# SustainFARM
# Public Goods Tool



# Instruction Manual

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# Introduction to the SustainFARM Public Goods Tool

## *What is it?*

**It´s a sustainability assessment for farms that combine food and non-food production**

The SustainFARM Public Goods Tool helps farmers assess the sustainability of their farming system within a 12-month period. It can also be used as a decision support tool for farmers and land managers, to help them to identify the possible impacts of changing their system on performance across the full range of sustainability indictors.

The assessment takes a broad approach, using information that a farmer would have in their farm records already. It takes between 30 minutes and an hour to complete, depending on the complexity of the farm. It assesses a farm on a number of areas (spurs) which may be impacted by agricultural management practices and are related to public goods such as water quality, air quality, etc.

These "spurs" are:
- Soil management
- Landscape and heritage
- NPK balance
- Energy and carbon
- Food security
- Agricultural systems diversity

- Social capital
- Farm business resilience
- Animal health and welfare management.
- Governance

Each spur is assessed by asking questions based on a number of key "activities". Answers are scored on a scale between 1 (poor) and 5 (excellent) and an overall score given for each spur. Results are captured on a radar diagram (Figure 1) to give an instant visual overview of the sustainability of the farm.

Farmers can also use the tool to investigate the effects of changing or introducing new practices or management to the farm on the sustainability indicators.



*Figure 1. Radar diagram showing results of SustainFARM PG Tool*

## *Who is it for?*

- The Tool can be used on farms in Europe of all sizes that produce both food (crops, livestock, vegetables, fruit, olives) and non-food (timber and woodfuel) products.
- The Tool can be used by farmers, land managers, advisors and anyone else with an interest in the sustainability of a particular farm and access to information on the inputs and output data from the farm (e.g. yields, fuel use and management).
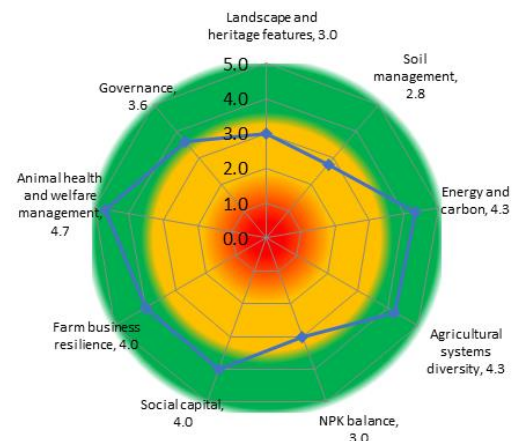
*How do I use it?*

**Overview**

- Download the SustainFARM Tool ([link](link)). This is an excel workbook of less than 1 MB.
- The Tool consists of a series of sheets that should be worked through consecutively from left to right.
- The first sheet on the left contains instructions (this manual) and the references that were used in developing the original tool.
- The second sheet (Initial data collection) is the most time consuming to complete as it collects detailed data on the farm for a 12-month period but is very important as it supports many calculations carried out elsewhere in the Tool.
- The next ten sheets relate to the different spurs; these contain a mixture of questions with answers selected from drop down lists and questions requiring data input. Two sheets require no inputs but show detail on certain aspects of the spurs, e.g. the NPK balance and energy benchmarks.
- The final two sheets on the far right of the Tool contain the results. The first is for farms including livestock; the second for farms without livestock. The spur scores are summarised on a radar diagram, and there is also a detailed bar chart showing the scores of the activities within each spur. A final table captures key elements of interest, including the Land Equivalent Ratio, the NPK balance, energy and $CO_2$ benchmarks and labour use. The results can be printed out and used to demonstrate the sustainability of the farm to other people (Figure 2).

**Taking it further….**

- To investigate the effects on the sustainability indicators of changing or introducing new practices or management to the farm, simply copy the completed assessment as a new file, change the questions relating to the proposed changes and compare the results of the ´before´ and ´after´ scenarios.
- Results can also be compared with a range of case study farms across Europe. These are:
  - 🌳 [Taastrup experimental farm, Denmark](link), which has a combined food and energy system with alleys of cereals separated by biomass belts of short rotation coppice.
  - 🌳 [Il Sasso farm, Italy](link), an organic farm combining olive groves with sheep grazing for milk production.
  - 🌳 [Top fruit and vegetable farm, Poland](link), where fruit trees are intercropped with vegetables including tomatoes, paprika, cucumber.
  - 🌳 [Wójcik farm, Poland](link), an organic Limousine beef farm where grassland is mixed with individual trees, hedges and forested land.
  - 🌳 [Mihalca Farm, Romania](link), a silvopastoral farm with dairy cattle, pigs and poultry
  - 🌳 [Wakelyns Agroforestry, UK,](link) a silvoarable system combining short rotation coppice with organic arable crops.
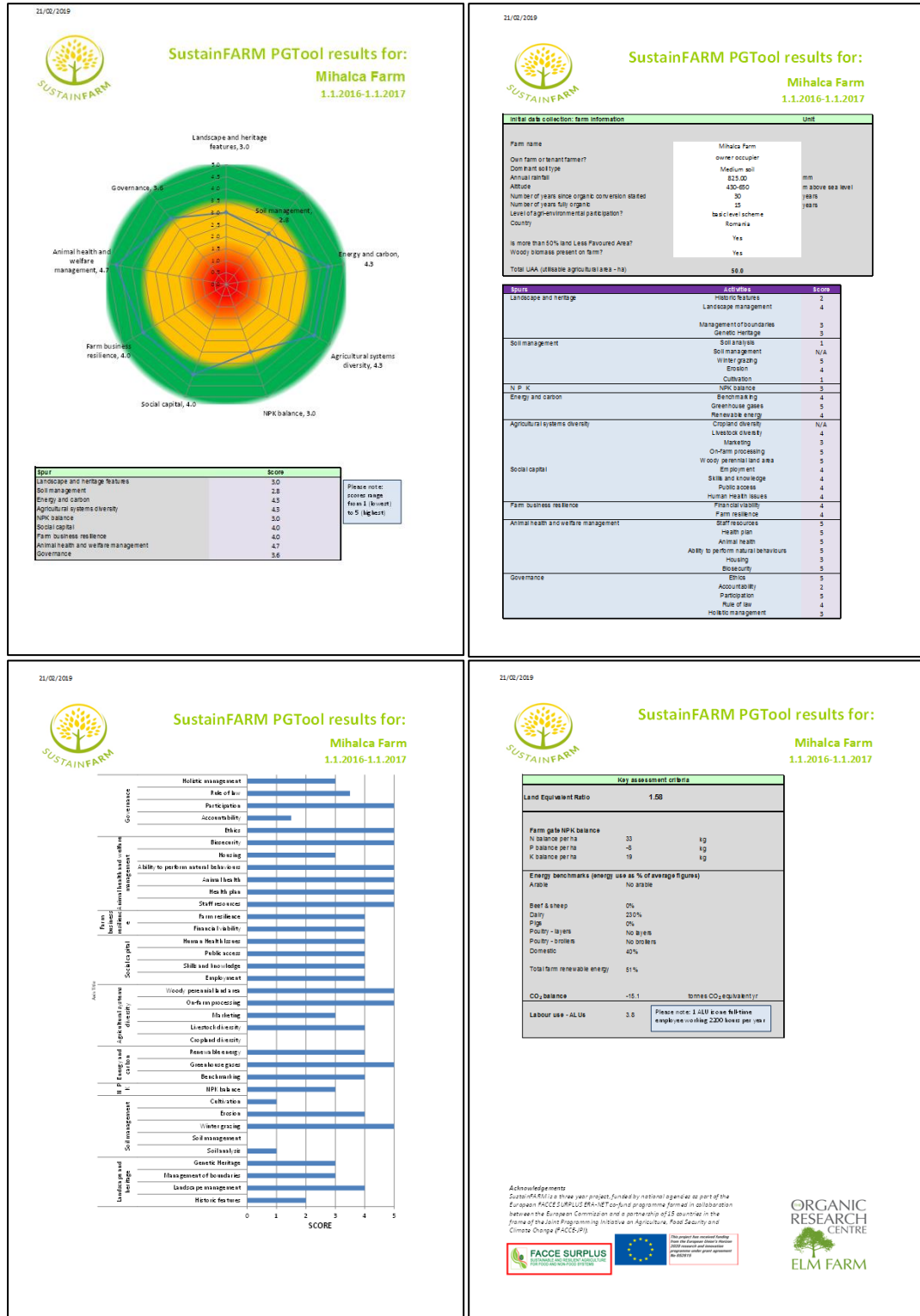
*Figure 2. Results pages for an example farm with livestock*

**Reference:** Organic Research Centre (2019) The SustainFARM Public Goods Tool v1.0.

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## Step 1: collect your data

Before getting started on entering your information into the tool, it is best to collect all the data you need together first. You can use the checklist below (Table 1). The assessment is for a 12-month period. It is up to you to decide whether you choose to do it on a calendar year, a financial year, or some other 12-month period that makes most sense to you (e.g. harvest to harvest, lambing to lambing). It´s important to be consistent throughout the assessment to make sure all the data is for the same period.

Table 1. Data checklist

| Data type | Data needed | Check? |
|---|---|---|
| Farm environmental data | • Average rainfall | |
| | • Height above sea level | |
| Crops: arable, vegetables, fruit (trees and soft fruit), energy crops, and forage | • Hectares | |
| | • Yields | |
| | • Imports | |
| | • Exports | |
| | • Number of varieties | |
| Livestock and livestock products over the 12-month period, | • Number of animals on farm | |
| | • Number of breeds | |
| | • Imports | |
| | • Exports (including deaths) | |
| | • Yields of milk, eggs, wool | |
| Farm woodland, short rotation coppice and agroforestry | • Hectares, | |
| | • Tree densities, | |
| | • Fuel and timber harvests and yields | |
| Other land use | • Hectares of other land use including built up areas, ponds, hedge lengths | |
| Imported seeds | • Tonnes imported | |
| Imported and exported animal feeds: forage | • Tonnes imported or exported | |
| Imported animal feeds - arable crops/straights | • Tonnes imported | |
| Arable straw | • Tonnes imported or exported | |
| Organic and inorganic fertilisers | • Tonnes imported or exported | |
| | • NPK contents (if available) | |
| Fuel use (diesel, petrol, propane, heating oil, electricity, woodfuel) | • Amount of different types of fuel used over the 12-month period, divided between the different enterprises, including for domestic use. | |
| Staff: casual, full time, family labour | • Number of hours and full-time equivalents | |
| | • Staff time looking after livestock | |

## Step 2: Enter data into the Initial Data Collection sheet

Throughout the assessment, the same colour coding of cells is used to help you identify where data needs to be added and highlights key results, notes and scores:

**Key to colour coding**

| | |
|---|---|
| (dark purple) | Worksheets with a dark purple tab are those where spur scores are given |
| (yellow) | Worksheets with a yellow tab are for data entry |
| 0 | White boxes: your data input |
| 0 | Grey boxes: calculated inputs |
| 0 | Light purple boxes: calculated scores for sub-spurs |
| 0 | Green boxes: overall score for spur |
| | Blue boxes: instructions |

The Initial Data Collection sheet collects data on your farm, including crops grown (hectares, yields, exports), livestock (numbers, imports and exports), farm woodland and agroforestry, animal feeds (imports and exports), and organic and inorganic fertilisers during a 12-month period, it is very important to use the same 12-month period consistently throughout your data entry. The data input on this sheet are on a farm-gate basis i.e. if wheat is grown for feed and used on the farm then it is not added to the export column or the import column although it is shown in the hectare and yield columns. Where weights are required these are fresh weights.

### *Farm Information (lines 15-32)*

The first section asks for basic data on your farm (Figure 3). Enter data or choose from the drop-down lists in the white cells. The question relating to woody biomass production for energy on farm includes biomass from any woody element on the farm (woodland, hedges, short rotation coppice etc.). The Utilisable Agricultural Area is automatically calculated from the cropped and pasture area you will add later in the sheet.

| Farm information | Answer |
|---|---|
| Farm name | Wakelyns |
| Dates covered (note that this should be a year) | 01/01/2009-31/12/2009 |
| Own farm or tenant farmer? (if both, give one which is predominant) | owner occupier |
| Dominant soil type | Medium soil |
| Annual rainfall (mm) | 622 |
| Altitude (metres above sea level) | 50 |
| Number of years since organic conversion started (years and months) | 20 |
| Number of years fully organic (years and months) | 18 |
| What is the level of agri-environmental participation? | higher-level scheme |
| Country | United Kingdom |
| Is more than 50% land in a less favoured area (productivity limited by altitude, climate, steepness of land) | No |
| Is woody biomass production for energy present on the farm? | Yes |
| Fuel type replaced through use of wood product (i.e. select dominant type that **WOULD HAVE** been used if woodfuel unavailable) | Heating oil |
| Dominant **FIELD CROP** system in surrounding area | Cereals |
| Dominant **FRUIT CROP** system in surrounding area | Apples |
| Total UAA (utilisable agricultural area, hectares, automatically calculated) | **17.3** |

*Figure 3. Farm information section*

## Crops (lines 33-110)

This section includes arable crops, vegetables/horticulture, tree fruit crops such as apples and olives, soft fruits, energy crops and section for other crops not listed. You need to insert the area grown, whether it was grown in an agroforestry system (yes or no), marketable yield (tonnes/ha), and the tonnes exported (Figure 4).



*Figure 4. Crops data input section*

Winter cover arable crops have been left out of the data collection, as they are unlikely to be leaving the farm gate and will therefore not affect the 'farm-gate' NPK budget.

For crops with more than one sowing to harvest cycle within a 12-month period please total the yields. Do not increase the hectarage to allow for multiple harvests as this will distort the tool's calculations.

This section also includes forage crops, including leys, temporary and permanent pastures. Say whether these are in an agroforestry system. The import and export of these forage crops are included in lower sections.

Energy and NPK contents and calculations are shown in columns K to P; these are standard figures taken from literature (references can be seen in the Instructions and Information sheet). These calculations are used to work out the NPK and energy balance results.

## Livestock (lines 112-149)

This section (Figure 5) collects information on the livestock on the farm (if present); the number of animals on the farm over 12-month period, whether they were in an agroforestry system (yes or no), the number of animals imported and exported (exports includes deaths). It also collects data on imports and exports of eggs (dozens), milk (1000s of litres) and wool (tonnes).



*Figure 5. Livestock data input section*

Energy and NPK contents and calculations are shown in columns K to P; these are standard figures taken from literature (references can be seen in the Instructions and Information sheet). These calculations are used to work out the NPK and energy balance results.

## Farm woodland and agroforestry (lines 151-199)

This section relates to trees being grown on the farm (Figure 6). The first question (line 153) asks for the total tree area on the farm, including woodland, short rotation coppice (SRC), woodland pasture and agroforestry. DO NOT include fruit and olive trees as these are recorded in lines 68-75. However, if there are other trees growing within the fruit/olive tree orchards (e.g. for timber or fuel), they should be included here. Please remember that this is for the tree area only (e.g. in an alley cropping system, just the area within the tree rows, not the whole area including the crops).



*Figure 6. Farm woodland and agroforestry data input section*

The following lines focus in turn on Agroforestry with Crops, Fruit and Olive Tree Agroforestry, Agroforestry with Livestock.

Within each type of agroforestry, you are asked the same questions relating to the woody area managed for fuel and timber: the total area being managed for woodfuel/timber, the average tree densities/ha of this woody area, the dominant tree type (broadleaf, conifers, mixed), the previous land use before trees were planted (arable or grassland) (if applicable), and the percentage of trees harvested for woodfuel or timber in the 12-month period. This last parameter (% trees harvested) should be set to 0% if no trees were harvested.

When trees have been harvested within the 12-month period, first choose the unit for the wood product (Cell F153) as either tonnes or $m^3$. Then enter the yields exported in Column I. If you harvest your olive trees for timber and/or woodfuel, please enter the yield in Cell I173 or I179 but nothing in Column B.

For woodland and agroforestry, energy (MJ) exported is shown in Column M based on standard data for energy content of wood. Sequestration of soil and biomass carbon (tonnes/yr) and total C and $CO_2$ are shown in Columns Q to T. These have been calculated based on standard data on C sequestration in soil and woody biomass by trees determined by tree type (conifers or deciduous) and previous land use type (assuming an increase in soil C if changing from arable to trees but no change in soil C if converting from grassland to trees).

**Land Equivalent Ratio**

The data entered in this section on agroforestry is combined with the data entered previously on crops and livestock present within the agroforestry area to calculate the Land Equivalent Ratio, which is presented on the Results sheet. The Land Equivalent Ratio (LER), first proposed by Mead and Willey (1980), is a means of comparing productivity of intercropping and monocropping systems. It is calculated as the ratio of the area needed under sole cropping to the area of intercropping at the same management level to obtain a particular yield:

LER = (Tree agroforestry yield)/ (Tree monoculture yield) + (Crop or livestock agroforestry yield)/ (Crop or livestock monoculture yield)

A LER of 1 indicates that there is no yield advantage of the intercrop compared to the monocrop, while a LER of 1.1 indicates a 10% yield advantage i.e. under monocultures, 10% more land would be needed to match yields from intercropping.

Within the SustainFARM PG Tool the LER is calculated for the whole agroforestry area of the farm (i.e. if there are multiple agroforestry systems on the farm, it combines them into a single calculation). Standard yield data for the typical arable or fruit crop and tree timber or woodfuel crop for the specific country are used for the monocrop yield (converted to Metabolisable Energy), as most farms won't have monocrop yields available for the comparison. This means that the LER produced is a simple indication of the performance of the agroforestry system compared with standard monocrop systems typical of the country, rather than a robust on-site comparison that fully reflects the complex interactions between trees and crops/livestock.

## Hedges (lines 195-198)

If there are field boundary hedges on the farm, fill out the total hedge length in metres, and average hedge width in metres (Figure 7). If you harvest the hedge for woodfuel or timber, add the length of hedge harvested in the 12-month period within cell B198, and the yield exported in I197 (for woodfuel) or I198 (for timber).



*Figure 7 Data entry for Hedges and other land uses*

## Other land use

Include in this section the area of other land uses including ponds and watercourses, non-cropped areas and built up land including roads (Fig 7).

## Imported seeds, imported and exported animal feeds: forage, Imported animal feeds - arable crops/straights, Arable straw

In these sections, enter as appropriate tonnes imported and exported (Figure 8). As before, Energy and NPK contents and calculations are shown in columns K to P; these are standard figures taken from literature (references can be seen in the Instructions and Information sheet). These calculations are used to work out the NPK and energy balance results.



*Figure 8 Imported and exported feeds section*

## Organic and inorganic fertilisers

The final section on this page covers organic and inorganic fertilisers imported onto or exported from the farm in the 12-month period (Figure 9). Standard NPK contents have been included in Columns N-P but if you have more accurate data for the fertilisers you use, you can overwrite the standard figures.



*Figure 9. Organic and inorganic fertilisers section showing Columns N-P where you can overwrite standard figures for NPK if you have more accurate data for your fertilisers*

# Step 3. Completing the spurs

The other sheets are quicker to complete, consisting mostly of drop-down lists to choose from. Work your way through the questions, the scores for the sub-spurs and overall score for the spur are shown in the box at the top right of the sheet (Figure 10).



*Figure 10. Typical layout of the 10 sheets on the spurs showing the questions on the left and the spur scores on the right*

Three further sheets require more data input:

**The Fuel Use input data sheet**: in this sheet you are asked to enter the amount of fuel and contractor hours used over the last 12 months, divided between the different enterprises on your farm (Figure 11). This will contribute to calculations of energy and carbon benchmarks.



*Figure 11. Fuel use and contractor use data sheet*

**Social Capital:** in this sheet you are asked to enter data on labour use (hours per year for casual staff and full-time equivalents for long term staff including family labour) (Figure 12).



*Figure 12. Employment on the farm over the 12-month period including casual and long-term staff*

**Animal health and welfare management**: in this sheet you are asked about labour use again, this time in terms of labour use for different livestock enterprises. You are asked to enter the full time equivalent looking after each species of livestock (Figure 13).



| | A | B | C | D | E |
|---|---|---|---|---|---|
| 9 | **Animal Health & Welfare** | **Answer** | **Unit** | **Calculations** | **Score** |
| 11 | **Does the farm have livestock** (including tack grazing/ flying livestock)? If yes, please continue with these questions. If no, please go straight to the Governance page | no | | | |
| 12 | **Staff resources** | | | | |
| 13 | Number of Full Time Equivalents (FTEs) labour units looking after livestock? (type n/a if you do not have these livestock on farm) | | | | |
| 14 | dairy cattle | n/a | FTE | #VALUE! | n/a |
| 15 | **Please note:** 1 FTE is one employee working 2200 hours per year so if e.g the farmer's wife does 600 hours per year on the farm then family labour would be 600/2200 = 0.27 FTE     beef cattle | n/a | FTE | #VALUE! | n/a |
| 16 | sheep | n/a | FTE | #VALUE! | n/a |
| 17 | pigs | n/a | FTE | #VALUE! | n/a |
| 18 | laying birds | n/a | FTE | #VALUE! | n/a |
| 19 | table birds | n/a | FTE | #VALUE! | n/a |
| 20 | How often per day are livestock inspected for signs of illness/injury? | irregularly | | | 1 |
| 21 | Are your stock-people trained? | No | | | 1 |
| 22 | | | | | 1 |
| 23 | **Health plan** | | | | |

*Figure 13. Labour use allocated to looking after livestock in the Animal health and welfare management spur*

### NPK budget and Energy and Carbon benchmarks

Two sheets require no data input: The NPK budget sheet shows the results of the farm-gate NPK ratios based on data entered in the initial data collection sheet of the imports and exports of crops and livestock and their associated NPK contents. The Energy and Carbon sheet automatically compares your energy use with benchmark figures from the CALU & ADAS 2007 publication 'Managing Energy and Carbon: The farmer's guide to energy audits'. The percentage use of renewable energy, biomass, $CO_2$ balance and GHG emissions avoided from use of woody biomass are also calculated.

# Step 4. Results, case studies and testing scenarios

## Results

Once you have completed the initial data collection sheet and subsequent spur sheets the results are automatically generated and shown in the red tabbed Results sheets on the far right of the workbook. There are two sheets – one for farms with livestock (Results with livestock) and one for farms without (Results without livestock). The results sheet is divided into four pages which can be printed out to have a paper copy to keep or share with others. The first page shows the scores of the spurs in a radar diagram (Figure 14). To understand the spur scores, the individual scores of the sub-spurs are shown in the table on page 2 of the results and bar chart on page 3 (Figure 15).
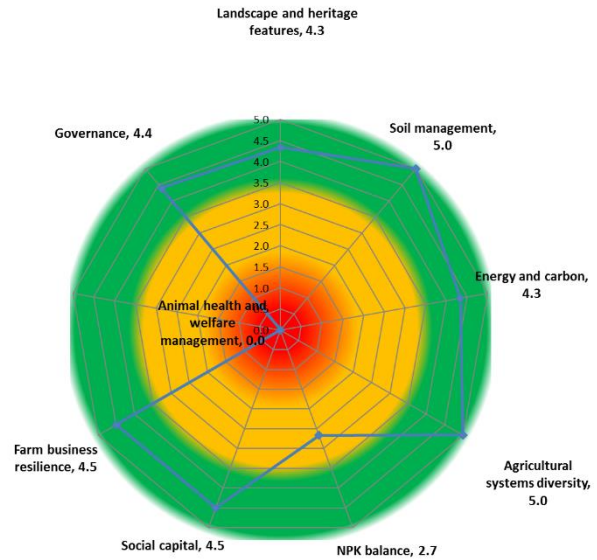


*Figure 14. Radar diagram showing spur cores*

Key results are shown in the Table on Page 4, including the Land Equivalent Ratio, the Farm Gate NPK balance, Energy benchmarks, CO2 balance and Labour Use (Figure 16).
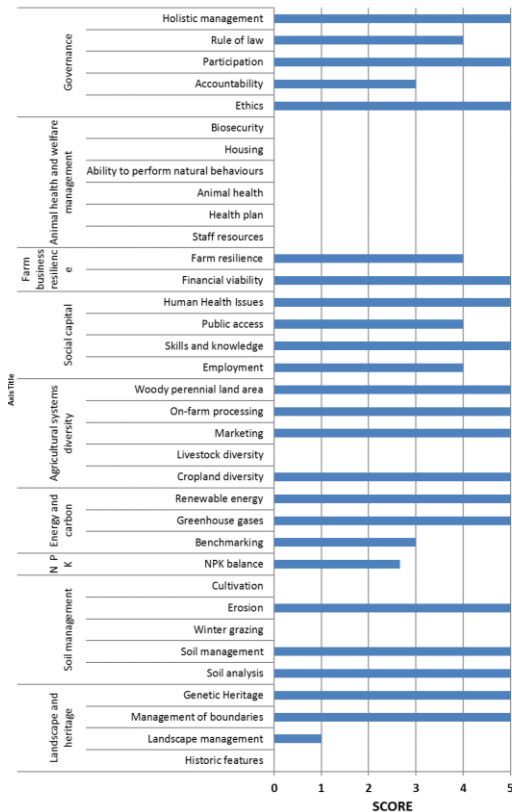


| Key assessment criteria | | |
|---|---|---|
| **Land Equivalent Ratio** | **1.34** | |
| | | |
| **Farm gate NPK balance** | | |
| N balance per ha | 91 | kg |
| P balance per ha | -2 | kg |
| K balance per ha | -12 | kg |
| | | |
| **Energy benchmarks (energy use as % of average figures)** | | |
| Arable | 61% | |
| | | |
| Beef & sheep | No beef or sheep | |
| Dairy | No dairy | |
| Pigs | No pigs | |
| Poultry - layers | No layers | |
| Poultry - broilers | No broilers | |
| Domestic | 367% | |
| | | |
| Total farm renewable energy | 80% | |
| | | |
| **CO$_2$ balance** | -10.2 | tonnes CO$_2$ equivalent yr |
| **Labour use - ALUs** | 2.7 | **Please note:** 1 ALU is one full-time employee working 2200 hours per year |

*Figure 16. Key results on Page 4*



*Figure 15. Bar chart showing sub-spur cores*

## Case studies

The SustainFARM PG Tool assessment has been carried out on a diverse range of farms across Europe. Compare your results with these case studies:

### Denmark

Taastrup experimental farm has a combined food and energy system with alleys of cereals separated by biomass belts of short rotation coppice. [More](#)



### Italy

Il Sasso farm is an organic farm combining olive groves with sheep grazing for milk production. [More](#)



### Poland

A top fruit and vegetable farm where fruit trees are intercropped with vegetables including tomatoes, paprika, cucumber. [More](#)



### Poland

Wójcik farm is an organic Limousine beef farm where grassland is mixed with individual trees, hedges and forested land. [More](#)



### Romania

Mihalca Farm is a silvopastoral farm with dairy cattle, pigs and poultry. [More](#)



### United Kingdom

Wakelyns Agroforestry is a silvoarable farm combining short rotation coppice with organic arable crops. [More](#)

## Scenario testing

The SustainFARM PG Tool can be used as a decision support tool for farmers and land managers, to help them to identify the possible impacts of changing their system on performance across the full range of sustainability indictors. To investigate the effects on the sustainability indicators of changing or introducing new practices or management to the farm, simply copy and save the completed assessment as a new file, change the questions relating to the proposed changes (check through all the sheets) and compare the results of the ´before´ and ´after´ scenarios.

## Note

This guide, the SustainFarm PG Tool and case studies can all be found at
http://tinyurl.com/SustainFARM-PGtool

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