the flexibility of agriculture is greatly restricted.

The supposedly simplest solution appears to be to expand the agriculturally used land areas further. However, already for most farms this is only possible to a limited extent. Regions not used so far are frequently borderline areas that can only be used for farming with substantial effort, being ecologically dubious or only allowing low efficiency levels. Scarcity of land is reflected in Germany above all in constantly rising land lease and purchase prices. Land scarcity is also a global problem. Losses due to erosion, salinification, harmful compaction and dwindling groundwater availability swallow up large areas of previously agriculturally used land and increase the pressure on the remaining production areas with sufficient yield potential every year. However, the higher the yield potential of the land, the more efficiently farm inputs such as efficient varieties, fertilizers and plant protection agents should be used. Optimal deployment of these factors is vital for conserving and boosting area yields (Figure 1). Increasing these yields is necessary in order to produce sufficient foods and raw materials for a constantly growing world population on shrinking areas of arable land.

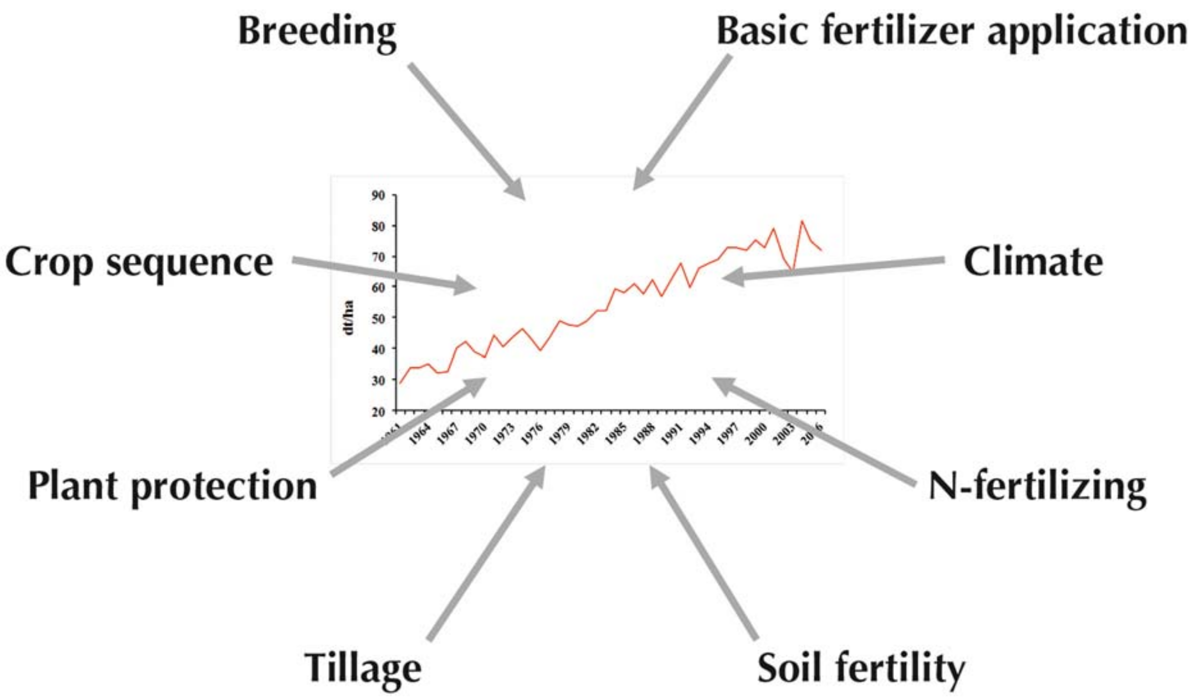

Figure 1: Factors influencing yield

3. Sustainability between society and agriculture

In connection with these developments the concept of sustainability in agricultural production is arising more frequently in public debate. Sustainable development is often viewed as synonymous with "environmentally friendly" or "organic". The confusion in public discussion is still upheld today by contradictory communication and definitions of sustainability.

As already stated, the term sustainability stands for long-term effects of measures, which need not necessarily be environmentally friendly or conservationist.

Of course, sustainable farming can ultimately also conserve the environment. However, this is not automatic and does not apply in every case. All efforts to achieve strictly environmentally friendly farms are frustrated if they can only survive on the market in the short term due to social and economic aspects.

Here the primary interests of society (as consumers or represented by policy makers) and of the farmer as entrepreneur stand against each other. While society calls for low-cost, sufficient and good foods from ecologically balanced production and politicians take environmental priority areas into account in their planning, the business farmer is faced with the challenge of earning a livelihood from his farm, securing jobs and gearing his business for the future.

Despite this, farmers cannot avoid taking ecological aspects into account alongside economic aspects. Without conserving natural resources such as water, soil and air, the range of plant species and varieties, animal organisms, as well as soil fauna and pollinating insects, plant production cannot be maintained in the long term.

In addition, family, labour and social aspects have to be included in considerations. Without family support, let alone an heir to the farm, the healthy entrepreneurship of the farmer will end in the medium term. Staff can only be kept in the long term if fundamental interests such as fair payment, accident and health protection, as well as further training and co-determination exist or are promoted.

Farmers will agree to these arguments and are aware that most points are already taken into account in any case, as the farm is to be managed on a long-term basis. However, it cannot be assumed that this guarantees sustainable production per se. Some long-term consequences of production cannot be grasped and experienced directly visually or by simple measurements. Where the economics are concerned, established ratios are available for steering farm management. By contrast, this is less customary in the ecological and social sector. This is where the particular challenges lie for the future of sustainable development in agriculture. For example, the long-term effect of operating a biogas plant on the humus content can hardly be measured at the level of the individual farm, if at all. The same challenge also applies to appraising positive or negative impacts of the use of new machinery on harmful compaction of the subsoil. Interactions between various measures are very difficult to determine or evaluate. Accordingly, the aspect of sustainability involves more than taking evident impacts into account.

4. The three pillars of sustainability – Significance for agriculture

The goal of sustainable development is to farm in an environmentally friendly fashion that conserves the environment and at the same time to cater to economic and social demands. A central characteristic of sustainable development is thus consideration of the environment, economics and social affairs with equal weighting (Figure 2).

In order to survey sustainability at farm level and make it comparable, criteria that supply objective information about the condition of the farm must be specified for all three pillars. However, when fixing criteria, standard values and indicators, it is important to allow scope for individual development for each farm and farm owner within and between these criteria. After all, it is ultimately the task of the farm manager to adapt his production system to the given – and often individual – conditions of his farm. This includes sustainability management on the farm and takes ecological, economic and social frameworks and development opportunities into account.

Ecology	Economics	Social affairs
Nature conservation	Cost efficiency	Workplace
Landscape management	Food production	Family
Biodiversity	Energy production	Continuing training
Maintenance of the cultivated landscape	Investments	Tradition
Water, air and soil protection		Social commitment
Animal welfare		Regional acceptance
		Rural regions

Figure 2: The three pillars of sustainability and module examples

Active sustainability management supports enterprises in combining economic goals with ecological and socially compatible production-related demands. By analyzing the ACTUAL conditions, farmers are able to identify interactions between the various areas. Alongside a vertical farm comparison over many years of cultivation and hence development of their own farms, farmers can more easily conduct horizontal farm comparisons and thus compare their own farms with others working under similar conditions. These comparisons especially provide transparent information about the status of their own farms, enabling them to analyze and manage weaknesses. In this way, for example, potentials for savings in nitrogen management can be identified on many farms.

In addition to the enterprises' own interest in obtaining information about future viability via sustainability analyses, the sustainability aspect is becoming increasingly important for communication with society, politicians and downstream value chains. Agriculture as a primary producer of foods and energy can thus make a key contribution to the social challenges of the 21st century.

5. The DLG Sustainability Standard

5.1 The certification system

An appropriate system is needed to appraise the sustainability of an agricultural production system. Within the framework of a research project, DLG together with academic partners has developed the DLG Sustainability Standard for farms. The resulting software solution represents a system that takes farmers with different operating and technical prerequisites into account.

Based on the environmental and quality management system REPRO, the system evaluates the complete farm, independently of whether the raw materials are processed in food or non-food sectors. The DLG Sustainability Standard takes up the principles of sustainable farming – protection of soil and water, efficient use of resources, consideration of the climate impacts of agricultural production, biodiversity, plant protection, food safety and hygiene, industrial safety, and continued training of farm managers and staff. Thus established indicators in agriculture such as the nitrogen, humus and phosphorous balance, as well as newly developed indicators such as greenhouse gas emissions and biodiversity are included. Furthermore, established key economic and social ratios are determined. Table 1 shows the indicators used in the DLG Sustainability Standard for the operational sustainability analysis.

With the certification system, a uniform method for evaluating sustainability in agriculture is available. It applies equally for producing food plants and energy plants and can be applied for both conventionally and organically farmed units. The system takes site-specific frameworks into account and thus enables comparisons to be made between individual fields, but also at a regional level.

The detailed evaluations form the basis for optimizing production (e. g. the use of farm inputs), with the consideration of cropping systems over several years allowing continuous improvement of production. Based on a macro-farm overview, farmers can consider the effects of individual process stages in detail and apply them accordingly to their production methods. Impacts on other aspects quickly become visible and can

Table 1: Indicators and analysis sectors

	Analysis sector	Indicator	Farm analysis
Ecology	Climate impacts	Greenhouse gas emissions	Emission inventory
	Use of resources	Energy intensity, use of phosphorous	Energy balancing, P-loss potential
	Biodiversity	Agro biodiversity, plant protection intensity	Farm organization/ process structuring treatment index
	Soil protection	Soil compaction, erosion, humus balance	Tendency to compaction, soil loss, humus formation of the methods
	Water and air pollution	N-balance	N-loss potential
Economy	Profitability	Farm income, remuneration factor	Value added by the farm/ paying for the factors of production
	Liquidity	Debt servicing limit	Commercially possible debt servicing
	Stability	Profit rate, net investment, change in equity	Farm stability, farm investments, capital for investments, living allowance
Social affairs	Labour and employment	Wages and salaries, average workload, holidays, training, industrial safety, co-determination	Staff remuneration staff working times staff holidays staff training
	Social commitment	Communication with the public, cooperation arrangements, regional commitment	Activities of the enterprise
	Quality assurance	Use of quality assurance systems	Securing product quality/ food safety

be taken into account. The objective is to prevent incidents with undesirable consequences for mankind and the environment and to identify their possible occurrence in the ongoing production process. The sustainability of agricultural production can only really be evaluated by considering the aspects connected in the production process together with their interactions.

5.2 Methodology of the indicators

Farm data are collected in various ways. Data about the social affairs sector of the farm are collected via a questionnaire for farm managers. Data for the economic analysis are drawn and offset from the annual financial statements. The data for analyzing ecological indicators are taken from the field file. Thus the three pillars of sustainability can be evaluated with on-farm and hence comparatively easily available information. The basic data consist of the mean farm ratings of the last three farming years. This prevents e. g. climatic exceptions, one-off events or the like from influencing the sustainability assessment too strongly. Values for the different indicators are determined from the data collected. There are boundary values for each indicator that are specified via scientific methods and in discussion with relevant groups.

For the example of the N-balance indicator, the limits move as shown in Table 2. The N-balance is evaluated in accordance with the level in kg N ha^{-1} a^{-1}. The example shown displays an N-balance value from 0 to 50 kg N ha^{-1} a^{-1} in the optimal range and is thus awarded the score 1.

Table 2: Ranges and evaluations of N-balance values

Area	Values in kg N ha^{-1} a^{-1}	Score/evaluation
Optimal	0 – 50	1
Sustainable	-25 to 75	0.75
Tolerance limit	> 150	0

N-balances between -25 and 75 kg N ha^{-1} a^{-1} are classified as sustainable and scored between 1.0 and 0.75. This means that although improvements are possible, these are not the top priority. The value 0.75 represents the sustainability boundary. N-balances below -25 kg N ha^{-1} a^{-1} are thus below the sustainability limit, as this is where the danger of excess humus degradation and hence the risk of lasting soil harm starts.

N-balances above 75 kg N ha^{-1} a^{-1} are also beyond the sustainability boundary, as at this level there is a considerable risk of N-losses. Infiltration of nitrate into the groundwater, gaseous emissions and eutrophication of adjacent ecosystems would be the consequences. Both cases – excessively low and excessively high N-balances – would sustainably disturb the natural resources of soil, water and air, and by influencing water and air they would also represent a health risk. At scores below 0.75, therefore, farmers should take action and review their production systems for weaknesses not only in an environmental sense. In this example, improved management could save costs in nitrogen fertilizing and achieve higher efficiency levels.

N-balances with a score of 0 lie beyond the tolerance limit. This means that there is no further sub-division there, as balance values of over 150 kg N ha^{-1} a^{-1} represent substantial danger for the environment and for cost efficiency on the farm. The fertilized nitrogen quantities bear no relation to the yield produced. The production system would have to be fundamentally reassessed, weaknesses identified and countermeasures taken.

Each indicator in the DLG Sustainability Standards is assessed on the basis of this principle, illustrated here with the example of the N-balance.

As shown in Figure 3, all the indicator assessments recorded are transferred to a clear network diagram. The graphic on the left shows the assessment function, from which the corresponding sustainability assessment can be read off from the field-specific N-balance. This assessment is transferred to the network diagram on the right. In this type of diagram all the indicators are shown clearly in the same way so that the farm sustainability status can be read out from just one diagram.

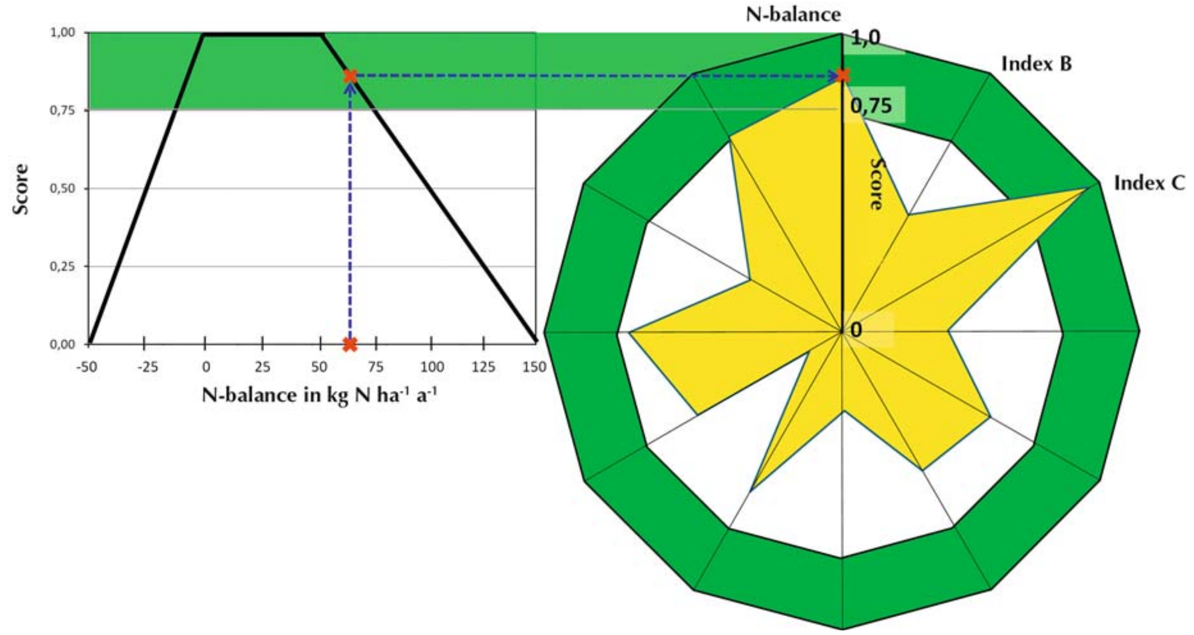

Figure 3: The field-specific N-balance (red cross) is assessed by the mathematical function (left) (blue arrow).
Scores between 0.75 and 1.0 (green area) correspond to a sustainable N-balance.
The sustainability score is then transferred to a clear network diagram (right).

All the ecological indicators are calculated at field level in the DLG Sustainability Standard and shown accordingly in graphic form (Figure 4). This allows the farm manager to evaluate the different fields depending on location, crop rotation or stand management and to identify the reasons for this assessment quickly.

Figure 4: Graphic representation of the field-specific N-balances

To assess the plant protection intensity, crop-specific application frequencies are determined and compared with typical application rates for the region. The Julius Kühn-Institut (Institute for Strategies and Technology Assessment) has defined the regions, taking into account the same climate conditions and hence similar growth conditions and pressure of disease. Here customary local plant protection strategies are recorded on the basis of surveys conducted on reference farms and corresponding target values are calculated for adapted appropriate intensity of herbicide, fungicide etc. applications. In view of the relatively large time intervals between the regional surveys, it is only conditionally possible to take developments in plant protection into account. For instance the updating of target values in the year 2011 showed a general increase in application frequencies. Up to then the assessments had been based on statistics from the year 2004 (see also farm examples).

6. Sustainability analysis of farms

Farms differ not only on the basis of their location conditions, but also in terms of their production systems and the entrepreneurial capabilities of the farm managers. Skills, personal inclinations and individual risk management influence farm development.

Model farms spread throughout the whole of Germany are presented to show individual farm context situations and their impacts on the sustainability score (Table 3). This method aims to provide the reader with an overview of how site and production system influence even the most important indicators for assessing sustainability.

The territorial distribution of the farms considered ranges from the hilly landscape of Lower Bavaria in the south, through the Ore Mountains (Erzgebirge) in the east, the fertile Hildesheimer Börde, up to the Holstein marsh land in the north. This distribution is reflected in the respective soil scores which range between 25 and 77.

With the sometimes strongly differing site conditions, winter wheat turned out to be the most important market crop for most of the farms selected. Two animal improvement farms were also taken into account. Dairy cattle farming dominates in the Eastern Erzgebirge. The farm in the hilly landscape of Lower Bavaria carries out pig finishing. Arable farming on these farms is thus geared to providing feed, and farmyard manure is to be taken into account in the fertilizing strategy.

Table 3: Ratios of the model farms

Ratio	ME	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5
Site		**Lower Bavaria, hilly**	**East Ore Mountains**	**Hildes-heimer Börde**	**Hildes-heimer Börde**	**Holstein marsh land**
Soil index score		25	55	76	77	72
Agric. useful land (LF)	ha	70	1411	234	279	261
Arable land (AF)	ha	62.7	1154.2	232.6	277.9	257.1
Animal pop. (large unit)	LU/ha	1.5	0.8	–	–	–
Grassland	% LF	10.5	18.2	0.6	0.4	1.5
Grain	% AF	64.3	48.6	66.6	58.5	69.2
Winter wheat	% AF	36.9	18.3	50.8	58.5	59.8
Triticale/winter barley	% AF	27.4	14.6	15.8	–	9.4
Summer barley	% AF	–	15.7	–	–	–
Oil crops	% AF	6.1	17.6	4.2	9.1	12.1
Root crops	% AF	29.6	13.6	23.3	18.3	–
– Sugar beet	% AF	–	—	23.3	18.3	–
– Maize	% AF	29.6	8.5	–	–	–
– Potato	% AF	–	5.1	–	–	–
Field fodder	% AF	–	20.1	–	–	–
Grain legumes	% AF	–	–	1.1	7.7	6.1
Catch crops	% AF	17.0	1.7	–	22.6	–
Set-aside	% AF	–	0.1	4.8	6.4	12.6

Two similarly structured farms in the Hildesheimer Börde were selected to assess the situation under the aspect of comparable site factors.

The DLG sustainability analysis was conducted for each farm and the results set out in the network diagram already explained. The results of the five farms selected at the arable farming level are shown below and then compared directly with each other.

6.1 Overview of indicators for Farm 1, pig finishing farm in the hilly landscape of Lower Bavaria

The farm investigated is located in the arable farming region of Lower Bavaria. With a medium site soil index score, it is possible to realize high yields on the loamy or sandy-loamy soils with an annual average precipitation of 765 mm. Cereals and grain maize are cultivated exclusively for the on-farm pig finishing operations.

The high number of animals per unit area results in particular in difficulties in implementing a balanced material cycle. In particular the humus balance displays high scores, as a result of which – with mineralizing thrusts in the long term – the danger of negative environmental impairment (nitrate elution) rises. Altogether the farm operates sustainably under ecological aspects (Figure 5).

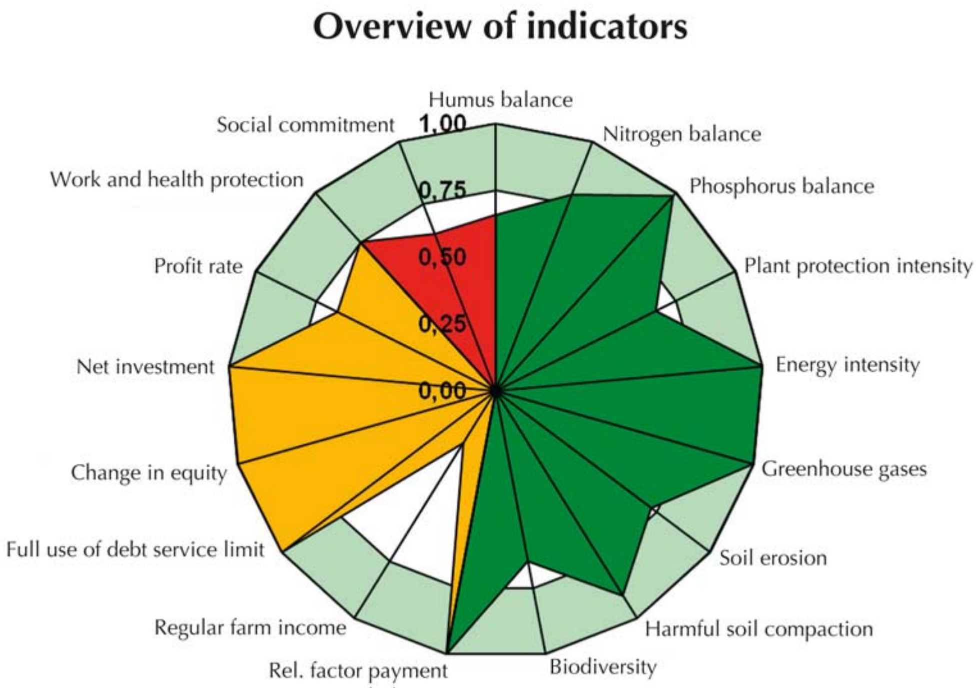

Figure 5: Graphic representation of the scores on Farm 1

The farm displays the maximum score of 1 for four economic indicators. Optimal values are achieved for everything except regular farm income and profit rate. This means that on the one hand the value added by the farm is below average compared with that of the farms in the Federal Ministry of Food, Agriculture and Consumer Protection test farm network, and on the other hand the farm may be more vulnerable to price fluctuations due to the lower profit rate.

As the farm, operated as a family enterprise, does not employ any external labour, only two indicators in the social pillar are scored.

6.2 Overview of indicators for Farm 2, dairy cattle farm in the East Erzgebirge

This farm is located in the medium-level mountain region of the East Erzgebirge (Ore Mountains). Sandy loam dominates the soils, which are of low quality with an average soil index score of 25. Annual precipitation is around 960 mm. The low annual average temperature of 5.8 °C is due to the high elevation of the farm land. Alongside market crops, feed plants dominate the cultivation structure and are used for on-farm milk production as well as to produce biogas.

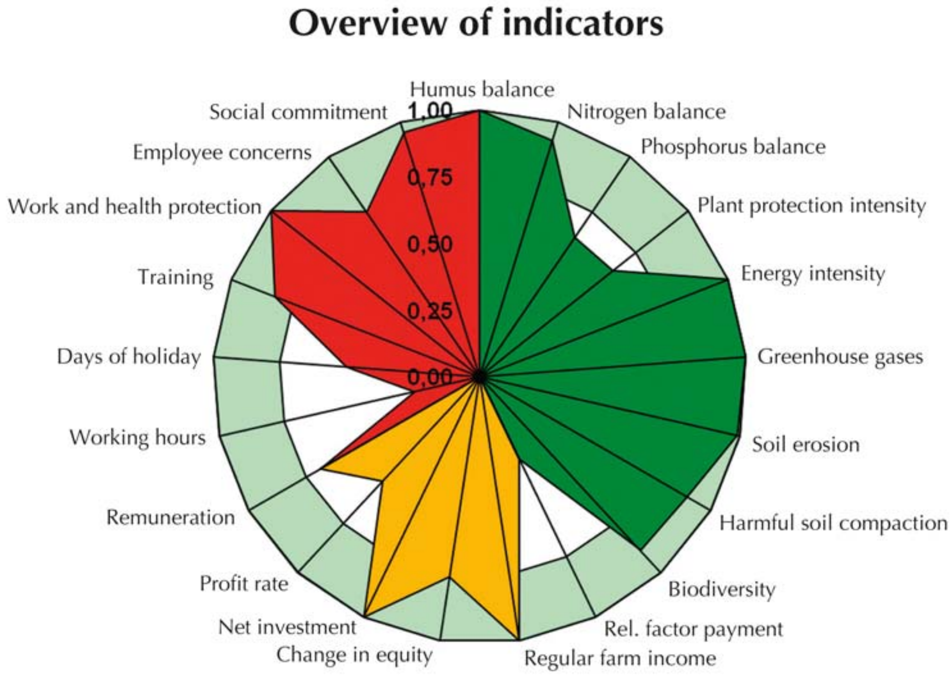

Figure 6: Graphic representation of the scores on Farm 2

The results show a high level of ecological sustainability (Figure 6). The very good score is attributable to high diversity of cultivation as well as the adapted intensity level of farming. With its different business sectors, the farm has sufficient scope for structuring a versatile range of crop species. Need for action can only be inferred in phosphorus fertilization and use of plant protection agents.

In the field of economics, the farm just misses reaching the sustainability threshold. It cannot pay as much for the factors of production as the other farms studied by way of comparison. Furthermore, the farm responds sensitively to price fluctuations.

As regards the social indicators, the farm displays an unsatisfactory result in the level of wages, working hours and holiday.

6.3 Overview of indicators for Farm 3, arable farm in the Hildesheimer Börde

This farm manages land on the fringes of the Hildesheimer Börde, characterized by loamy and sandy-loamy loess soils. The production of this market crop farm is oriented chiefly to cultivating grain and sugar beet. The sustainability indicators are comparatively low (Figure 7).

The farm's cultivation system is structured such that there are elevated risks regarding environmental resources. Distinct weaknesses are revealed in humus and nutrient management and in the use of plant protection agents. The indicators energy intensity and harmful soil compaction scored positively.

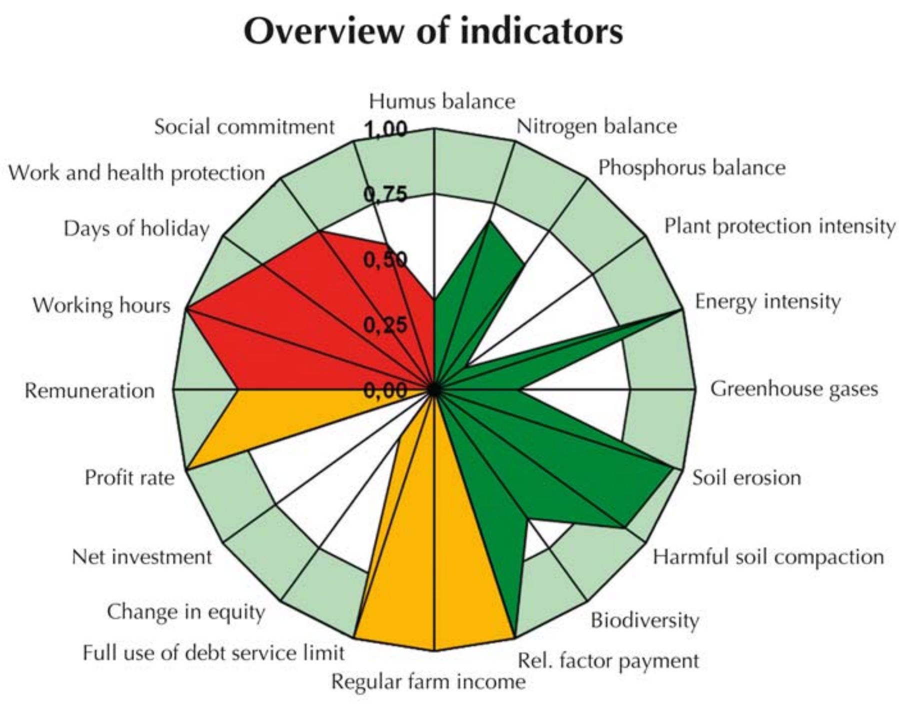

Figure 7: Graphic representation of the scores of Farm 3

In the economic sector the farm also lies beneath the sustainability threshold of 0.75. Indicators representing stability ratios show that the long-term stability of this farm may be jeopardized.

However, most specifications for the social criteria were satisfied, making it possible to achieve the sustainability threshold.

6.4 Overview of indicators for Farm 4, arable farm in the Hildesheimer Börde

This farm too is located in the Hildesheimer Börde with loamy and sandy-loamy loess soils. The farm cultivation structure is chiefly characterized by grain and sugar beet production. One special feature is the continuous cultivation of catch crops prior to sugar beets. Despite the elevated intensity of plant protection and greenhouse gas emissions, this farm operates altogether sustainably under ecological aspects (Figure 8).

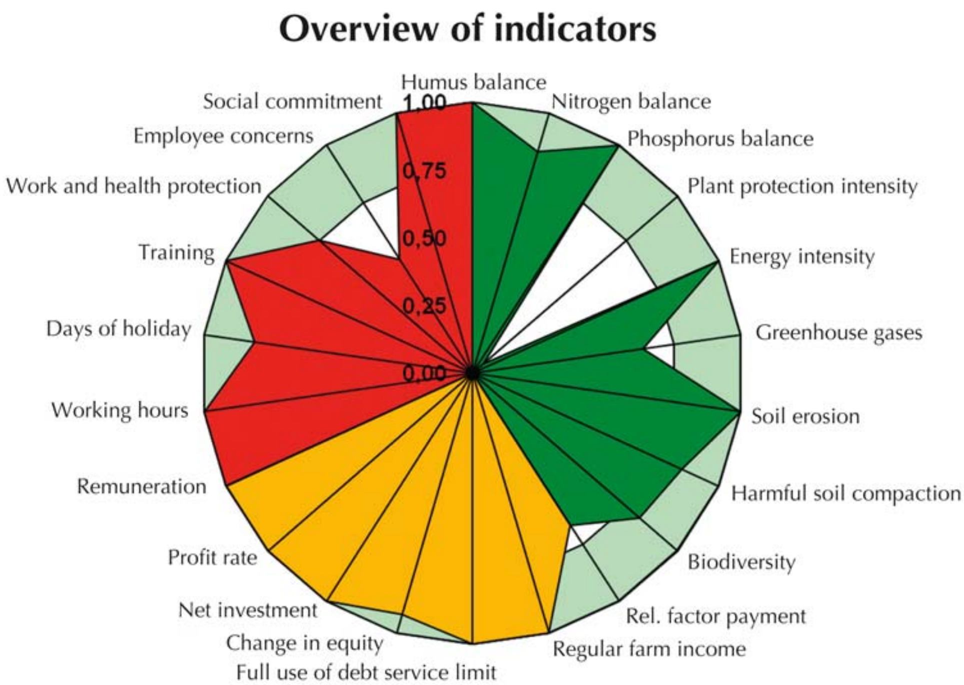

Figure 8: Graphic representation of the scores on Farm 4

The farm can also be evaluated as sustainable in the fields of economics and social affairs. Only the payment for the factors of production deployed is insufficient by comparison with the farms in the Federal Ministry of Food, Agriculture and Consumer Protection test farm network.

6.5 Overview of indicators for Farm 5, arable farm in the Holstein marsh land

The farm is located in the Holstein marsh land and thus at a site with a high yield level. Operating as a purely arable farm, it gears production to bread cereals and oilseed rape.

The structuring of the management system displays only few negative effects on the environment and on consumption of resources (Figure 9). There is need for action, however, above all in phosphorus supply. Here high fertilization levels are needed for optimal soil supply. In view of the production sector, a high safety standard is practiced in plant protection use. The amounts applied are above the average regional intensities.

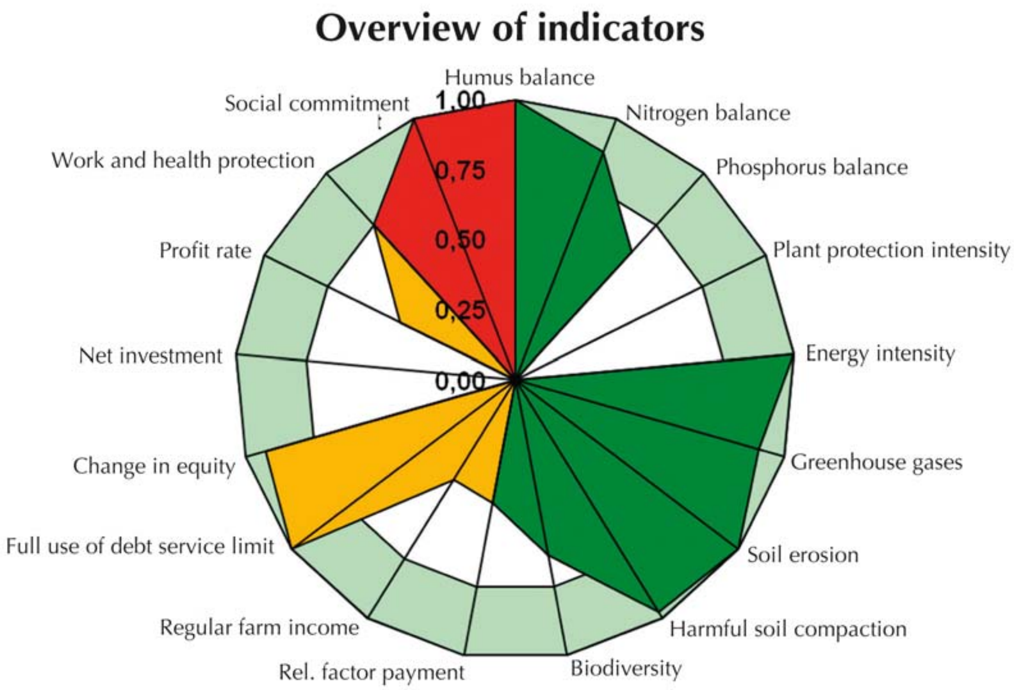

Figure 9: Graphic representation of the scores on Farm 5

The farm score for economics was low for the net investment indicator and means that particularly low levels of replacement investments have been made by comparison with the farms in the BMELV test farm network.

As far as can be evaluated, the farm is very well organized as regards the social affairs sector.

6.6 Sustainability assessment and individual farm structure

Following presentation of the individual results, it is interesting to compare them to derive information about the influence of the site, production system and farm philosophy.

The rough sub-division into animal husbandry farms and purely arable farms shows great differences above all in the indicator of plant protection intensity. While the animal husbandry farms pursue a comparatively moderate plant protection strategy, the arable farms analyzed all practice high intensity levels, followed by non-sustainable indicator scores for plant protection intensity in the range of 0. These differences can all be explained by the special features of the production branches. Whereas animal husbandry farms orient their plant cropping primarily to providing feed (basic diet, grain), the purely arable farms concentrate on producing high-quality market crops such as bread cereals and sugar beet. These market crops involve higher plant protection intensities due to their natural requirements and certain quality parameters. For system-related reasons it is not possible to award optimal scores for this production sector and very difficult to reach a 'sustainable' assessment. Furthermore, as described above for plant protection, the database for evaluating individual indicators can change. A consideration based on individual indicators, without taking the farm objective and other indicators into account, is difficult and does not reflect the holistic sustainability assessment of a farm.

While the plant protection intensity represents a challenge for purely arable farms, the humus and nitrogen balance on livestock improvement farms calls for greater attention. As can be seen on Farm 1, the use of farmyard manure can have negative impacts on a balanced humus content. This results in further effects on the N-balance. The spreading of farmyard manure, chiefly on land close to the farmyard, which is often expedient under energy aspects leads to elevated concentrations of organic substances there. In view of the fact that it is difficult to assess the impact of organic fertilizers, mineral N-applications are often carried out in addition. Both measures can have negative consequences for the humus and N-regime in the soil.

The farms on the Hildesheimer Börde, which have not only a similar location but also similar production backgrounds can be compared with each other. As just described above, both farms display high levels of plant protection intensity due to their focus on market crops. Both farms cultivate sugar beet on similar shares of land, which has an unfavourable effect on the humus balance. As root crops are cultivated, the soil is without cover for a long time and strong tillage and a lack of return of organic material lead to an elevated reduction of humus.

Farm 4 can compensate the negative humus effect of sugar beet by continuous cultivation of catch crops and a low share of grain legumes on the agriculturally useful areas and thus display a sustainable humus balance. These measures, cultivating catch crops and legumes, also have a positive influence on the biodiversity indicator. Farm 3 is in the non-sustainable zone here too. With targeted arable measures, an intensive market crop farm can influence a number of sustainability indicators positively at the same time.

7. The sustainability score as a tool for farm management

The DLG Sustainability Standard with a clear presentation of the results of all relevant indicators in a network diagram provides a swift overview of the sustainability status of the farm for the three pillars of ecology, economics and social affairs. On the basis of this overview the farm manager can identify the weaknesses in his production system. This can trigger an optimizing process for the production system on the farm.

The results of the sustainability analysis should be examined step by step for weaknesses in farm management. A poorer score in the ecological sector can on the one hand mean excessive and inefficient use of farm inputs and implementation of excessively intensive measures. On the other hand, such values can indicate insufficient use of farm inputs and hence degradation of natural resources. Furthermore, there are interactions between various indicators, for example the N-balance and the humus balance. If the N-balance is too low, this also influences the humus balance in the long term. Insufficient N supplies mean that the soil humus content is depleted, with corresponding consequences for soil fertility and stability. This detailed analysis of the individual indicators is vital in order to subsequently derive measures for improvement from the results. The measures to be taken cannot be recommended across the board, but depend on a variety of different factors such as the farm location, the machinery and equipment available, the financial resources, the skills of the farm manager and the market environment. If the market calls for high quality buckwheat, it is difficult to avoid higher plant protection intensities. On the other hand, by means of advance fertilizing with phosphate, it is possible to react site-independently and comparatively quickly to a poor phosphorus balance.

Above all in areas with high lease price levels and low availability of additional land, it is extremely important to conserve soil resources. With balanced management and expedient crop sequences, needs-driven fertilizing, low soil stresses etc., it is possible to use the available agriculturally useful land sustainably and under certain circumstances with rising yield potential.

8. Certificates as an instrument of communication

Agriculture is generally held in high regard among the population. Consumers also have very high expectations of agriculture and do not always consider these fulfilled. For instance, the general public's perception of farming is that it is characterized by substantial deficits in animal welfare, nature conservation and environmental protection. There is a great discrepancy between consumer expectations on the one hand and the supposed reality on the other. Consumers want products from romanticized farming. This is set against the image of technology-oriented agriculture that operates in partly very large units on the basis of labour management and cost efficiency. The picture of these extreme opposites shows that agriculture has failed to communicate to consumers the need for - as well as the positive aspects of - technological progress. The great challenge is to create confidence among consumers by means of the right communication and PR work. As a result of the decline in the share of population working in agriculture, there are ever fewer points of contact between a great part of the population and the agricultural production processes. Consumer confidence in farming can be strengthened again by a certification system. The sustainability certificates can create a good basis, as they certify responsible management for agriculture. In this way farmers can argue along two lines – they show consumers that they are coping with ecological requirements as well as with economic aspects in their farm management. In addition, the food industry can procure and process raw materials from sustainable cultivation and communicate this. The fact that the sustainability aspect plays a great role in public perception is shown by the results of the DLG Regionality Study 2011. The interest of the interviewees in the subject of *sustainability* ranked here on the same level as the topic of *organic farming*.

The comprehensive documentation of work steps on the farm offers a great opportunity for publicizing information and thus creating transparency vis-à-vis customers. This would be an important step for the perception of agricultural production in the media and the general public. Agriculture thus has the chance to communicate proactively. However, farmers must pursue these steps voluntarily and out of conviction, for only then does this process have any prospect of broad-based acceptance. By contrast, if this transparency is ordered by state institutions or other partners in the value chain, it generally leads to a relatively critical view. Changes and optimization at farm level are generally not achieved if measures are not implemented voluntarily. Certification on the basis of voluntary choice by a farm manager can, on the other hand, strengthen transparency vis-à vis market partners and also achieve learning effects on the farm.

9. The role of the trade

Alongside the farm analysis and securing of farm productivity and viability, processing and trading in agricultural products also play a significant role in the development of sustainable agriculture. If they assume a bottleneck position, processing enterprises can exert a crucial influence on the cropping contracts or other quality specifications for agricultural products. Precisely specified standards can be realized above all in small production quantities and with a small number of producers. If this situation is compared with a mass product such as wheat, it becomes evident that enforcing standards in the value chain is much more demanding here. For some years now there has been a distinct trend in the retail trade or the food industry towards making more complex requirements of agricultural production. These requirements go well beyond the aspect of product quality and are to be classified in the field of process quality.

Why are the aspects such as product and process quality and the associated observance of standards so important for the companies? On the one hand these are pure marketing aspects. In addition to this, they create opportunities for tracing and securing raw material supplies. The standards also make it possible to implement a complete and coherent sustainability concept. In the context of the discussion on Corporate Social Responsibility being conducted throughout the economy, there is a noticeable trend in agriculture and the food sector for participants in the value chain, and here in particular the trade, to identify and use advances in the sustainability sector as a competitive advantage. To what extent such concepts on the part of the trade or the processing industry represent an improvement in production in the sense of sustainability depends above all on the process of drawing up such standards. It is important that the selection and setting of boundary values be carried out on the basis of the same criteria as in other areas. Comprehensive and targeted systems can evolve if standards and coordination between producers, processors and the trade are ensured. Ultimately this can be communicated directly to the end consumers – if desired – and may lead to a higher acceptance of the standard. Naturally it should not be disregarded that there are also risks in this cooperation within the context of the value chain. These lie, for example, in the structure of the food trade and food processing. Large companies or trading chains could decide on standards and implement these without sufficient consideration given to agricultural concerns. On the experience gained to date, narrow fixation on a single feature, such as the CO_2 footprint or biodiversity, does not lead to the required results. Such a limited approach leads to confusion among consumers and does not do justice to the concept of sustainable development.

Furthermore, it is important to involve not only the time-based and geographical aspects of individual products into the assessment. One example here is grain cultivation. The production of flour and bakery products can only be assessed properly with consideration given to the crop sequence. In order to be able to consider social aspects in addition, it is urgently necessary to look beyond grain cropping at the next higher aggregation level, i.e. the farm and its assessment score.

Farmers understand quickly that under certain circumstances a system that they have difficulty in influencing or steering alone may be started. There is even a danger that it will be imposed on them externally by the trade, politicians or consumers, in other words non-agricultural experts. This is precisely where the chances of farm certification lie from the very start. The DLG Sustainability Standard was developed jointly with politicians and environmental representatives, but above all with the collaboration of farmers, and thus enjoys a higher level of acceptance among farmers. The downstream value chain can be obliged with this sustainability standard before a system created without the participation of agriculture is developed. The sustainability certification also has the advantage for farmers that they can pro-actively furnish evidence to the trade and thus increase their chances of co-determination.

10. The sustainability self-check

Sustainability aspects play a greater role in practical farm management than is frequently suspected. Farms are generally oriented to long-term production. Generally, investment decisions only pay off after years or decades. Furthermore, many farm managers have a close emotional link with their local region, their farm and their production sector.

DLG has developed a sustainability self-check for business-minded farmers to carry out a first appraisal of the sustainability of their farm management. This self-check is based on a questionnaire addressing themes from the now familiar fields of ecology, economics and social affairs.

Not all the questions in the sustainability self-check correspond precisely to the indicators used in the DLG sustainability standard, but they represent questions concerning the long-term goal of the farm.

Attention is expressly drawn to the fact that this self-check can in no way replace a sustainability analysis along the lines of the DLG sustainability standard. Instead, it aims to draw the attention of the farm manager to aspects that are vital for viable farm development. The questions lead to detailed consideration of various thematic areas, examining a production system once again and giving farmers a first impression about the sustainability of their own farm.

For the result of the sustainability self-check to be realistic, users should answer honestly and clearly in their own interest. Over-estimation or under-estimation of measures, conditions or skills quickly reduces the informative power of the self-check.

Sustainability Self Check

Total ecology	
Total economics	
Total social affairs	
Grand total	

Assessment key:

Ecology:	9 points	You farm completely sustainably with regard to ecology
	8 – 6 points	You farm sustainably with regard to ecology on the whole. There is potential for optimizing individual aspects.
	< 6 points	You do not farm sustainably with regard to ecology. There is great potential for optimizing.
Economics:	10 points	You farm completely sustainably with regard to economics.
	9 – 7,5 points	You farm sustainably with regard to economics on the whole. There is potential for optimizing individual aspects.
	< 7,5 points	You do not farm sustainably with regard to economics. There is great potential for optimizing.
Social affairs:	10 points	You farm completely sustainably as regards social affairs.
	9 – 7,5 points	You farm socially sustainably on the whole. There is potential for optimizing in individual aspects.
	< 7,5 points	You do not farm socially sustainably. There is great potential for optimizing.
Total:	29 points	You farm completely sustainably in all areas. Your farm is viable for the future in all aspects of sustainability.
	28 – 22 points	You operate average sustainable agricultural production. Optimization is possible in some sub-points.
	< 22 points	Your agricultural production is not sustainable. Detailed identification of weak points should be carried out. There is a high demand for optimizing and opportunities for savings.

Sustainability Self Check

– Data on ecological sustainability –

yes= 1 / not consistently = 0.5 / no = 0					
					Score
1. N-balance					
The farm N-balance is ≤ 60 kg N/ha					
2. P-balance					
The farm P-balance is between -25 and 25 kg P/ha					
3. Humus-balance					
The farm humus-balance was surveyed and is between -137.5 and 200 kg C/ha					
4. Plant protection intensity					
Plant protection application is not conducted in routine fashion and the threshold value recorded influences the nature and scope of application					
5. Energy intensity					
You observe the energy consumption in use of machinery and farm inputs (appropriate machine size, number of passes)					
6. Soil erosion					
You farm land subject to the risk of erosion and take erosion-reducing measures such as e.g. mulch sowing, undersowing, catch crops, etc.					
7. Harmful soil compaction					
a) The soil condition (compaction) is investigated.					
b) You take the possible harmful soil compaction into account in your arable farming decisions (e.g. tires, wheel load, soil condition, etc.)					
8. Biodiversity					
a) Are more than three crop types cultivated?	yes	no		x 0.25	
	1	0			
b) Are at least two varieties per crop type cultivated?	yes	Partly	no	x 0.25	
	1	0.5	0		
c) On what share of arable land is no chemical plant protection carried out?	> 20 %	< 20 % > 5 %	< 0.5 %	x 0.25	
	1	0.5	0		
d) Is reduced tillage applied?	yes	partly	no	x 0.25	
	1	0.5	0		
				Total:	

Sustainability Self Check

– Data on economic sustainability –

yes = 1 / not consistently = 0.5 / no = 0	
	Score
1. The regular farm income (profitability ratio) is determined.	
This is the amount available for paying for all factors used in the business.	
2. The relative factor remuneration (profitability ratio) is determined.	
The business income is related to the factors of production. This means the regular business income is divided by the factor costs for labour, land, delivery rights and capital.	
3. The exhaustion of the medium-term debt service limit (liquidity ratio) is determined.	
Performance power of the business for paying back and paying interest on external capital. The actual debt service is related to the medium-term debt service limit.	
4. a) The regular equity capital change (stability characteristic) is determined.	
This takes into account deposits and capital increases as well as withdrawals and profit dividends and private withdrawals. It makes clear whether there is a sufficient base for a livelihood for the entrepreneur.	
4. b) Your business displays a positive change in equity capital over a three-year average.	
5. The net investment (stability characteristic) is determined.	
Is calculated from the change of capital assets, animal assets and stocks including field inventory.	
6. The profit rate (profitability and stability characteristic) is determined.	
Shows the ratio between regular income for the farm results (sales proceeds plus allowances and subsidies and other farm yield).	
7. You know what the production of your products costs (e.g. production costs per dt wheat, per kg milk, etc.)	
8. You draw up a detailed analysis of production sectors every year.	
9. You know the ground rent earned per hectare of cultivated land and take this into account when leasing new land.	
Total:	

Sustainability Self Check

– Data on social sustainability –

If no external labour is employed on the farm, only take Block II into account and double the score.

	yes = 1 / not consistently = 0.5 / no = 0
	Score
I The staff	
1. All employees have a written contract of employment and are paid according to the valid tariff.	
2. The average weekly working time of staff is ≤ 42 hours.	
3. The number of holidays taken per year by staff is at least 22 days.	
4. The number of employees who make active use of training offerings is ≥ 50 % over an average of three years.	
5. Employees are actively encouraged to talk about work themes and introduce new ideas to the farm.	
II The farm manager and general	
6. So far there have been no complaints by the Employers' Accident Insurance, and if there were any, these have been eliminated.	
7. You are socially committed or hold an honorary office (party, municipal sector, farmers association, cooperative, church community).	
8. You allow outsiders insights into the farm and production (e.g. direct marketing, farm festival, tours of the farm).	
9. You take at least two weeks holiday a year yourself.	
10. The farm succession is regulated and there is an emergency regulation. (will, emergency file, etc.)	
Total:	

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- A copy of each trade fair catalogue
- Regular DLG newsletter
- Test reports of agricultural machinery tested by DLG www.DLG.org/dlgtestreports
- The magazine 'agrifuture', magazine for international agribusiness published four times a year

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