Organic Research Centre Report

OCIS Public Goods Tool Development

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Contents

EXECUTIVE SUMMARY

There has recently been an increase in interest amongst policy-makers in the question of whether farming provides a "public good" beyond the simple production of food, which justifies support from, for instance, EU agricultural policy. Benefits such as an improved environment or better water quality can be perceived to be public goods. It is the provision of these sorts of benefits which may be used in the future to justify continued support of the agricultural sector through subsidies.

Given the current level of interest in this topic Natural England, with the approval of Defra, through OCIS (Organic Conversion Information Service), wished to create a tool which could be used by an advisor or an informed land owner to assess the public good provided by a/their farm. Thus, the OCIS Public Good Tool was developed. The OCIS Public Goods project has been driven by a desire on the part of OCIS to ensure a joined-up approach to measurement and optimising of public goods gained through organic farming and of farm business viability. It was suggested that the OCIS Public Goods tool should achieve a range of objectives including:

- Establishment of a 'Public Goods' baseline prior to conversion to an organic farming system and OELS agreement.
- Measurement of the projected 'Public Goods' over the 5 year lifetime of an OELS agreement.
- The active management and provision of 'Public Goods'.
- Accountability for the land manager and accessibility for the General Public.
- Defining of the 'Public Goods' which accrue through participation in an OELS agreement and an organic farming system.
- Structure and principles to underpin the legitimacy of the 'Public Goods' plan template.

A variety of public goods were identified in a stakeholder workshop involving various experts including researchers, advisors and representatives from Natural England, which may be provided by an agricultural enterprise and against which the tool assesses each individual farm. These were:

- Soil management,
- Biodiversity,
- Landscape and heritage,
- Water management,
- Manure management and nutrients,
- Energy and carbon,
- Food security,
- Agricultural systems diversity,
- Social capital,
- Farm business resilience,
- Animal health and welfare.

These areas were chosen to account for a range of benefits; social, environmental and economic, which may be provided by farming systems. These public goods are known as "spurs" for the purpose of the OCIS Public Goods Tool. For each spur a range of activities was selected based on discussion during the stakeholder workshop and a subsequent literature review. These were selected to give sufficient in-depth information on the performance of the farm on that spur while being straightforward for the farmer to provide from their own records and allowing the assessment to be carried out within two to four hours thus not taking up too much of the farmer's time. They were also selected to give a reasonable balance between quantitative and qualitative measures.

The scores for each spur are obtained by averaging the scores for all its activities. These are then shown on a radar diagram, allowing farmers to see in which areas they perform well and which areas could be improved. Figure 1 is an example radar diagram showing the mean, minimum and maximum scores across all of the farms assessed.

The tool was tested on forty farms in a pilot assessment. The advisors who carried out the assessments also provided feedback on the tool which will be used to improve it further and

the farmers who were assessed were given feedback forms to allow them to rate the tool's performance.

The advisors provided their feedback throughout the pilot via e-mail and telephone calls. Additionally two conference calls were held on 15th and 16th of December to discuss the OCIS Public Goods Tool, future development and to allow the advisors further opportunity to give feedback on the tool. The general opinion of the Tool was positive with some advisors wanting to separate off sections of it (such as the nutrient budget and the energy benchmarking) to use as stand-alone assessment tools in those areas.

Of the 40 farms assessed 12 farmers returned their feedback forms. Of those, 8 would recommend the tool in its current format and 2 more would recommend it once it had been modified. It would also appear that the tool has increased farmers' understanding of public goods with 9 of the farmers reporting a higher level of knowledge and understanding of public goods after the assessment than they had reported prior to it. Another area in which farmers scored the OCIS Public Goods Tool highly was the opportunity to ask questions, 8 rated this as excellent and the remaining 4 rated it as good. The reporting format was also rated well with 2 excellent ratings, 9 good and one fair. Lower ratings were obtained for the length of time taken to carry out the assessment which obtained 4 good ratings and 8 fair ratings. The quality of questions received a mixed response with 6 farmers rating the quality of the questions as good, 4 as fair, 1 as fair/poor and 1 as poor/excellent (explaining that he felt that some were excellent but others required work). With regards to value to their business 7 farmers rated it as above average and 3 as high, 1 felt that it was too soon to tell and 1 rated it as below average. With regards to demonstrating the public goods obtained from farming to the wider community 1 farmer thought it was of little use, 1 thought it was of no use, 4 felt that it partly demonstrated this and 6 felt that it was a help in doing so.

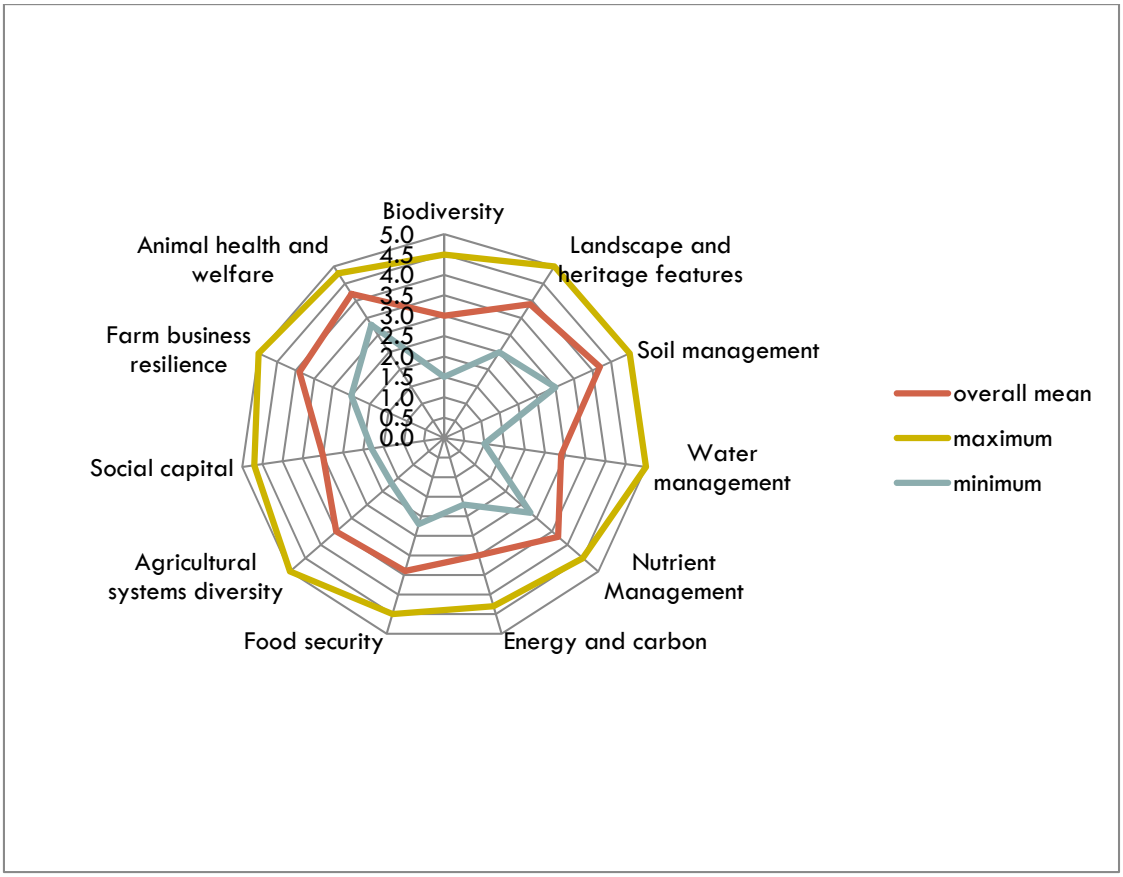


Figure 1: Radar diagram showing the minimum, mean and maximum scores across all forty farms in the pilot assessment.

For the pilot assessment, the highest scoring spurs were animal health and welfare and soil management, both with a mean score of 4.2 and the lowest scoring was water management with a mean of 2.9. All of the spurs showed some variation, however none showed a variation with a standard deviation greater than 1.

Various factors which might be responsible for these variations in the spur scores were investigated using simple statistical tests. The factors that were considered were: robust farm type, level of agri-environmental participation, whether or not the farm was solely grassland, the advisor who carried out the assessment, tenancy/ownership status and the length of time the farm has been fully organic.

The last two (tenancy/ownership status and length of time the farm has been fully organic) appeared to have less of an impact on the scores than the other factors considered. Level of agri-environmental participation only had an impact on the biodiversity spur (but it should be noted that all of the farms were members of either OELS or HLS so the statistical test carried

out was only comparing the impact of being a member of HLS rather than OELS). For farm type and whether or not the farm was solely grassland the same three spurs showed significant results: energy and carbon, food security, and nutrient management. For the advisors the significant variations were found for the spurs energy and carbon and food security (as for the previous two factors), as well as farm business resilience, water management and social capital. The three factors, farm type, whether or not the farm is solely grassland and advisor are not independent i.e certain farm types are likely to be solely grassland.

Various options for future development of the tool are now being put forward including implementing the suggestions made by the advisors, adapting the tool to assess conventional, as well as organic, farms, and moving towards a web-based format.

1. INTRODUCTION

1.1. Concept

There has recently been an increase in interest amongst policy-makers in the question of whether farming provides a "public good" beyond the simple production of food, which justifies support from, for instance, EU agricultural policy (Cooper *et al.*, 2009). As discussed by Cooper *et al*. (2009), a public good must be non-excludable, i.e. available to all, and non-rival, i.e. its consumption by one individual does not diminish its availability to others. As such, benefits such as an improved environment or better water quality can be perceived to be public goods. It is the provision of these sorts of benefits which may be used in the future to justify continued support of the agricultural sector through subsidies.

There is currently no simple reporting system that gives a measure of the Public Goods supplied by a land manager to the general public. This OCIS Public Goods tool is designed to provide a simple, measurable and accessible way to show the Public Goods that accrue through organic farming systems and via the addition of an OELS agreement. It is designed to provide a measurable and quantifiable system of recording the provision of Public Goods over a given time period.

Natural England in agreement with Defra commissioned this pilot to assess a methodology to measure the 'Public Goods' gained when a Holding converts to organic and enters into an Organic Entry Level Stewardship agreement.

The aim for the pilot study was to create a tool which could be used by a trained advisor to assess the public good provided by a farm in the course of carrying out its daily business. The aim of this was that an advisor would spend approximately two to four hours on the farm interviewing the farmer and inputting information from the interview into the Public Goods Tool. These data were then used to assess the provision of public goods. The information used in the tool is therefore required to be of a type that a farmer would have in their farm

records already, ie: not requiring any further surveys to be carried out. Furthermore the tool should calculate a score immediately and allow the farmer to see the results for their farm at the end of the interview, as the more timely the results are, the more likely it is that they will be of use to the farmer (Measures, 2010; Thimm, 2005). It should be noted that the eventual objective for the Public Goods Tool is to adapt it into a web-based tool which can be used by informed farmers and land managers for self-assessment purposes.

2. APPROACH

2.1. Previous Audits and Assessment Tools

The concept of carrying out an audit on a farm which assesses not only its financial performance but also its performance in other areas, such as sustainability, care for the environment, reducing carbon footprint, or socio-economics, has recently gained a high level of interest and a number of different tools and assessment methodologies have been developed. Some of these are discussed below to illustrate the background to the development of the OCIS Public Goods Tool.

Measures (2004) devised a sustainability audit which made use of a spreadsheet-based assessment to evaluate a set of parameters covering social function, animal welfare, food production and quality, closed farming system, decentralisation, resource use, soil fertility and biodiversity. The spreadsheet-based assessment was completed by a farmer together with an advisor who provided guidance and independent assessment. The data collected was compared to standard data, in other areas a qualitative assessment was made (Lampkin *et al.*, 2006).

Halberg *et al*. (2005b) have suggested that encouraging voluntary participation by farmers can be an effective tool for benchmarking purposes. They refer to the Danish Green Accounts tool which encourages farmers to record, calculate and report nutrient balances and the use of energy and pesticides on the farm. The assessment is usually carried out with the help of advisors. Farmers receive subsidies of up to 1000 Euros per year for participation in this scheme. The aim behind the project is that the Green Accounts will allow farmers to compare their agri-environment performance by benchmarking the results of their self-assessments against similar farms.

Similarly, self-assessment is also encouraged by LEAF (Linking Environment and Farming) through their online questionnaire (Linking Environment and Farming, 2008). This whole farm audit poses questions on all areas of the farm business, ranging from financial performance to animal welfare and energy use. On completion, the LEAF service offers an online performance monitor, which can give detailed information on targets for action and benchmarks for environmental effects/impacts. As well as encouraging farmers to consider these areas and the efficiency of their management approach in more detail, the LEAF audit also helps farmers encourage consumer confidence through a labelling scheme which farmers can apply for if they meet the 'LEAF Marque' standard. The requirements to be eligible for the LEAF Marque are referred to as 'Critical Failure Points' (CFPs) and the assessment of these areas is included in the questionnaire. An independent certification officer will visit the farm to ensure compliance with the LEAF standards/CFPs.

Halberg *et al*. (2005a) highlight that other environmental assessments are compulsory. In the UK, for example, Nitrate Vulnerable Zones are tracked by the Environmental Agency and farmers must comply with Action Programme Measures, in terms of fertiliser management to reduce the risk of eutrophication, in order to protect drinking water sources (Lampkin *et al*., 2008). Cross Compliance regulations in the UK also state that in order to receive subsidy through the Single Payment Scheme (SPS) land must be farmed in accordance to the Statutory Management Requirement (SMR) and be kept in Good Agricultural and Environmental Condition (GAEC). Farms receiving SPS payments are open to inspection by the Rural Payments Agency. In the Netherlands, farms are required to report their nutrient inflow and outflow, using a Mineral Accounting Software Tool (MINAS). Any surplus in nutrient input/output is then compared to European environmentally safe standards, called the Levy Free Surpluses (LFS). For nutrient levels exceeding this limit the farmer is then taxed. Such taxes can induce an improvement in management, if the improvement costs less than the marginal tax rate, however if the tax is less than the cost of making improvements, such methods may lose their efficacy.

The EMA tool, Environmental Management for Agriculture, compares actual farm production practices and site-specific details with what is perceived to be best practice(Halberg *et al.*, 2005a). A score is then provided of between -100 and +100 and is based on the accumulation of a number of sub-indicators (e.g: the level of nitrate leaching affects the score for nitrogen fertiliser). The baseline is affected by 'local conditions' such as rainfall levels and soil type. Other methods also make use of scoring systems, such as the IFS

(Indicators of Farm Sustainability) method which was used for the evaluation of the agroecological, socio-territorial and economic sustainability of different farm types in France (Van der Werf and Petit, 2002). The Ecopoints (EP) Programme, designed by Mayrhofer *et al*. (1996) works on a similar principle, assigning scores to farmer production practices and landscape maintenance.

The Suffolk Farm Sustainability Appraisal (Ridley and Woolley, 2002) also uses a scoring system along with a series of relative importance weights to allow aggregation of scores within 'impact categories'. This study found that it was a useful exercise for the farmers to see how they performed in relation to others in their area, but that gathering and processing the environmental data was a time-consuming and expensive process. Solagro (2000) devised a system of scores for 16 agri-environmental indicators which give a rapid and global evaluation of the environmental risks on a farm. The indicators included crop diversity, grassland management, manure and soil management, presence of hedges, input use and nitrogen, phosphorus and potassium (N, P and K) surplus. The system allows a farmer to compare performance levels of farm diversity and input use (energy) to benchmarks.

Organic Centre Wales (OCW) (Fowler *et al.*, 2004) also used a scoring system in their assessment of the environmental impacts of organic farming in the hills and uplands of Wales. Environmental impacts were assessed under the following headings: Biodiversity, Soil quality, Air quality, Water quality and Non-renewable resource use. The scoring system was based on the system used in the ADAS Review of the Environmental and Socio-Economic Effects of Organic Farming (Frost, 2003, cited by Fowler *et al*. (2004)) which attempted to assess the extent to which systems of organic farming benefit key species and habitats that have been identified in the UK Biodiversity Action Plan. In the OCW study, each organic farming practice was assessed and scored between 1 and 4 against the above levels of environmental prescription.

Some assessment methods make use of surveys to accumulate and compare data, for example Lobley *et al*. (2005b) carried out a postal survey of 655 organic and non-organic farmers to compare their 'socio-economic footprint'. This covered business sales and purchases, labour inputs, integration with local socio-economic networks and participation in rural development activities. Comparisons were then made between the non-organic and organic farming systems in each of these areas.

Other assessment methodologies take a more direct approach, for example Whay *et al*. (2002) developed a welfare assessment protocol for cattle, which was carried out on 53 dairy farms in England, involving a scoring system for cattle by an independent observer. The Duchy College Organic Studies Centre (2007) also completed a review of dairy farms, through a series of semi-structured interviews by an independent veterinary researcher. It is worth noting that some farmers participating in this process experienced feelings of exposure and vulnerability as a result of allowing such an assessment to be carried out (Burke and Roderick, 2006). This highlights the need for sensitivity and also confidentiality when carrying out assessments of this nature.

Most of the above methods of assessing impact use land-based scaling of agri-environmental topics (e.g: nutrient surplus or energy use per ha) to derive a result, using means and effect based indicators. However, in recent years there has been an increasing interest in product-oriented, life cycle based environmental assessments (LCA), because there is a need to evaluate global emissions and impacts from the whole production chain in relation to types and amounts of products consumed (British Standards Institution, 2008). This method allows the identification of the main pollution sources through the chain (including production of farm inputs) as far as the farm gate and the evaluation of possible modifications of the farms or farming methods (Halberg *et al.*, 2005a). In Denmark the system of Green Accounts has been supplemented with a tool for performing LCA on the farms, which has been tested on 20 private farms. These tools are, however, not widely used by farmers or advisors so far. Some of the concepts behind LCA can be difficult to interpret. Halberg *et al*. (2005b) found that farmers struggled to understand the idea of 'indirect energy use', which seemed to be too abstract a concept. Also, the time required for the completion of LCA is a limiting factor for their application. Despite such difficulties, Nissinen *et al*. (2005) have been developing LCA based environmental benchmarks. This is being achieved through benchmarking the environmental effects against a European average. This aims to help consumers make informed decisions about the products they buy.

Some assessment tools are aimed at very specific sectors. For instance the MOTIFS (Monitoring tool for Integrated Farm Sustainability) tool (De Mey *et al.*, 2010 in press; Meul *et al.*, 2008) which has been developed to assess a farm's sustainability has been initially aimed at dairy farms. MOTIFS assesses ecological, economic and social sustainability through ten themes. These themes are: internal social sustainability, external social sustainability, disposable income, use of inputs, quality of natural resources, biodiversity,

entrepreneurship, efficiency and productivity, profitability, and risk. The MOTIFS tool operates on three levels: level one is an overview of the farm's sustainability, level two focuses in on a specific sustainability dimension and its underlying themes and level three focuses into the individual indicator scores for a theme. During the course of its development this tool was trialled on 200 farms and as a result some critical success factors (Campbell *et al.*, 1999) were identified which De Mey *et al*. (2010 in press) suggest may extend to all tools of this type. These CSFs are:

- Attitude of model users towards sustainability – a positive attitude increased interest in using the tool.
- Compatibility – compatibility with current data systems, especially terminology, increased uptake.
- User-friendliness – easy use increased interest. Farmers didn't want to spend time trying to calculate values – workload, costs and implementation are important.
- Data availability – ease of access to required data. They identified a need for improvements to availability of data particularly with regard to social aspect.
- Transparency – farmers needed to understand results especially with new/ complex topics
- Data correctness – inaccuracy in reported data from farmers led to inaccurate results and caused farmers to lose confidence in the assessment
- Communication aid – the authors found the tool useful as a starting point for discussions between farmers and between farmer and advisor
- Complexity – They found that the assessor needed to explain complex issues in a straightforward way
- Organisation of discussion sessions – communication was affected by trust amongst participants. Groups should not exceed 12. Similar farms were grouped so that the results were comparable.
- Effectiveness – farmers were finding it a useful tool to get a comprehensive view of a farm's sustainability. Also appreciated the opportunity to share knowledge during discussion session.

2.2. Development

The Organic Research Centre's work on the development of sustainability assessment tools began in 2005 through a Defra funded project on quality and environmental benchmarking for organic agriculture (Organic Research Centre, 2010). This project aimed to develop a "quality and environmental benchmarking" tool for organic farmers to assess the performance of their farm and the interaction between ecological, social and financial factors, through triple bottom line accounting (Global Reporting Initiative, 2010; ICAEW, 2009). The approach taken within the research project was to identify the public goods that organic farming delivers within each of these areas, through a desk study and consultation with experts. Benchmarks were then created and incorporated into a tool which was piloted on one group of farmers.

The Energy, Emissions, Ecology and Agricultural Systems Integration Project (EASI) (Smith and Woodward, 2010) continued the ORC's work in this area through the development of a farm assessment tool to compare farms' performance in terms of resource use efficiency and greenhouse gases. The tool allowed an advisor to complete a detailed assessment of performance in both of these areas, for example comparing energy use and greenhouse gas emissions from each farm enterprise. The tool also accounted for the interaction of multi-functions such as energy production and biodiversity at farm level, the aim being to understand these interactions and the impacts they might have on each other, optimise the overall benefit, assess the economic impact and potential and, as a result of these, develop an appropriate management plan

The OCIS Public Goods project has been driven by a desire on the part of OCIS to ensure a joined-up approach to measurement and optimising of public goods gained through organic farming and of farm business viability. It was suggested that the OCIS Public Goods tool should achieve a range of objectives including:

- Establishment of a 'Public Goods' baseline prior to conversion to an organic farming system and OELS agreement.
- Measurement of the projected 'Public Goods' over the 5 year lifetime of an OELS agreement.
- The active management and provision of 'Public Goods'.
- Indicators/measures of success.

- Accountability for the land manager and accessibility for the General Public.
- The parameters and scope of the OCIS 'Public Goods' Plan.
- Defining of the 'Public Goods' which accrue through participation in an OELS agreement and an organic farming system.
- Identification of tools to assist in the measurement and definition of 'Public Goods'.
- Structure and principles to underpin the legitimacy of the 'Public Goods' plan template.

To assist in achieving these objectives Natural England set up a steering committee and a workshop was held on 23rd February 2010 involving various key stakeholders from the organic industry to discuss the project. The workshop attendees were Stephen Briggs, Nic Lampkin, Mark Measures, John Pawsey, Phil Stocker, Stephen Jacobs, Martin Davies, Matt Heaton, and Nick Cooper. At the workshop the spurs which should be assessed by the OCIS Public Goods Tool were decided upon (these are discussed in Section 2.3) and it was decided that a radar diagram would be the best format for reporting the results in a clear and accessible manner. It was also discussed that the tool should be seen as a learning, rather than a policing tool, which would help the farmer to manage their land to increase the public good provided.

Following on from these discussions Natural England, with the consent of Defra, agreed for funding to be made available to the Organic Research Centre (ORC) to begin work on a first draft of the OCIS Public Goods Tool which would incorporate the spurs discussed at the workshop and would provide a means of assessing the public goods provision performance of a farm.

2.3. Spurs and Activities

A variety of public goods were identified during the workshop discussed in Section 2.2 which may be provided by an agricultural enterprise and against which the tool would assess each individual farm. These were: **soil management, biodiversity, landscape and heritage, water management, manure management and nutrients, energy and carbon, food security, agricultural systems diversity, social capital, farm business resilience, and animal health and welfare**. These areas are similar to those suggested by previous authors (BioBio, 2009; Cooper *et al.*, 2009; Kuratorium fur Technik und Bauwesen in der Landwirtschaft, 2009; National Institute of Statistics of Italy, 2001; Organic Research Centre, 2010) and were

chosen to account for a range of benefits; social, environmental and economic, which may be provided by farming systems. These public goods are known as “spurs” for the purpose of the OCIS Public Goods Tool.

The tool has been constructed as an excel workbook with a worksheet for each spur. In addition there is an initial data sheet collecting general farm information used in multiple spurs and a final results sheet which provides graphical representations of the farm’s assessment as soon as the interview is complete and can be printed easily.

Each spur is assessed by asking questions based on a number of key “activities”. Each activity has at least one corresponding question and these allow the advisor to evaluate the detailed ways in which the farm provides each public good. For example, with regards to biodiversity the activities assessed are: agri-environmental participation, BAP (biodiversity action plan) habitats and SINCS (sites of importance for nature conservation), SSSI (sites of special scientific interest), BAP and rare species, whether there is a conservation plan for the farm, whether the farm has won biodiversity awards, and provision of wildlife habitats. Thus the activities have been selected to test the range of ways in which a farm might provide each individual public good. The activities are tested via detailed questions such as “what is the amount of your land that is woodland consisting of native species?” and “what percentage of your land is left as over-wintered stubble?”.

The activities were identified as a result of discussion amongst the experts at the workshop discussed in Section 2.2 and a literature review carried out at the Organic Research Centre. The choice of activities was influenced by a desire for the data collected to be of a type that a farmer would have in their farm records already, ie: not requiring any further surveys to be carried out, as discussed in Section 1.1. Care was also taken to balance quantitative and qualitative activities as quantitative data can be seen as less subjective but to measure areas such as social capital and animal health and welfare it is likely that some qualitative data will require to be captured. In the final version of the tool the balance between quantitative activities, qualitative activities and those that are a mixture of the two is: 18 quantitative, 28 qualitative and 8 which are a mixture of the two giving a reasonable balance. In addition the initial data collection sheet inputs data on hectares of crop, numbers of livestock etc which is entirely quantitative. It was also necessary to maintain a balance between obtaining sufficient detail to assess the spurs while keeping the assessment to a reasonable length of time. The OCIS Public Goods Tool assessment takes two to four hours to complete depending

on the size and complexity of the farm and therefore does not ask for a commitment of time on the part of the farmer which he may be unable to make but does collect sufficient information to provide a reasonably in-depth analysis of each spur.

2.4. Scoring System

Each question is marked with scores between 1 and 5. 1 is the lowest mark, indicating that no benefit is being provided and 5 is the highest score. Some questions have a not applicable (n/a option). This is the case where a situation may arise such that the farmer cannot possibly provide that benefit, for instance, a farmer who does not have dairy cows will not include mastitis prevention on their livestock health plan but should not be scored lower for failing to do so and therefore can choose n/a as the answer for this question.

Some activities are assessed using several questions while others require only one. Where multiple questions are asked their scores are averaged and rounded to the nearest whole number to give the score for that activity. Thus an activity requiring several questions is not weighted more heavily than one requiring only a few or one question.

The various spurs and their activities will be discussed in further detail in Section 3 along with the sources of information used in developing the questions and scores.

2.5. Graphical Presentation of Results

The scores for each spur are obtained by averaging the scores for all its activities. These are then shown on a radar diagram, as shown in Figure 2, allowing farmers to see in which areas they perform well and which areas could be improved. A bar chart showing the activities on each spur gives more detailed information so that if the farmer sees from the radar diagram that they scored less well on a particular area they can then identify the specific activities to work on to improve the score in the future.

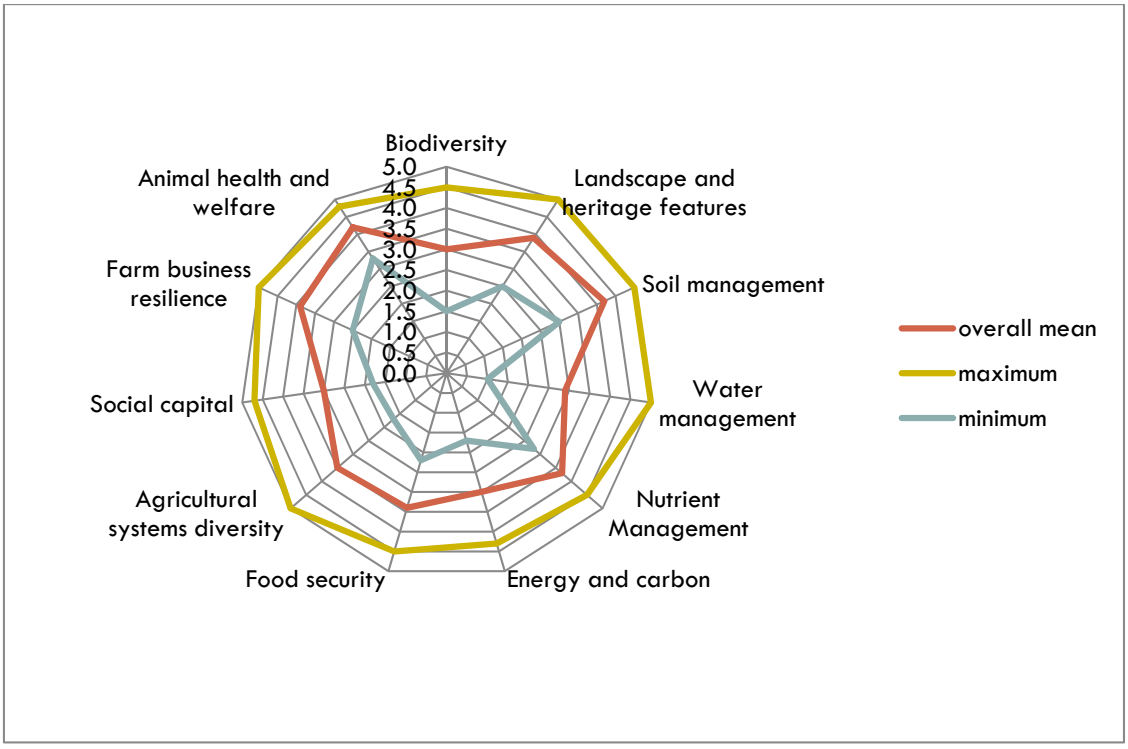


Figure 2: Presentation of results – a radar diagram showing the mean, minimum and maximum scores across the forty farms in the pilot assessment.

2.6. Pilot Runs and Testing

Once the initial draft of the OCIS Public Goods Tool had been produced it was tested on two farms; a large, mixed farm with a dairy (including cheese processing) on site and a farm shop through which some of its produce is sold and a smaller farm mainly focussed on cropping, and beef and sheep production. After the pilots some questions were removed and/or adapted.

The pilot run of the tool on forty farms was then instigated. The advisors who were to use the tool on the selected farms were invited to a training day held at the Organic Research Centre (ORC) to give their input and, as a result of their comments, further adaptations and updates were subsequently made. The advisors involved in this final input to the tool before its use were: Martin Davies, Mike Tame, Phil Stocker, Phil Sumption, Stephen Briggs, Steve Merritt, William Waterfield, Gerard Dinnage, and Mark Measures. Nick Cooper from Natural England gave feedback at this stage and advice on questions tying in with the option bundles for OELS.

It was decided that the farms assessed would be chosen such as to cover a spread over the main robust farm types as defined by Defra for the Farm Business Survey (FBS) (DEFRA, 2010). Thus cereal, general cropping, beef and sheep, dairy and mixed farms would be covered in sufficient numbers (five or more as per Defra practice for FBS data) that they could be analysed separately. Details were also recorded of soil type, rainfall levels, ownership status of farm, metres above sea level, number of years since conversion and number of years fully organic.

The forty pilot assessments were then carried out and the results are summarised in Section 4 of this report. The advisors also provided feedback on the tool and the farmers who were assessed were given feedback forms to allow them to rate the tool's performance (see Section 5 for a summary of this feedback). The advisors suggestions for updating the tool are discussed in Section 6 on future development of the tool.

3. DETAILED DESCRIPTION OF SPURS AND ACTIVITIES

3.1. Soil Management

The soil management spur assesses a farm's performance in terms of monitoring of soil organic matter and nutrient levels, in addition to assessing the amount of damage done to the soil from erosion, eg: from leaving land bare over the winter or out-wintering cattle.

The questions for each of the activities are based on guidelines from the Code of Good Agricultural Practice for the Protection of Soil (MAFF, 1993), the Environment Agency Document 'Think Soils' (Davis and Smith, 2008) and the Defra Soil Protection Review (DEFRA, 2009). Some assessment criteria have also been based on the EMA tool (University of Hertfordshire, 2006). Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.2. Biodiversity

The biodiversity spur assesses how well the farm is managed with regards to environmental stewardship and encouraging native wildlife. The activities assessed are agri-environmental participation, BAP habitats and SINCs, SSSI, conservation plan, awards and habitat. The scores for these combine to give an overall score which gives an indication of the farm's contribution towards biodiversity. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.3. Landscape and Heritage

The landscape and heritage spur assesses how well a farm contributes towards preserving the countryside and its heritage. The activities which are used to assess this are: historic features, JCA and landscape features, and management of boundaries. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.4. Water Management

The water management of the farm is assessed through the measures being taken to reduce pollution, the sources of water being used and the efficiency of irrigation systems that are put in place. The questions for each of the activities are based on guidelines from Waterwise on the Farm(Environment Agency, 2007) , the Soil Association organic standards (Soil Association, 2008), Cranfield University's Improving irrigation efficiency checklist (Cranfield University at Silsoe, 2007) and the EMA tool (University of Hertfordshire, 2006). Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.5. Manure Management and Nutrients

The manure management and nutrients spur is spread over two worksheets; the first worksheet is an NPK (nitrogen, phosphorus, potassium) budget which takes information from the initial data collection sheet and calculates a 'farm gate' balance for these macro nutrients, the second worksheet for this spur contains more qualitative questions about the management of nutrients, manure and wastes on farms. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.6. Energy and Carbon

The energy and carbon spur is spread over three separate worksheets: the first worksheet focuses on the farm's own fuel and electricity use, recording both the total amount used and the amount attributed to the various farm enterprises: arable, beef and sheep, dairy, horticulture, pigs and poultry; the second worksheet for this spur uses the energy and carbon benchmarks contained in the Centre for Alternative Land Use (CALU) booklet 'Managing Energy and Carbon (CALU and ADAS, 2007) to compare the farm's performance in terms of MJ of energy per head of livestock, or per hectare; the final worksheet for this spur asks more qualitative questions regarding the farm's energy use. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.7. Food Security

The food security spur assesses the contribution of the farm towards food quality and availability of food in the local area. The activities assessed are total productivity, local food, off-farm feed, food quality awards, food quality certification and production of fresh produce. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.8. Agricultural Systems Diversity

The Agricultural Systems Diversity spur determines the extent to which the farm is incorporating a range of crop varieties and animal species in its production methods. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.9. Social Capital

This spur assesses the farm's community engagement and the benefits it provides to its local community from public access to training for its employees. It is assessed through the following activities: employment, skills and knowledge, community engagement, corporate social responsibility initiatives and accreditations, public access, human health issues. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.10. Farm Business Resilience

This spur assesses the financial resilience of the farm as a business and whether it is a long-term prospect. It uses two activities to assess this – financial viability and farm resilience. The questions asked were considered carefully to attempt to strike a reasonable balance between not being perceived by farmers as being too intrusive but still obtaining sufficient information to build up an idea of the farms' financial situations. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

3.11. Animal Health and Welfare

The animal health and welfare spur assesses how the farmer manages their livestock so as to ensure their health and welfare. The activities under which this is assessed are staff resources, health plan, animal health, ability to perform natural behaviours, housing and biosecurity. The questions used in assessing this spur were considered carefully to ensure that they cover a range of species and are sufficiently detailed while not causing offence to farmers by giving them the impression that they were being accused of having low welfare standards. The indicators of welfare also needed to be those that could be assessed by an interview rather than requiring advisors to see and assess the animals themselves thus ruling out the kind of indicators suggested by Leeb *et al*. (2004), and Burke (2006a; 2006b). After the first draft of these questions was produced the opinions of two animal welfare scientists (Nicholas, 2010; Roderick, 2010) were sought and the questions were added to and updated based on their feedback. Please see **Appendix 3** for details and **Appendix 2** for the full list of questions.

4. RESULTS

4.1. Descriptive Statistics for Entire Sample

Table 1 shows the mean, median, minimum and maximum scored for each spur across all 40 farms in the pilot study along with the standard deviations of the scores for each spur. The

mean, minimum and maximum scores can be seen in Figure 1 in the executive summary and Figure 2 in Section 2.

Table 1: Individual spurs showing their mean, median, minimum and maximum scores and the standard deviation across the spurs.

	Mean	Median	Minimum	Maximum	Standard Deviation
Biodiversity	3.0	3.0	1.5	4.5	0.7
Landscape and Heritage	3.9	4.0	2.5	5.0	0.6
Soil Management	4.2	4.3	3.0	5.0	0.4
Water Management	2.9	3.0	1.0	5.0	0.9
Nutrient Management	3.7	3.8	2.8	4.5	0.4
Energy and Carbon	3.0	3.0	1.7	4.3	0.7
Food Security	3.4	3.3	2.2	4.5	0.6
Agricultural Systems Diversity	3.5	3.3	1.7	5.0	0.9
Social Capital	3.0	3.2	1.8	4.7	0.7
Farm Business Resilience	3.9	4.0	2.5	5.0	0.6
Animal Health and Welfare	4.2	4.3	3.3	4.8	0.3

It can be seen from this that, while there is some variation in the scores, no spur gives a standard deviation of one or greater and three spurs (soil management, nutrient management, and animal health and welfare) have a standard deviation of 0.5 or less. The higher the standard deviation is the higher is the variation between farms. It can be seen, as discussed below, that there is greater variation in individual activities than in the spurs. The highest scoring spurs on average were animal health and welfare and soil management (both with a mean of 4.2 and a median of 4.3) and the lowest scoring on average was water management with a mean score of 2.9.

The individual activities show a greater variation in scores as can be seen in **Table 8** in **Appendix 4**. The highest scoring activities with a mean score of 5 were erosion management on the soil management spur and food quality certification on the food security spur (but as this scored 5 for organic certification and all of the farms in the pilot are organic this result

was to be expected). The lowest scoring activity was the awards activity on the biodiversity spur with a mean of 1.5 and a median of 1 (however, as can be seen from **Table 2**, the highest score for this activity was 5). The greatest variation in scores was shown for the activities conservation plan under biodiversity, water management plan under water management (with standard deviations of 1.8) and on-farm processing in the agricultural systems diversity spur with a standard deviation of 2.0. The activities showing the least variation in scores were food quality certification, with a standard deviation of zero (as all of the farms in the pilot are organic), and the erosion activity in the soil management spur with a standard deviation of 0.2.

To investigate whether the variation in the scores for the spurs is influenced by certain factors such as, for example, farm type, advisor carrying out the assessment , level of agri-environmental participation (OELS/HLS), or status of ownership (short-term tenant versus owner-occupier) a more detailed analysis was carried out across the spurs by the use of ANOVA or t-test. The results of these analyses are discussed in the next sections.

ANOVAs and t-tests are statistical tests which can be used to compare data from within different categories of a larger sample to assess whether the category they belong to has an impact on the results. For instance, in Section 4.2 the results of an ANOVA comparing farm types are presented. The ANOVA test compares the variation in scores within a subsection of the sample (ie a specific farm type such as dairy) with the variation in scores across the whole sample and provides an estimate of the probability that differences in score between any two categories are due to their type rather than other factors. A t-test is carried out to compare two categories within a sample and an ANOVA when there are more than two categories.

4.2. ANOVA on Farm Type

As discussed in Section 2.6, the farms chosen for the pilot were selected to cover a spread over the main robust farm types (DEFRA, 2010). Given the confidentiality requirement to have five or more farms in each category, the farm types analysed here are cereals, dairy, beef and sheep, general cropping and mixed farms. These cover 36 of the 40 farms in the pilot. The remainder classify as horticulture (2) or pigs and poultry (2).

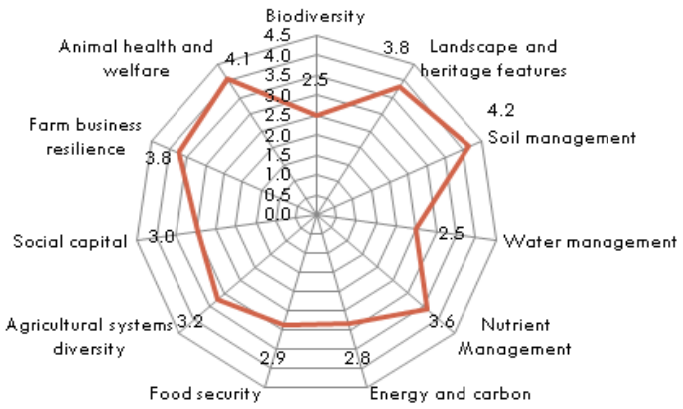
Table 2 shows the results of ANOVAs for each spur giving the probability that the variation recorded is due to chance rather than farm type (the P-value). **Table 9** in **Appendix 4** gives more detailed results showing the means for each spur for each farm type while the figures in **Figure 3** and **Appendix 5** show the mean scores for each spur on a Spider's web diagram for each farm type. The spur which shows significant variation across farm type is energy and carbon (at the 1% level), and food security and nutrient management show a trend towards significance (at the 5% level).

It was noted, as the pilot was carried out, that organic farms tended to perform above benchmark on the arable energy and carbon benchmarking activity (the energy benchmarking activity is discussed in **Appendix 3**) but below benchmark for livestock enterprises. The benchmark figures which have been used are from conventional farms and it is possible that this difference between arable and livestock farms is part of the reason for the significant difference between farm types on the energy and carbon spur.

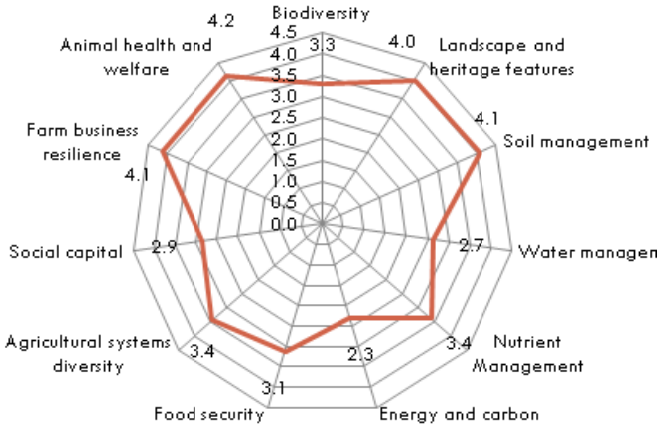
Table 2: Results of the ANOVA over farm type for each of the spurs showing the p-value for each.

Spur	P-value	Spur	P-value
Biodiversity	0.2399	Food Security	0.0128
Landscape and Heritage	0.6557	Agricultural Sys. Div.	0.7515
Soil Management	0.5833	Social Capital	0.4876
Water Management	0.4239	Farm Bus. Res.	0.3612
Nutrient Management	0.035	Animal Health and Welfare	0.7496
Energy and Carbon	0.0093		

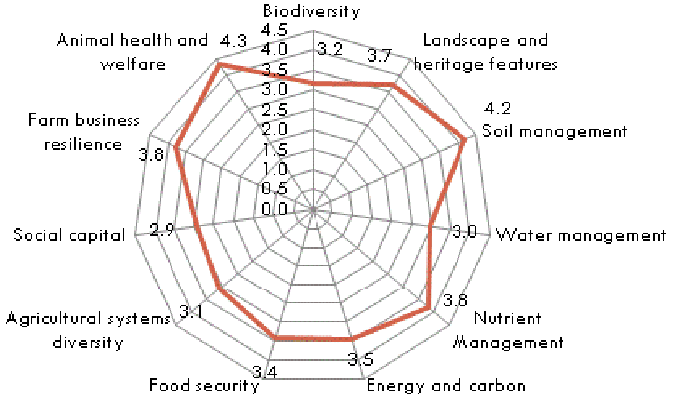
Dairy



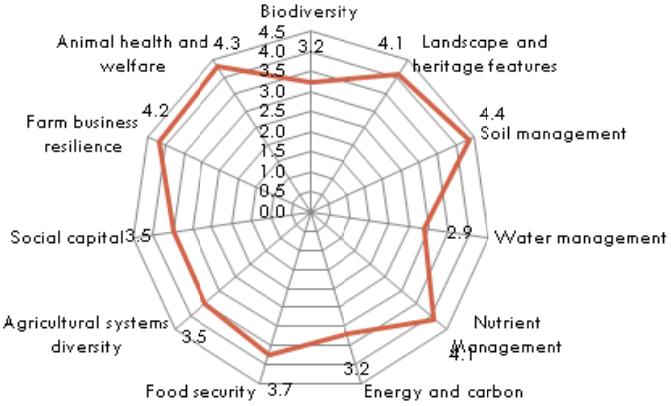
Beef and Sheep



Cereals



General Cropping



Mixed

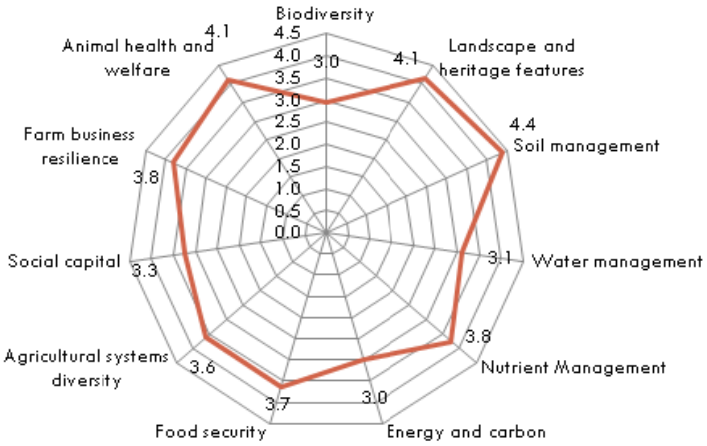


Figure 3: Charts showing the average scores for the farm types.

4.3. T-test Over OELS/HLS

To ascertain whether a higher level of agri-environmental participation, i.e being part of the HLS rather than OELS scheme, has an impact on the provision of public goods on the farm a t-test was carried out over the farms based on whether they were a member of the OELS or HLS schemes. Three farms were excluded from the sample as they were a member of neither, carrying out cross-compliance only. The score for the biodiversity spur, shown in **Table 1**, includes an agri-environmental participation activity which uses a question which scores 5 for HLS, 3 for OELS, and 1 for cross-compliance. The score for this question was discarded and a new biodiversity score based on averaging over the remaining questions was calculated and used in the biodiversity t-test for this section of the analysis. This prevented a skew towards significance being introduced by this question.

Table 3: Results of the t-test over OELS/HLS showing the p-value for each and, for each spur, the mean score for both of the agri-environmental schemes.

Spur	P-value	Mean per Scheme	Scheme
Biodiversity	0.0237	3.28	HLS
		2.8	OELS
Landscape and Heritage	0.4254	3.98	HLS
		3.94	OELS
Soil Management	0.1848	4.16	HLS
		4.29	OELS
Water Management	0.1836	2.95	HLS
		2.66	OELS
Nutrient Management	0.377	3.69	HLS
		3.73	OELS
Energy and Carbon	0.2194	3.07	HLS
		2.89	OELS
Food Security	0.2055	3.26	HLS
		3.42	OELS
Ag. Sys. Diversity	0.1104	3.6	HLS
		3.29	OELS

Social Capital	0.4536	3.05	HLS
		3.08	OELS
Farm Business Res.	0.2755	3.93	HLS
		3.83	OELS
Animal Health and Welfare	0.2102	4.24	HLS
		4.13	OELS

The results of the t-test are shown in **Table 3**. It can be seen that the only spur showing any significant difference is biodiversity (significant at the 5% level). The mean score for HLS is higher for biodiversity than for OELS farms suggesting that farms which are members of a higher level agri-environmental scheme are likely to do more to promote biodiversity than those which are not. It should be noted that the test was only comparing the impact of HLS compared with OELS. To assess the impact of stewardship schemes it would be necessary to carry out a further study using farms which only carry out cross-compliance to provide a comparison with those in the stewardship schemes and so assess the impact of scheme membership.

4.4. T-test Over Whether a Farm is Solely Grassland or Not

It was suggested by one of the advisors that farms which are solely grassland may score lower on the OCIS Public Goods Tool than those with some arable land. To test whether this was the case a t-test was carried out for each spur comparing grassland farms with those which also grow some crops. Eight farms were grassland only, the remaining thirty-two also grow some crops. **Table 4** shows the results of the t-test giving the p-value (the probability that the results are due to chance rather than the factor being tested – i.e. whether the farm is solely grassland or not) and the mean for each spur for each type of farm.

Table 4: Results of the t-test over whether or not a farm is solely grassland. The p-value is shown for each spur and the mean score for solely grassland farms and for those which are not solely grassland.

Spur	P-value	Mean over Grassland	Status
Biodiversity	0.3389	2.95	Other
		3.09	just grassland
Landscape and heritage	0.4588	3.93	Other
		3.89	just grassland
Soil Management	0.2412	4.21	other
		4.11	just grassland
Water Management	0.2044	2.91	other
		2.65	just grassland
Nutrient Management	0.0224	3.78	other
		3.35	just grassland
Energy and Carbon	0.001	3.15	other
		2.28	just grassland
Food Security	0.0167	3.45	other
		3.06	just grassland
Ag Sys Diversity	0.3422	3.48	other
		3.33	just grassland
Social Capital	0.2174	3.07	other
		2.81	just grassland
Farm Business Res	0.264	3.89	other
		4	just grassland
Animal Health and Welfare	0.4662	4.2	other
		4.19	just grassland

From the table it can be seen that the spurs for which there is a significant difference between farms which only have grassland and those which also grow crops are energy and carbon (significant at 1%) and nutrient management and food security (significant at the 5% level). It should be noted that these are exactly the same spurs which are affected by farm type according to that ANOVA and so it is going to be extremely difficult to separate whether the effect is due to the farm being solely grassland or due to the presence of livestock on these farms. This will be discussed further in Section 4.8.

4.5. ANOVA Over Advisors

It is possible that the variation between farms may be due to slightly different scoring by advisors – some spurs require the use of discretion and, in all cases, if the farmer undertakes a management practice which is not an option in the drop-down box embedded in the OCIS Public Goods Tool then the advisor must use their judgement to decide which option is equivalent. Eight main advisors were used, seven of whom assessed 5 farms and one of whom assessed 4 farms, and Mark Measures assessed one further farm. To test this an ANOVA has been carried out across all of the spurs for the eight main advisors (39 farms) and **Table 5** shows the summarised results, while **Table 10** in **Appendix 4** shows the mean scores across the spurs for each advisor.

Table 5: Results of the ANOVA over advisors showing the p-value for each spur.

Spur	P-value	Spur	P-value
Biodiversity	0.4209	Food Security	0.0008
Landscape and Heritage	0.578	Ag Systems Diversity	0.1625
Soil Management	0.9307	Social Capital	0.0204
Water Management	0.0014	Farm Business Resilience	0.0067
Nutrient Management	0.5379	Animal Health and Welfare	0.5903
Energy and Carbon	0.00034		

The spurs which show significant results at the 1% significance level are energy and carbon, food security, and farm business resilience. At the 5% level, water management and social capital show significant differences. It is worth noting that many advisors only assessed one or two robust types of farm and so it may be difficult to isolate whether it is farm type rather than advisor that is having an effect in this case. It is noticeable that energy and carbon and food security are also spurs for which farm type was seen to have a significant effect on score in Section 4.2.

4.6. ANOVA Over Tenancy

It is plausible that the farmer's ownership status may influence management decisions with regard to provision of public goods. Ownership of a farm may confer a greater advantage to

providing public goods such as soil management as the farmer relies on the quality of the soil for future production or social capital, as the farmer will benefit in the long-term from the knowledge and skill of the staff he trains. Whereas a farmer on a short-term tenancy may have less of an incentive to look after their land or to provide other public goods. **Table 6** shows the results of an ANOVA over ownership for 38 of the pilot farms (4 tenant less than 5 years, 4 tenant greater than or equal to 5 years, 4 successional tenant and 26 owner occupier), the other two having the ownership status "other" and not being included in this analysis. **Table 11** in **Appendix 4** shows more detailed results including the mean score for each spur for each form of ownership/tenancy considered.

Table 6: Results of the ANOVA over tenancy status showing the p-value for each sub-spur.

Spur	P-value	Spur	P-value
Biodiversity	0.72513	Food Security	0.3453
Landscape & Heritage	0.0717	Ag Sys Diversity	0.3067
Soil Management	0.7584	Social Capital	0.2828
Water Management	0.3144	Farm Business Resilience	0.1048
Nutrient Management	0.371	Animal Health & Welfare	0.2836
Energy & Carbon	0.5553		

From **Table 6**, it can be seen that tenancy/ownership status appears to have relatively little impact on provision of public goods. Only the landscape and heritage spur shows even a mild trend towards significance and then only at the 10% level.

4.7. ANOVA Over Length of Time the Farm Has Been Fully Organic

It is also plausible that the length of time a farm has been fully organic may have an impact on its score in some categories. Some effects may require a build-up over time, e.g. biodiversity may increase over time as pesticide residues reduce and a more species-friendly environment is created. To test this an ANOVA was carried out over all the farms. The length of time the farm had been organic was split into several categories over which the farms were reasonably well spread. These categories were: less than or equal to 2 years (8 farms), 3-4 years (8 farms), 5-8 years (9 farms), 9-10 years (8 farms), 11-44 years (6 farms). This

totals 39 farms, 1 farm from the pilot is not fully organic and so has not been included in this section of the analysis.

Table 7 gives the summarised results over all spurs giving the probability that the difference is due to chance rather than the length of time the farm has been fully organic. **Table 12** in **Appendix 4** gives detailed results including the mean score for each spur for each time category. It can be seen from **Table 8** that the length of time that the farm has been fully organic has less impact than some of the other factors considered in this report with the only spur which shows a significant difference being water management which gives a significant difference at the 5% level.

Table 7: Results for the ANOVA over how long a farm has been fully organic showing the p-values for each spur.

Spur	P-value	Spur	P-value
Biodiversity	0.307	Food Security	0.3195
Landscape and Heritage	0.2265	Agricultural Systems Diversity	0.1238
Soil Management	0.3093	Social Capital	0.7428
Water Management	0.0223	Farm Business Resilience	0.9747
Nutrient Management	0.3907	Animal Health and Welfare	0.7254
Energy and Carbon	0.3967		

4.8. Discussion

The highest scoring spurs are animal health and welfare and soil management, both with a mean score of 4.2 and the lowest scoring is water management with a mean of 2.9. The highest scoring activities are food quality certification and erosion management and the lowest is biodiversity awards. The activities show greater variation than the spurs with the greatest variation being for conservation plan (biodiversity), water management plan (water management), and on-farm processing (agricultural systems diversity). None of the spurs show a variation with a standard deviation greater than 1 however all do show some variation.

Various factors which might be responsible for these variations in the spur scores were investigated using the statistical tests of ANOVA and t-test which calculate a probability that

the variation seen arises simply due to diverse differences between the farms rather than as an effect of the factor being investigated. The factors that were considered were: robust farm type, level of agri-environmental participation, whether or not the farm was solely grassland, the advisor who carried out the assessment, tenancy/ownership status and the length of time the farm has been fully organic.

The last two (tenancy/ownership status and length of time the farm has been fully organic) appeared to have little impact on the scores. Level of agri-environmental participation only had an impact on the biodiversity spur where membership of HLS had a significant chance of increasing the mean score suggesting that farms which hold HLS agreements do more to promote biodiversity.

The remaining factors investigated – farm type, whether or not the farm is grassland, and advisor – all showed significant differences on more than one spur. For farm type and whether or not the farm was solely grassland the same three spurs show significant results: energy and carbon, food security, and nutrient management. For the advisor factor significant variations were again found for the spurs energy and carbon and food security (these were also significant spurs for the previous two factors), and additionally farm business resilience, water management and social capital.

These three factors (farm type, whether or not the farm is solely grassland and advisor) are closely related. Grassland farms are livestock farms and so tend to be dairy or beef and sheep robust farm types. Most advisors specialise in a particular area of the country and/or certain types of farms and so have assessed only one or two robust types for this pilot. It is, thus, possible to say that any or all of these three factors may have an influence on the results but it is impossible to say, from the analysis that has been carried out, whether the factors are independently significant or whether they interact with each other. To carry out an analysis which would give such information would require a larger data set with all advisors covering all types of farm and then would need the use of more sophisticated statistical techniques such as factorial ANOVA and is thus out of the scope of this project.

At present, given the analysis which has been carried out, it is simply interesting to note that one or all of robust farm type, whether or not the farm is solely grassland, and the advisor carrying out the assessment have a significant effect on the scores for some of the spurs, although all of these may be related.

5. FEEDBACK ON THE OCIS PUBLIC GOODS TOOL

5.1. Advisor Feedback

The advisors who were involved in the pilot provided feedback throughout the experience via e-mail and telephone calls. Additionally two conference calls were held on 15th and 16th of December to discuss the OCIS Public Goods Tool, future development and to allow the advisors further opportunity to give feedback on the tool. The suggestions for further improvements are discussed in Section 6.2 in greater detail. The general opinion of the Tool appeared to be positive with some advisors wanting to separate off sections of it (such as the nutrient budget and the energy benchmarking) to use as stand-alone assessment tools in those areas.

One advisor commented that "Overall it was an interesting exercise and could be a useful tool with a bit of tweaking." Similarly another advisor commented that, "on the whole it is a good tool and as it is used more I think it will just improve"

One of the advisors also commented on farmer's reactions to the tool saying "I would like to add that farmer's reaction was, on the whole, very positive. They were interested in the tool and its concept and entered into discussion very freely. The spider [radar] diagram was well received with interest not only in the high scores but also the low scores and the reason for them and how they could be improved." He goes on to say, "I also feel that meeting the farmer face to face allows him to engage in positive discussion with a knowledgeable advisor. The advisor hopefully brings a breadth of experience of other farms and systems and can offer views, courses of action and interpretations that the farmer might not have considered if he was interacting with a web based tool. Farmers also find direct verbal explanations much more acceptable than written explanations as it allows them to raise the inevitable questions and receive an immediate answer – hopefully! My personal view is that this is a very useable and useful tool that has the potential to become the tool of choice for assessing the public good. It not only acknowledges the areas at which the farmer excels but it also

highlights areas where improvements could be made. Above all farmers seem to like it and find it interesting and helpful."

5.2. Farmer Feedback

Farmer feedback has also been generally positive. The first farm on which the OCIS Public Goods Tool was trialled, prior to the pilot resulted in very positive feedback. The farmer commented that the OCIS Public Goods Tool was the best tool of its type that he had met.

Appendix 6 shows a table summarising the results from farmer feedback forms which were issued immediately after the pilot assessments. Of the 40 farms assessed 12 returned their feedback forms. Of those, 8 would recommend the tool in its current format and 2 more would recommend it once it had been modified. It would also appear that the tool has generally increased farmers' understanding of public goods with 9 of the farmers reporting a higher level of knowledge and understanding of public goods after the assessment than they had reported prior to it. The remaining thee farmers already reported a knowledge and understanding level of either 9 or 10 out of 10 and so would appear to have already been very knowledgeable prior to using the pilot. Reflecting the advisor's feeling that using an advisor to carry out the assessment allowed the farmer to engage in a positive and useful discussion and that verbal explanations are more valuable than written ones, another area in which farmers scored the OCIS Public Goods Tool highly was the opportunity to ask questions, 8 rated this as excellent and the remaining 4 rated it as good. The reporting format was also rated well with 2 excellent ratings, 9 good and one fair. Lower ratings were obtained for the length of time taken to carry out the assessment which obtained 4 good ratings and 8 fair ratings, one farmer commented that a farmer "would need to be dedicated to return to it". The quality of questions received a mixed response with 6 farmers rating the quality of the questions as good, 4 as fair, 1 as fair/poor and 1 as poor/excellent (explaining that he felt that it was, "early days – some great bits - some bits need work!"). Further comments on the questions included "some of the questions need refining in order to reflect properly the reality on the farm" and "I think it is good to be able to assess the public goods gained but some of the questions are a little vague and so don't always give a fair result as they don't give the whole picture but I suppose the tool would end up overcomplicated".

These comments will be addressed when the advisors' suggestions for improvements (Section 6.2) are incorporated into the next version of the OCIS Public Goods Tool.

There was also a positive response to questions about the overall value of the Public Goods Tool. With regards to value to their business 7 farmers rated it as above average and 3 as high, 1 felt that it was too soon to tell and 1 rated it as below average. With regards to demonstrating the public goods obtained from farming to the wider community 6 felt that it was a help, 4 felt that it partly demonstrated this, 1 thought it was of little use and 1 thought it was of no use.

6. FUTURE DEVELOPMENT OF THE TOOL

6.1. Intellectual Property and Copyright for Unpublished Data/Questions

There are issues with regard to intellectual property (IP) and copyright concerning the OCIS Public Goods Tool. The OCIS Public Goods Tool was developed under the NE OCIS contract which assigns all IP produced by the contractor to Natural England (OCIS terms and conditions para. 7.1). This was envisaged to cover publicity and technical documents to assists with the delivery of the OCIS scheme. However, with the research and development activity undertaken to produce the OCIS Public Goods Tool a different situation has arisen. Background Intellectual Property: ORC and others brought background IP to the project that was not identified ahead of the project start. This needs to be catalogued and agreed. There is also third party background IP in that some of the data used for benchmarking and to form the questions used in the tool is unpublished and published data sourced from organisations other than ORC or Natural England. This data has been identified but its further use needs to be clarified and agreed with the data owner.

In addition to the background IP issues that need to be resolved ORC request from Natural England (in the spirit of what is included in most Defra R&D contracts) a royalty-free non-exclusive licence to use and develop the tool for its own charitable and commercial purposes and that any further development of foreground IP within the tool will be the property of ORC.

Prior to using the tool for the pilot all of the advisors were asked to sign a user-agreement indicating that they understood that the tool is the property of the ORC and that they will not use or distribute it, or its components parts without first obtaining permission to do so and will acknowledge it in any related publications.

A data protection agreement has been produced which was sent to each farmer who participated in the pilot. This stated that the data would be used for research projects and would be shared in confidence with any organisations or persons helping Natural England and ORC to assess the tool. It also confirmed that the farm data would be treated in such a way as to keep the farms anonymous.

6.2. Revisions in the Light of Advisor Feedback

There were 119 comments from the advisors (both during and after the pilot) with regards to future changes to the tool demonstrating their high level of engagement with this project. Their general comments are listed below and comments on the specific spurs have been combined and consolidated into the list in **Appendix 7**:

General comments

- The accuracy of the score is dependent on the farmer's answers and he has an incentive to get a high score (and can probably guess which are the "right" answers) so there is a need to emphasise to farmers that if answered accurately the tool can help them with management decisions to improve their farm's performance.
- Timing can be quite rushed meaning farmers may feel under pressure to get on with other work by the end of the assessment therefore it is important to go through it in the correct order so that data-heavy areas such as "energy and carbon" do not get left until last and suffer from little time being available to search out the most accurate data.
- Consider offering farmers the chance to see their results overlaid with average results either for similar types of farm or for organic farms so that they can see how they performed compared with their peers. This benchmarking approach is discussed in Section 5.5.
- Care should be taken not to load the tool too heavily in favour of organic farming as this could leave it open to criticism if/when it is used to assess conventional farms.

- May need to consider whether some questions should be weighted more heavily than others in the scoring system.

6.3. Updates to Allow Assessment of All Farm Types and Production Systems

The OCIS Public Goods Tool in its current format has been aimed at assessing the public goods provided by organic farms. To a large extent, however, a question that measures the public good provided by an organic farm should also measure whether that good is provided by any farm. Thus, there would be only a limited number of changes required to make the tool applicable to conventional farms. The main changes required are listed below:

Biodiversity spur

- Include ELS as an agri-environmental participation option.
- Modify question on “in-field” OELS options.

Water management

- Modify question on “in-field” OELS options.

NPK budget

- Include figures for non-organic fertilisers etc.

Manure Management and nutrients

- Include questions on non-organic fertilisers etc.

Energy and carbon spur

- Modify question on “in-field” OELS options.

Food security

- May need to add further options to food quality certification question.

Social Capital

- Obtain a conventional benchmark for labour (current figure is based on labour requirements in organic agriculture, as discussed in Section 1.3).
- Add further schemes to the ethical trade scheme question under CSR to include conventional agriculture schemes.

Farm Business Resilience

- The price benchmarks against which the farm is scored are based on organic farming and so will include the organic premium. Conventional benchmarks will be required.

Animal Health and Welfare

- Look at health plan question and modify as necessary.
- Modify the veterinary spend question as necessary – emphasise that preventative treatment/management should score more highly and alter the benchmark scoring to take into account the higher veterinary spend on conventional farms.
- Housing question currently refers to whether housing is in accordance with organic standards and so will require rephrasing to reference a standard familiar to conventional farmers.

6.4. Developing "Benchmarks"

Benchmarking is a well-established management tool, used across a range of industries (Campbell *et al.*, 1999). Several different forms of benchmarking exist including:

- Best-in-class benchmarking
- Competitive benchmarking
- Strategic benchmarking
- Functional benchmarking

In this case it should be possible to use the OCIS Public Goods Tool to provide farmers with a benchmark score for each spur based on averaging the scores of other, similar farms i.e to provide the data for competitive benchmarking.

Initially, given that only forty farms have been assessed during the pilot, this benchmark figure may simply be given by the median score for all forty farms or, for cereals, dairy, beef and sheep, mixed and general cropping farms, it may be possible to use the medians of the scores for each spur for those particular robust farm types. Alternatively it may be possible to give a range against which to benchmark, either giving the minimum and maximum scores or, as the data set increases in size, using quartiles.

As the tool continues to be used, it will be possible, if either all the data is returned to the ORC or it feeds into a database (if the tool becomes web-based), to build up a benchmark for each farm type by continuing to take the median over all available data thus fine-tuning the initial benchmarks and ensuring that they are as accurate as possible.

If the tool is adapted such that it can be used to assess all farm types and production systems then it will be necessary to separately produce benchmarks for organic and conventional farms.

The median result appears to be the best single statistic to use as a benchmark because, as can be seen from Section 4, it gives a very similar value to the mean, suggesting a normal distribution of the data, but the mean would be sensitive to outlying results whereas the median is less sensitive and so would not result in the benchmark being skewed by one farm with a very different profile. This is important in a benchmark figure as farmers require a realistic benchmark which is relatively representative of their type of farm. If the benchmark appears to be unattainably high then it may have a demoralising effect. Similarly, if it is too low then it may result in no further effort being made to improve the farm's performance. Thus, the median over a group of similar farms should provide the most suitable single benchmark figure. Alternatively a range could be used instead so that, for instance, the farmer can see how they perform compared to the lowest and highest scores for that spur or activity.

As more data is built up it should be possible to, not only take the median over the same robust type of farms but also to select farms of similar size and location (ie less favoured areas versus lowland areas) to improve the benchmarks further. It would also be possible to take quartiles and use these to specify ranges of performance i.e using the scores of the bottom 25% of farms and top 25% of farms.

6.5. Web-Based Approach

A web-based approach is the favoured way forward in a similar manner to the CALM calculator produced by the Country Land and Business Association and SAVILLS (CLA, 2010) but would require further development of software, and resolution of intellectual property and hosting issues.

APPENDIX 1: LIST OF ACRONYMS

OCIS	Organic Conversion Information Service
CFP	Critical Failure Point
SMR	Statutory Management Requirement
GAEC	Good Agricultural and Environmental Condition
MINAS	Mineral Accounting Software Tool
LFS	Levy Free Surpluses
EMA	Environmental Management for Agriculture
IFS	Indicators of Farm Sustainability
EP	EcoPoints
OCW	Organic Centre Wales
LCA	LifeCycle Assessment
MOTIFS	Monitoring Tool for Integrated Farm Sustainability
CSF	Critical Success Factor
BAP	Biodiversity Action Plan
SINC	Site of importance for Nature Conservation
SSSI	Site of Special Scientific Interest
EMA	Environmental Management for Agriculture
SPS	Single Payment Scheme
RPDE	Rural Development Programme for England
OELS	Organic Entry Level Scheme

HLS	Higher Level Scheme
ESA	Environmentally Sensitive Areas
CFE	Campaign for the Farmed Environment
JNCC	Joint Nature Conservation Committee
EASI	The Energy, Emissions, Ecology and Agricultural System Integration Programme
LEAF	Linking Environment and Farming
JCA	Joint character Area
FEP	Farm Environment Plan
NCA	National Character Area
HEV	High Environment Value
NPK	Nitrogen, Phosphorus, Potassium
CALU	Centre for Alternative Land-use
CALM	Carbon Accounting for Land Managers
GAP	Good Agricultural Practice
UAA	utilisable Agricultural Area
ALU	Agricultural Labour Units
CSR	Corporate Social Responsibility
IIP	Investor in People
COSHH	Control of Substances Hazardous to Health
FTE	Full-Time Equivalent
ORC	Organic Research Centre
FBS	Farm Business Survey

ELS	Entry Level Scheme
NE	Natural England

APPENDIX 2: DETAILED LIST OF QUESTIONS ASKED FOR EACH SPUR

Soil Management

Soil analysis

- How often do you undertake soil analysis?
- Are you increasing, decreasing or maintaining Soil Organic Matter levels?

Soil management

- Have you completed a Soil Protection Review and are you acting on it?
- What % of arable land is left as bare ground (e.g: over winter stubble without a cover crop) over the winter?
- What % of cropped arable land (not including pasture) is harvested before the 1st of October?

Winter grazing

- Do you out-winter cattle?
- Is there any poaching over winter?

Erosion - Please report % of land affected by the following

- Sheet erosion
- Rill erosion
- Gully erosion
- Ponding
- Capping of soil surface
- Wind erosion
- Other soil damage/erosion

Measures taken to reduce the risk of erosion

- On what percentage of your cultivated land are you implementing cultivation that reduces risk of erosion? eg minimum tillage and contour ploughing

- Are you implementing measures to reduce the risk of erosion and run off?

Biodiversity

Agri-environmental participation

- What is your level of agri-environmental participation?
- How many of the "in field" OELS options (listed below) do you have on your farm?
- Are you contributing to the targets for the Campaign for the Farmed Environment (see below for more information)

BAP habitat and SINCS

- What area is a BAP (biodiversity action plan) habitat or SINC (sites of importance for nature conservation)? (see Natural England webpage for more information)
- Do you manage this land with a view to conservation and improving biodiversity? N/A (ie no BAP/SINC), don't manage for conservation/biodiversity, some management for conservation/biodiversity, almost entirely managed for conservation/biodiversity

SSSI

- Where you farm an SSSI how is it rated by Natural England?

BAP and rare species

- Do you survey/monitor flora and fauna species on your farm?
- How many of the rare/red list species (some of which are listed below the documentation section on this worksheet) do you have evidence of on your farm? (please identify in notes column)

Conservation plan

- Do you have a voluntary conservation plan? None, LEAF, whole farm plan developed, whole farm plan acted on and revised regularly

Awards

- Have you received any biodiversity awards? None, local, regional, national?

Habitat

- What is the amount of land which is permanent pasture? (taken from Initial data collection sheet)
- What percentage of permanent pasture is managed as "low input" or "very low input" (as defined on pages 107-8 of the OELS handbook). Calculated from Initial data collection sheet.
- What percentage of your arable area contains buffer strips?
- What percentage of your arable land is left as over-wintered stubble?
- What is the amount of land that is woodland consisting of native species - broadleaved, mixed or coniferous?
- To what extent do you manage farm woodland? n/a, not at all, manage some woodland edges, manage all woodland edges, woodland management for conservation/biodiversity, very active woodland management for conservation/biodiversity
- Do you exclude livestock from woodland?
- Do you protect in-field trees?
- How much new hedge have you planted in the last 10 years per 100 hectare?
- Are you maintaining hedges, if so how regularly? Not maintained, maintained rarely (5 years), maintained infrequently (3 years), maintained frequently (2 years), maintained regularly (yearly)
- Are you restoring and/or establishing wildlife habitats (eg wet grassland) on your land? If so, how much land is being restored as a percentage of total land area?
- Are you maintaining habitats, if so how regularly? Not maintained, maintained rarely (5 years), maintained infrequently (3 years), maintained frequently (2 years), maintained regularly (yearly)

Landscape and Heritage

Historic features

- Are there historic features present on the farm (including archaeological features, traditional buildings, listed monuments)? If yes then answer questions below:
- If there are, what sort of condition are they in? Condition A (Maintain), Condition B (Maintain and restore), Condition C (Restore). See Farm Environment Plan (FEP) manual for condition definitions p 104-108.
- If there are, how much maintenance/care do you give them? None, little, some, much, N/A (note: in the case of archaeological features a high level of care may involve keeping them buried and not ploughing/cultivating in the areas where they exist).

JCA and landscape features

- How closely does the farm's landscape reflect the the JCA (joint character area)/ NCA (national character area) of the area? Not at all, little, partially, mostly, fully

Management of boundaries

- Do you have High Environmental value (HEV) boundaries on your farm (see FEP manual p47-54 for definition of boundaries).
- How many hedgerow trees per 100m do you have on the farm?
- Are you taking action to restore appropriate (to the JCA/NCA in your area) boundary features (e.g hedges, hedge banks, earth banks, stone faced banks, stone walls, ditches)? No, partly/infrequently, regularly/frequently

Water Management

Implementation of measures to minimise water pollution and maximise water efficiency

- How many resource protection OELS options (see list at bottom of page) do you have on your farm?
- What intensity of action(s) is/are being taken for water resource protection?

Flood defence and runoff prevention

- What is the condition of your flood defence or water runoff mitigation system?

Water audit and management plan

- Have you completed a water audit/management plan and if so are you acting on it?

Water harvesting

- How much of the water you use on farm is recycled?
- How much rainwater or groundwater do you harvest for use on farm?

Irrigation

- Do you irrigate crops?
- What % of UAA is irrigated using mains or abstracted water?
- What application system do you use?
- Do you know the rate of water (e.g: cubic metres per hour) applied by your system?
- Does your irrigation system (e.g: gun boom) operate at its design pressure in each field?
- How uniformly does your system apply water within each field?
- Do you modify your irrigation applications in response to forecast/weather conditions?
- Do you summer irrigate from mains/abstracted water or collect/store water over winter and extract when necessary?
- What is the physical condition of your pumping, distribution and application system?

Manure Management and Nutrients

The results of the NPK budget are also included in this spur.

Manure management

- How do you determine the level of nutrient application for crops?
- Do you know the N,P, K content of organic manures/composts applied?

Manure Storage

- How do you store/manage manure on farm?
- How do you store slurry?

- What is the condition of the floor for your slurry storage system?
- How many months storage capacity do you have for slurry/dirty water?
- How often do you completely empty and inspect waste storage facilities?

Manure application

- How do you spread slurry?
- What time period do you leave between FYM and/or slurry applications?
- At what time of year do you spread manures/slurries?

Farm waste disposal

- What percentage of farm waste (e.g: plastics, metals, timber etc) is recycled?
- How do you dispose of unused/unwanted medicines?

Winter grazing

- Do you outwinter sheep and/or cattle?
- Is there any poaching over winter?

Energy and Carbon

This spur includes the results of the energy benchmarking and energy balance calculations.

Energy saving options

- Do you monitor/record on-farm energy use?
- Have you completed an energy audit to explore efficiency options and are you acting on it?

Greenhouse gases

- Have you completed a CALM audit (www.calm.cla.org.uk) or similar and are you acting on recommendations?
- How many Climate Change OELS option crosses (see list Row 90 below) do you score for your farm?

Land use change

- Have you converted woodland or grassland to arable in the last 20 years? If so what % of your total woodland/grassland was converted?
- Have you converted arable land to permanent grassland or woodland in the last 20 years? If so what % of your total arable area was converted?

Renewable energy

- What % of your energy use is from renewable sources? This includes 'green tariffs' for electricity consumption
- Do you produce any energy on farm or have you considered installing energy generation capacity (e.g: solar, wind, biofuel) or are you planning to install?

Food security

Total productivity

- How would you describe your yield compared with average yields for similar types of farm?

Local food

- Approximately what percentage of your produce (by weight) is sold to the following:
  - local sales (<10 miles)
  - county sales
  - regional sales
  - national sales
  - international sales

Off farm feed

- What percentage of your total feed (forage and concentrate) is bought in from off-farm?

Food quality awards

- Have you received awards for food quality/local food production? None, local, regional, national

Food quality certification

- What level of food quality certification do you have? Farm assured, Global GAP/ Europe GAP, organic certification

Production of fresh produce

- Hectares of farm used to grow fruit, roots and other vegetables
- What percentage (by weight) of your crops would you estimate goes for human consumption rather than animal consumption?

Agricultural Systems Diversity

Rotational and varietal diversity

- How diverse is the crop rotation on your farm in terms of numbers of crop types?
- How many species/varieties do you grow in total for each group of crops?
    - Arable - cereals
    - Arable - fodder crops
    - Grain legume and oilseeds
    - Vegetables
    - Forage/green manures/leys
    - Other crops

Livestock diversity

- How diverse is the livestock system on the farm with regard to numbers of species?
- How diverse is the livestock system on the farm with regard to numbers of breeds/crossbreeds?
    - Dairy Cattle
    - Beef Cattle
    - Sheep
    - Pigs
    - Poultry
    - Other livestock

Marketing outlets

- Through how many outlets do you market your produce?

On farm processing

- Do you process on farm products?

Social Capital

Employment

- How many staff do you employ?
    - Casual?
    - Long term?
    - family labour?

Skills and knowledge

- How many training days have staff had per year in total
    - Casual?
    - Long term (including family)?
- How well qualified are your staff? (by experience and/or courses/ certification)

Community engagement

- How many visitor events do you have per year?
- Do you use any of the means of communication listed below?
    - Information boards
    - farm walks
    - website
    - farm shop
    - farmers' markets
    - research/demonstrating projects
    - open days

- How many visitors come through the farm gate?
- Have you received any awards for staff welfare/community engagement? None, local, regional, national

CSR (corporate social responsibility) initiatives and accreditations

- Do you hold the "Investors in People" award or any other similar corporate social responsibility accreditations?
- Are you a member of an ethical trade scheme (for example, Soil Association ethical trade, SSE)

Public access

- How much access do you provide?
- Do you maintain areas of public access?
- Do you promote public access?

Human health issues

- How exposed are you or your workers to hazardous chemicals?
- Have you carried out a COSHH assessment?
- How rigorously is health and safety enforced on the farm?
- How would you describe the working environment at your farm?

Farm Business Resilience

Financial viability

- What sort of prices are you getting at present (type n/a if you do not produce the product)
    - price per litre milk
    - price for finished beef cattle (£/kg)
    - weaners - £/kg lw
    - finished pigs (£/kg dw)
    - price of finished lambs - lowland (£/kg dcw)
    - price of finished lambs - upland (£/kg dcw)
    - price of eggs - £ per dozen
    - table chicken - £/kg dcw
    - price per tonne of wheat (winter)
    - price per tonne of wheat (spring)

        - Price per tonne of barley
        - price per tonne of oats
        - price per tonne of potatoes (maincrop)
        - price per tonne of potatoes (early)
- How have your net assets (total assets less total liabilities) changed in the last year?

Farm resilience

- Have you been able to carry out the investment you would like? None, some, about half, most, all
- How many sources of farm income do you have? (see list below documentation for examples)
- How often do you review the state of your business?
- How is your farm doing? Struggling, surviving, making a reasonable living, booming
- Do you expect to still be in business next year?
- Do you expect your farm to still be farmed in the next decade?

Animal Health and Welfare

Does the farm have livestock?- if yes, please continue with this spur. If no, please go straight to the results page

Staff resources

- Number of labour units (FTEs) looking after livestock? (type n/a if you do not have these livestock on farm)
    - dairy cattle
    - beef cattle
    - sheep
    - pigs
    - laying birds
- How often per day are livestock inspected for signs of illness/injury? Irregularly, once, 2-3 times, 4-5 times, >5 times
- Are your stock-people trained?

Health plan

- Do you have a health plan?
- Was your vet/external consultant involved in drawing it up?
- Does it include:
    - lameness treatment
    - metabolic disorder treatment
    - reproductive disorder treatment
    - Mastitis treatment
    - Mortality reduction
    - contagious/parasitic disease treatment
    - lameness prevention
    - metabolic disorder prevention
    - reproductive disorder prevention
    - Mastitis prevention
    - contagious/parasitic disease prevention

Animal health

- How much do you spend on veterinary medicines (breakdown if known, total if breakdown is not available) ?
    - preventative
    - treatment - holistic (e.g. Homeopathic)
    - treatment - allopathic (e.g. Antibiotics)
    - Total

- Do you consider disease prevention in breed/ breeding stock selection (this may include considering rare/traditional breeds suited to your area of the country)?
- How would you describe the mortality/culling rates on your farm?
- How would you describe the longevity of your animals (dairy herds)
- How would you describe mastitis incidence in your herd (n/a of you do not have a dairy herd)
- How would you describe lameness incidence in your herd?
- What management methods do you use to reduce parasite burdens while minimising the use of anthelmintics?

Ability to perform natural behaviours

- Do you restrict grazing/outdoor access at certain times of year (for any species)?
- How much access do they have to grazing/outdoors on a daily basis during times of year when they are not kept in?
- How do you judge your animals' ability to perform natural behaviour?
    - feeding
    - resting
    - social/comfort

Housing

- How would you describe the housing/grazing options available to your livestock? Below organic standards, According to organic standards, higher than standards, much higher than standards
- How is the housing designed?
- Are feed and water positioned to minimise the risk of contamination?
- Do you have RSPCA "freedom foods" certification or Organic certification?

Biosecurity

- Do you have a biosecurity plan and disease control measures in place?
- How do you deal with new livestock coming on to your farm?

APPENDIX 3: DETAILED DESCRIPTION OF SPURS AND ACTIVITIES

Soil Management

Soil analysis

In order to determine their resource use sustainability, it is important for farms to be aware of the condition of their soil, both in terms of structure and nutrient availability. This area is assessed by checking the frequency of the farm's soil analysis, with 'Never' scoring 1 and 'Testing some fields every year' scoring 5.

Soil Management

To improve soil management all Single Payment Scheme (SPS) and certain Rural Development Programme for England (RDPE) scheme agreement holders must complete a Soil Protection Review as part of their Cross Compliance requirements (DEFRA, 2008). This first question in this sub spur refers to whether a review has been implemented and to what extent it is being acted on. A score of 1 is given if a review has not been completed, a score of 5 is given if a review has been completed and is being acted on fully.

The next question in this activity addresses the issue of nutrient loss and soil erosion which can result from soils being left open (ie: without a cover crop) over winter. This question asks what percentage of arable land is covered over winter, with a higher percentage receiving a higher score.

The final question within this activity refers to the percentage of cropped arable land (not including pasture) that is harvested before the 1st of October. Crop harvesting carried out earlier in the year, generally causes less damage than later harvests completed after October, due to an increase in wet weather conditions in the autumn/winter.

An average of the scores for these three questions is then taken to provide an overall score for the area of Soil Management.

Winter grazing

Severe damage to soil (ie: poaching) can result from over winter grazing of cattle at a high stocking density. This question ascertains how much damage is caused and over how wide an area. Higher scores are given for less severe damage, or for damage spread over a wide area. If cattle are not out-wintered then this activity is marked as n/a and no score is given.

Erosion

Symptoms of poorly structured or damaged soil are recorded within this activity as a percentage of land affected. The occurrence of sheet erosion, rill erosion, gully erosion, ponding, soil capping, wind erosion and other soil structural damage / erosion are recorded and scored accordingly.

Measures taken to reduce the risk of erosion

This sub spur measures the percentage of cultivated area that is being managed with practices that reduce the risk of erosion, for example contour ploughing. The second question in this sub spur addresses other actions that may be/are being taken to reduce the erosion risk, eg: taking land out of production. An average of the scores for the two questions within this sub spur is then taken.

Biodiversity.

Agri-environmental participation

This is assessed by considering the level of participation in environmental stewardship schemes currently undertaken by the farm. Information on the Organic Entry Level Scheme (OELS) (Natural England, 2010a), Higher level Scheme (HLS) (Natural England, 2010b) and the previous scheme, ESA (environmentally sensitive areas – under which some farms will remain until 2014) was obtained from the Natural England web page and from the OELS (Natural England, 2010a) and HLS (Natural England, 2010b) handbooks. Participation in HLS scores 5 whereas cross-compliance scores 1 and OELS sits between the two. A second question assesses the farm's use of "in field" OELS options which are known to encourage farmland birds and wildlife. The higher the number of such options, the higher is the score obtained. Finally, the contribution of the farm to "The Campaign for the Farmed Environment" (CFE, 2010) is assessed with a high contribution giving a high score.

BAP habitats and SINCS

The amount of land which is a BAP (biodiversity action plan) or SINC (site of importance for nature conservation) is recorded and expressed as a percentage of the total land with higher percentages scoring more highly. A further question is then asked regarding whether this land is managed with a view to improving biodiversity. If no land is a BAP/SINC then this second question may be answered with n/a. The two scores are averaged to give the overall score for this activity. BAP and SINC are shown on the "Nature on the Map" webpage produced by Natural England (Natural England, 2010c).

SSSI (Sites of special scientific interest)

This is scored based on how the SSSI, if there is one within the farm, is rated by Natural England. If the farm is not an SSSI then a n/a option exists allowing this activity to be removed from the overall score for the spur. The SSSI descriptions are taken from Natural England's webpage and the web page for the JNCC (Joint Nature Conservation Committee). SSSI are shown on the "Nature on the Map" webpage produced by Natural England (Natural England, 2010c).

BAP and rare species

This is assessed in two parts. Firstly, the farmer is asked whether they survey/monitor flora and fauna on their farm, scoring more highly if they do so and act on the survey results. Secondly, the farmer is asked how many red list and rare species (list taken from the EASI tool developed at the Organic Research Centre) are on the farm as the presence of such species gives concrete evidence that the farming system is encouraging biodiversity. The higher the number of rare species, the higher is the score.

Conservation plan

If there is a whole farm conservation plan in place which is reviewed and revised regularly and is acted upon then it scores a 5. If a whole farm plan has been developed but is not yet acted upon then that scores 4. Being LEAF (Linking Environment and Farming) approved scores 3.

Awards

Whether or not a farm has received awards for biodiversity is used as an activity because the receipt of an award indicates that a third party has a high opinion of the farm's contribution to biodiversity. No award scores 1, a local award scores 2, regional awards 3 and national recognition scores 5.

Habitats

There are several questions on this activity mirroring that there are many ways in which a farm could provide habitats for different animals. These include questions about the amount of land that is permanent pasture, low input, has buffer strips, has hedges, is native woodland, is over-wintered as stubble (providing food and habitat for birds) and whether wildlife habitats are being restored/maintained. The results of these are averaged to give a score for the activity and they are asked in such a way as to avoid over-weighting any particular type of habitat. The questions are based on options described in the OELS and HLS handbooks (Natural England, 2010a; Natural England, 2010b). The question on woodland asks specifically about native woodland as this is most likely to encourage native animal species and should exclude the growing of non-native, fast growing species for timber which may not benefit biodiversity. Coniferous trees are included as well as broad leaved trees as these are frequently mentioned in the JCAs (Joint Character Areas – see landscape and heritage) for the North of England.

Landscape and Heritage

Historic features

Farmers are often viewed as custodians of the land and therefore if their land contains historic monuments, prehistoric sites etc then they may be expected to look after these. If there are no historic features on the farm then a n/a option is used to remove this activity from the final score for this spur. The score for historic features is obtained via two questions. The first part asks the condition of historic features on the farm (based on the Farm Environment Plan (FEP) (Natural England, 2010e)). The second part asks how much maintenance/care is provided for the historic features. A better condition and higher level of care provided will result in a high score.

JCA and landscape features

The farm is assessed according to how closely it relates to the JCA (joint character area) (now known as NCA (national character area) for its specific area of the country (these can be found on the natural England webpage (Natural England, 2010d)). The JCA (now known as NCA) are essentially descriptions, for various regions of the country, of the natural landscape in that area. For instance the "border moors and forests" region of "The North East of England" is described as being characterised by (Natural England, 2010d):

- Large scale landscape of high, rolling or undulating plateau with expanses of sweeping moorland, extensive coniferous woodlands and large reservoirs, sparsely populated and with no major settlements.

- Exposed moorland areas heavily grazed by sheep and characterised by mixed heather and unimproved grassland, on broad hills which offer extensive long distance views.

- Extensive plantations mainly consisting of a patchwork of felled areas and different age classes of non-native conifers.

- Few broadleaved trees, mainly restricted to small woodland blocks, hedgerows and remnant semi-natural woodland in the more sheltered valleys.

- Network of small rivers in narrow gorges, streams, loughs and mires, with sandstone crags.

- Farmland of semi-improved pasture or rough grazing land in large rectangular windswept fields, often poorly drained, and subdivided by wire fences and dry stone walls; in-bye of semi-improved and improved pastures in sheltered valleys.

- Archaeological landscapes with evidence of settlements, tracks, field systems, shielings, burial areas, Roman forts and marching camps.

- Military training establishments in part of Spadeadam Forest and at Otterburn, affecting perceptions of remoteness and solitude.

The whole of England is split into regions which are broken down into smaller areas, each of which has their own defining characteristics. This activity assesses, therefore, to what extent a farm retains the natural character of the landscape surrounding it, rather than imposing a new character on that landscape.

Management of boundaries

This activity is assessed using three questions. The first asks whether there are high environment value (HEV) boundaries on the farm, as described in the FEP manual (Natural England, 2010e), and the greater the proportion of the farm boundaries which are FEP, the greater is the score obtained. The second question asks how many trees are in the hedgerow per 100m, again giving a n/a option (for farms with no hedgerow i.e those in areas of the country where hedges are not part of the JCA) and scoring more highly the more trees there are. Finally, the farmer is asked whether they are taking action to restore boundary features such as earth banks, and stone walls and is scored more highly the more frequently they do so.

Water Management

Implementation of measures to minimise water pollution and maximise water efficiency

The application of methods which reduce water pollution are measured according to the intensity of action being taken. Low intensity measures such as selecting appropriate stocking rates, are given a lower score (3) with higher intensity/more expensive measures such as non-inversion tillage (4) and planting buffer strips scoring higher (5).

Flood defences and runoff prevention

This question ascertains to what extent the farmer has implemented flood defence or water runoff mitigation measures on their farm, and the condition of the systems put in place.

Water management plan

Farms that abstract water or irrigate should draw up and implement a water management plan to assess and minimise impact on the local water resources. Moreover, under the Soil Association organic standards, the implementation of a plan will be compulsory requirement from 2012 onwards (Soil Association 2008). This sub spur assesses whether a farm has completed a water management plan and if so whether they are acting on it partially or fully. An n/a option may also be chosen.

Water harvesting

On-farm rainwater harvesting allows a farm to make better use of a natural resource and reduces a farm's burden on the public water supply. This sub spur measures to what extent water is harvested and/or re-used on the farm. An n/a option may also be chosen for this activity, for farms where harvesting is not an option, or not relevant.

Irrigation

This sub spur determines the percentage of utilisable arable area that is irrigated and the application system being used. Other questions within this sub spur focus on the issue of uniformity of application and the condition of the irrigation equipment being used. An overall/average score for this activity is then given based on these questions. An n/a option can also be chosen for farmers who do not irrigate.

Manure Management and Nutrients

The manure management and nutrients spur is spread over two worksheets;

1. The first worksheet is an NPK (nitrogen, phosphorus, potassium) budget which takes information from the initial data collection sheet and calculates a 'farm gate' balance for these macro nutrients. The balance for each of these is then divided by the hectarage of the farm to give a total weight of N/P/K per ha. The surplus or deficit is then scored according to the guidance notes provided. Data for NPK values is taken from the Guide to Nutrient Budgeting on Organic Farms (Watson *et al.*, 2010), PLANET (Planning Land Applications of Nutrients for Efficiency and the environment) (ADAS, 2008) and the Managing Manure on Organic Farms booklet (ADAS and Organic Research Centre, 2002) .

2. The second worksheet for this spur contains more qualitative questions about the management of nutrients, manure and wastes on farms. The first of these looks at how nutrient application rates are calculated, the second looks at the issue of manure storage and the third looks at manure application methods. An average score is then calculated based on all of these responses. Two separate activities are also given for farm waste disposal (based on the percentage of waste recycling) and winter grazing of sheep and/or cattle (scoring based on the amount of poaching caused). Questions for this worksheet are based on

information from the EMA tool (University of Hertfordshire, 2006) and the Managing Manure on Organic Farms booklet (ADAS and Organic Research Centre, 2002).

An overall score is then given for this spur based on the scores within the NPK budget and the more qualitative questions.

Energy and Carbon

The energy and carbon spur is spread over three separate worksheets:

1. The first worksheet focuses on the farm's own fuel and electricity use, recording both the total amount used and the amount attributed to the various farm enterprises: arable, beef and sheep, dairy, horticulture, pigs and poultry. Hectares of contract machinery work carried out are also recorded, with the fuel use per ha for the contactor operations being calculated from the Carbon Accounting for Land Managers (CALM) tool (CLA, 2010).

2. The second worksheet for this spur uses the energy and carbon benchmarks contained in the Centre for Alternative Land Use (CALU) booklet 'Managing Energy and Carbon (CALU and ADAS, 2007) to compare the farm's performance in terms of MJ of energy per head of livestock, or per hectare. Farms that use 0 to 50% of the 'typical energy use' for a farm of their type score 5, farms that use 50-75% of the benchmark sum score 4, 75-100% of the benchmark scores 3, 100-125% scores 2 and a total energy use figure of 125% or more of the benchmark figure scores 1.

An energy ratio, in terms of MJ (megajoules) of fossil fuel energy in, relative to MJ of energy out (ie: metabolisable energy or Kcal converted to MJ) is also provided for the different farming systems, with higher ratios (ie: greater than 7:1) scoring 5 and lower ratios (ie: less than 1:1) scoring 1. Energy values are based on "Feeding the Dairy Cow" (Chamberlain and Wilkinson, 1996) where possible, and the EASI tool (Smith and Woodward, 2010).

3. The final worksheet for this spur asks more qualitative questions regarding the farm's energy use. The first of these focuses on whether the farm records energy use or not and whether they have completed an energy efficiency audit – an average of these two scores is taken to provide an average score for the sub spur energy saving. A question on whether a farm has completed and is acting on a greenhouse gas assessment (eg: CALM (CLA, 2010), EASI) is then asked. The farmer is then asked whether there has been any significant land use change on their farm over the last 20 years (eg: conversion of woodland to arable, or arable to woodland), an n/a option may also be chosen for this question. Finally the farmer is asked what percentage of their energy use is from renewable sources and whether they have installed or are planning to install renewable energy generation on their holding.

An average of the scores for each of the sub spurs detailed above is then taken for all three spreadsheets, to provide an overall (average) score for the spur of Energy and Carbon.

Food Security

Total productivity

This asks the farmer to assess their yield compared with other farms of a similar type (to account for differences in yield between, for example, lowland and hill farms). The greater the yield is, the better the score.

Local food

This assesses whether the farm provides food for its local area or instead makes national or even international sales. Local sales score more highly as they increase local food security. The categories used are based on those used by Lobley *et al*. (2005a) in their report on "The Impact of Organic Farming on the Rural Economy in England".

Off-farm feed

The more animal feed the farm has to bring in from external sources the lower its score for this activity as this decreases food security as the farm is reliant on these other sources to continue its production.

Food quality awards

As with biodiversity awards, these are seen as evidence of third party recognition of the farm's ability to provide good quality food. The greater is the level of competition then the higher the score, therefore national awards score a 5.

Food quality certification

If the farm holds certification such as "farm assured", "global GAP (Good Agricultural Practice)" or organic certification then it scores more highly. The tighter the controls it faces then the greater the score.

Production of fresh produce

This activity is scored based on the answers to two questions. Firstly the amount of land used for the production of fresh fruit and vegetables, as a proportion of the utilisable agricultural area (UAA) is calculated. A greater proportion of the UAA used to produce fresh fruit and vegetables gives a higher score. Secondly, the amount of produce intended for human, as opposed to animal, consumption is asked. A higher amount intended for human consumption scores more highly as it provides greater food security.

Agricultural Systems Diversity

Rotational diversity

This activity assesses whether the farm has a diverse mix of crops or a very intensive mono-cultural cropping system, with higher scores given for very diverse crop rotations which are incorporated with livestock enterprises.

Number of crop varieties/species

The number of varieties/species grown is used to determine the diversity of the arable system at the farm, with 15 or more varieties/species scoring 5, and 1-3 varieties/species scoring 1. The justification for this being that more diverse cropping systems are more sustainable in the longer term (Döring and Wolfe, 2009).

Livestock diversity

Similarly for livestock, a more diverse system is seen as promoting a more bio-diverse and resilient farming system, therefore higher numbers of species, eg: 5 or more are scored more

highly. Numbers of breeds/crossbreeds are also scored in a similar manner to crops, with 5+ breeds/crossbreeds scoring 5 and 1 breed/crossbreed scoring 1.

Number of marketing outlets

This activity records the total number of outlets the farm uses to market its products, with higher scores being given to farms with a larger number of outlets (5 or more)

On farm processing

This is a yes/no question asking whether the farmer processes their own products on farm, thereby reducing transport and creating local employment. Farmers who do process on farm score 5, while those who do not score 1. An n/a option may also be chosen.

Social Capital

Employment

By providing employment a farm provides a benefit to its local area and allows its employees to continue to live in the rural community. This question asks how many staff are employees – casual, long-term and family – in Agricultural labour units (ALU)/100 hectares. The numbers given are compared with figures from Jeffreys *et al*. (2010) which looked at "labour use on organic farms". Employee numbers below the averages quoted by Jeffreys *et al*. (2010) score low and above average employment leads to a high score.

Skills and knowledge

This looks at the number of training days staff have had in total per year. A business which provides a high level of training provides a benefit to its employees and improves the overall skill-set of its community and therefore scores highly.

Community engagement

This activity is scored via four questions which assess different means of communicating with and engaging with the community. The first question asks how many visitor events are held on the farm. The second lists various methods of communication (information boards, farm visits, website, farm shop, farmers markets, research/demo, open days) and asks in which of them the farm is involved. The more methods of communication the farm uses the higher its

score will be. The third question asks the number of visitors through the farm gate and again higher numbers, suggesting a higher level of engagement, score more highly. The fourth question asks whether the farm has received awards for staff welfare or community engagement. As previously, national awards score the most highly as they involve competition from around the country.

Corporate social responsibility (CSR) initiatives and accreditations

If the farm has accreditations such as Investor in People (IIP), ISO14001 (Business Link, 2010) or similar, then it scores a 5. If it is currently working towards such accreditations then it scores 4. If it has policies in place (such as staff contracts, customer complaints procedures) but these are not externally audited then they score less highly. No CSR scores 1. A second question asks about membership of ethical trade schemes with membership scoring 5, working towards membership scoring 3 and no membership scoring 1.

Public access

This activity is assessed by means of three questions. The first question asks how much public access is provided. The greater is the level of access then the higher the score. The second question asks whether public access routes are maintained and the third whether they are promoted to the public. Thus the farm must not only have public access routes but actively encourage and allow their use to score highly for this form of public engagement.

Human health Issues

Given that farming is a higher risk industry these questions assess the working conditions for the farmer and their staff. The first question asks about the level of exposure to hazardous chemicals and the second asks whether a COSHH (Control of Substances Hazardous to Health) assessment (Health and Safety Executive, 2010) has been carried out. The third question asks about the farm's health and safety policies in general. The final question asks whether the farm is perceived as a positive working environment. For each of these questions a higher score is given where the answer indicates a safe, healthy working environment where all necessary policies and procedures are carried out.

Farm Business Resilience

Financial viability

Financial viability is assessed by asking the farmer what prices he is getting for a variety of common products and asking how the farm's net assets have changed in the last year. The prices that are being obtained are compared with prices for these products given in "2009 Organic Farm Management Handbook" (Lampkin *et al.*, 2008). If the farmer is only able to obtain prices below the standard prices quoted then a low score is achieved whereas if their prices are above those quoted then a high score is achieved. If the net assets of the farm have increased in the previous year then a higher score is achieved, if they have decreased then a lower score is given and if they show little or no change then 3 is scored.

Farm resilience

This activity is assessed by using six questions which indicate whether the farm is making sufficient money to survive in the long-term or whether it is likely to be unsustainable. The first question asks whether the farmer has been able to make all of the investment he would like to make, scoring higher if he has been able to do so. If the farm makes insufficient profit to make necessary investments in machinery, animals, etc then it will not be able to maintain its profits in the future and will continue to decline. The second question asks how many sources of farm income there are using examples from the OF0348 tool (Organic Research Centre, 2010) such as farm shop, farmers' market, website, farmers' co-operative, local mart. The more sources of income the farm has the higher it scores as this suggests that it is not overly reliant on one route and so is less vulnerable to any issues occurring within that one income stream. The third question asks how frequently the farmer reviews their business. If the business is reviewed regularly then any issues will be found earlier and can be dealt with before they become critical and so frequent reviewing scores highly. The fourth question asks the farmer to assess how their business is doing from "struggling" through to "booming" and the fifth question asks whether he expects to be in business next year – scoring 5 for "yes" and 1 for "no". The sixth question asks about the longer-term prospects for the business by enquiring as to whether the farmer believes that their land will still be farmed in the next decade.

Staff resources

This activity assesses whether there are sufficient people caring for livestock, whether they are adequately trained and whether they check on the animals frequently enough to ensure that any problems are identified and resolved quickly so as to ensure the health and welfare of the animals. The first question asked is the number of full time equivalents (FTEs) looking after various types of livestock. The figures given are compared with a calculated FTE per animal based on standard man days quoted in "The John Nix Farm Management Pocketbook 2010" (Nix, 2009). The higher is the number of FTEs compared with the standard amounts, the higher is the score. The second question asks how frequently livestock are inspected, with higher scores given for more frequent inspections. The third question asks whether stock-people are trained with highly trained stock-people resulting in a higher score.

Health plan

This activity firstly asks whether there is a health plan in place, scoring highly if there is one and it is regularly reviewed. The second question asks whether an external expert such as a vet or a consultant was involved in drawing it up. The final question lists conditions and their treatment or prevention and scores according to whether they are included in the health plan. If a condition is inapplicable to the type of livestock (e.g mastitis) then a n/a option is available to remove this condition from the score for the health plan.

Animal health

The first part of the questions for this activity asks how much is spent on veterinary care. A higher spend, indicating less healthy animals, scores lower. The advisor is given the ability, at their discretion to alter the scores to increase the score for farmers who have spent more but have done so on either homeopathic treatment or on prevention rather than treatment of illness as this shows a greater concern for their livestock's health and welfare. The amounts spent are compared with amounts quoted by farmers in the final report for OF0348 (Organic Research Centre, 2010) and with amounts obtained in the Farm Business Survey (2006) for organic farms, with the upper limit based on amounts given in the Farm Business Survey animal welfare module in 2005/06 (Animal Health and Welfare statistics Team DEFRA, 2006) (as these would have included conventional farms and so are likely to be higher than

veterinary costs for organic farming). The second question under this activity asks whether disease prevention is considered in breed/breeding stock selection, scoring highly where this is taken into consideration. The third question asks whether mortality/culling rates on the farm are below or above average with below average rates scoring highly. For dairy herds there are an additional two questions regarding longevity of animals and mastitis incidence compared with average. A n/a option is available on these questions to take them out of the scoring for all other livestock. For cattle and sheep farmers there is also a question about the incidence of lameness on the farm. Finally, the farmer is asked what methods they use to reduce parasite burden while minimising the use of anthelmintics and is scored highly for using a number of management methods including clean grazing and faecal egg counts.

Ability to perform natural behaviours

This activity is assessed by asking three questions. The first question asks whether outdoor grazing is restricted at any time of the year with unrestricted grazing scoring 5. The second question asks about daily access to the outdoors with unlimited, 24 hour access scoring 5. The third question asks the farmer to judge their animals' ability to perform three natural behaviours (based on the five freedoms (RSPCA, 2010c) – feeding, resting and social/comfort behaviour. If the animals are completely unrestricted in these behaviours then this receives the highest score. The more restricted they are then the lower the score.

Housing

The state of the livestock's housing is assessed through four questions. The first asks whether the housing and grazing comply with organic standards or are higher than standard. The second asks whether the housing design is first rate or in need of upgrading. The third question checks whether food and water are positioned so as to minimise the risk of contamination and the final question asks whether the farm has RSPCA "freedom foods" certification (RSPCA, 2010c) or organic certification, as some of the freedom foods standards, particularly with regard to stocking densities are more strict than the EU organic regulations (see specific RSPCA freedom foods guidelines for chickens, pigs, dairy cattle).

Bio-security

The bio-security activity can be seen as providing not just a public good in terms of animal health and welfare but also in terms of helping to ensure human health by minimising the risks of zoonoses. It is assessed by two questions. The first question asks whether there is a

bio-security plan in place giving a higher score if there is a plan and the measures are being taken. The second question asks how the farmer deals with new livestock coming onto the farm, with higher scores if the farm is a closed farm or applies quarantine procedures.

APPENDIX 4: ADDITIONAL TABLES OF RESULTS

Table 8: Individual activities with their mean, median, minimum and maximum scores and the standard deviation in those scores.

Spurs	Activities	Mean	Median	Minimum	Maximum	Standard Deviation
Biodiversity	Agri-environmental participation	3.4	3.0	1.0	5.0	1.2
	BAP habitat and SINCs	2.0	2.0	1.0	5.0	1.2
	SSSI	4.4	5.0	2.0	5.0	1.0
	BAP and rare species	4.2	5.0	1.0	5.0	1.1
	Conservation plan	3.4	4.0	1.0	5.0	1.8
	Awards	1.5	1.0	1.0	5.0	1.2
	Habitats	3.2	3.0	2.0	4.0	0.6
Landscape and Heritage	Historic Features	3.8	4.0	2.0	5.0	0.8
	JCA and landscape features	4.5	5.0	2.0	5.0	0.7
	Management of boundaries	3.4	4.0	1.0	5.0	1.0
Soil Management	Soil analysis	3.8	4.0	1.0	5.0	1.0
	Soil management	4.3	4.0	1.0	5.0	0.9

	Winter grazing	4.0	4.0	3.0	5.0	0.7
	Erosion	5.0	5.0	4.0	5.0	0.2
	Cultivation	3.8	4.0	2.0	5.0	1.1
Water Management	Reducing pollution	2.7	2.0	1.0	5.0	1.1
	Water management plan	2.4	1.0	1.0	5.0	1.8
	Water harvesting	2.3	2.0	1.0	5.0	1.4
	Irrigation	4.0	4.0	3.0	5.0	0.8
	Flood defences	4.2	4.0	3.0	5.0	0.9
Nutrient Management	NPK balance	3.1	3.0	1.0	4.0	1.0
	Manure management	3.3	3.0	1.0	5.0	0.8
	Disposal of farm waste	4.2	4.0	1.0	5.0	0.9
	Winter grazing	4.2	4.0	1.0	5.0	0.9
Energy and Carbon	Benchmarking	2.9	3.0	1.0	5.0	1.2
	Energy balance	3.1	3.0	1.0	5.0	1.4
	Energy saving options	3.1	3.0	1.0	5.0	1.3
	Greenhouse gases	2.6	3.0	1.0	5.0	1.3
	Land use change	3.8	4.0	2.0	5.0	0.7
	Renewable energy	2.7	2.0	1.0	5.0	1.1
Food security	Total Productivity	3.3	3.0	1.0	5.0	0.9
	Local food	3.6	5.0	1.0	5.0	1.7
	Off farm feed	4.1	4.0	1.0	5.0	1.0
	Food Quality	2.1	1.0	1.0	5.0	1.7

	Awards					
	Food Quality certification	5.0	5.0	5.0	5.0	0.0
	Production of fresh produce	2.2	1.5	1.0	5.0	1.3
Agricultural Systems Diversity	Cropland diversity	4.0	4.0	3.0	5.0	0.9
	Livestock diversity	3.4	4.0	1.0	5.0	1.1
	Marketing	3.7	4.0	1.0	5.0	1.3
	On-farm processing	2.8	1.0	1.0	5.0	2.0
Social Capital	Employment	2.2	2.0	1.0	5.0	1.3
	Skills and knowledge	2.8	3.0	1.0	4.0	1.0
	Community Engagement	2.5	2.0	1.0	5.0	1.4
	CSR (corporate social responsibility) initiatives and accreditations	2.3	2.0	1.0	5.0	1.4
	Public access	3.7	4.0	1.0	5.0	1.2
	Human Health issues	4.6	5.0	3.0	5.0	0.6
Farm Business Resilience	Financial viability	3.8	4.0	2.0	5.0	0.9
	Farm resilience	4.0	4.0	3.0	5.0	0.5
Animal Health and Welfare	Staff resources	3.8	4.0	3.0	5.0	0.6
	Health plan	4.6	5.0	2.0	5.0	0.8
	Animal health	4.3	4.0	3.0	5.0	0.6
	Ability to perform natural	4.4	4.0	3.0	5.0	0.6

	behaviours					
	Housing	3.9	4.0	3.0	5.0	0.4
	Biosecurity	4.1	4.0	1.0	5.0	1.2

Table 9: Results of the ANOVA on farm type giving the P-value for each spur and the mean scores for each farm type for each spur.

Spur	P-value	Means by Farm Type	Farm Type
Biodiversity	0.2399	3.18	Cereals
		2.49	Dairy
		3.22	general cropping
		3.30	beef and sheep
		2.95	Mixed
Landscape and Heritage	0.6557	3.70	Cereals
		3.81	Dairy
		4.10	general cropping
		4.02	beef and sheep
		4.13	mixed
Soil Management	0.5833	4.22	cereals
		4.17	dairy
		4.35	general cropping
		4.06	beef and sheep
		4.38	mixed
Water Management	0.4239	2.95	cereals
		2.50	dairy
		2.87	general cropping
		2.65	beef and sheep
		3.10	mixed
Nutrient Management	0.035	3.84	cereals
		3.63	dairy
		4.10	general cropping

		3.38	beef and sheep
		3.76	mixed
Energy and Carbon	0.0093	3.46	cereals
		2.83	dairy
		3.19	general cropping
		2.30	beef and sheep
		2.98	mixed
Food Security	0.0128	3.41	cereals
		2.86	dairy
		3.73	general cropping
		3.13	beef and sheep
		3.65	mixed
Agricultural Sys. Div.	0.7515	3.10	cereals
		3.21	dairy
		3.48	general cropping
		3.42	beef and sheep
		3.60	mixed
Social Capital	0.4876	2.91	cereals
		2.97	dairy
		3.47	general cropping
		2.85	beef and sheep
		3.25	mixed
Farm Bus. Res.	0.3612	3.78	cereals
		3.75	dairy
		4.20	general cropping
		4.13	beef and sheep
		3.81	mixed
Animal Health and Welfare	0.7496	4.33	cereals
		4.08	dairy
		4.32	general cropping
		4.15	beef and sheep
		4.12	mixed

Table 10: Results of the ANOVA over advisor showing the p-value for each spur and the mean score for each spur for each advisor.

Spur	P-value	Mean per Advisor	Advisor
Biodiversity	0.4209	2.5	Gerard Dinnage
		3.0	Martin Davies
		3.3	Mike Tame
		3.0	Phil Stocker
		3.1	Phil Sumption
		3.2	Stephen Briggs
		2.9	Steve Merritt
		2.5	William Waterfield
Landscape and Heritage	0.578	4.2	Gerard Dinnage
		3.7	Martin Davies
		4.2	Mike Tame
		3.8	Phil Stocker
		4.0	Phil Sumption
		3.4	Stephen Briggs
		4.1	Steve Merritt
		3.8	William Waterfield
Soil Management	0.9307	4.3	Gerard Dinnage
		4.1	Martin Davies
		4.4	Mike Tame
		4.1	Phil Stocker
		4.2	Phil Sumption
		4.2	Stephen Briggs
		4.0	Steve Merritt
		4.3	William Waterfield
Water Management	0.0014	2.4	Gerard Dinnage
		2.6	Martin Davies
		3.4	Mike Tame

		3.5	Phil Stocker
		2.8	Phil Sumption
		2.3	Stephen Briggs
		4.0	Steve Merritt
		2.0	William Waterfield
Nutrient Management	0.5379	3.6	Gerard Dinnage
		3.7	Martin Davies
		3.8	Mike Tame
		3.8	Phil Stocker
		3.9	Phil Sumption
		3.9	Stephen Briggs
		3.4	Steve Merritt
		3.7	William Waterfield
Energy and Carbon	0.00034	2.3	Gerard Dinnage
		2.3	Martin Davies
		2.8	Mike Tame
		3.4	Phil Stocker
		3.0	Phil Sumption
		3.8	Stephen Briggs
		3.6	Steve Merritt
		2.7	William Waterfield
Food Security	0.0008	3.0	Gerard Dinnage
		3.1	Martin Davies
		3.1	Mike Tame
		3.3	Phil Stocker
		4.1	Phil Sumption
		3.5	Stephen Briggs
		3.9	Steve Merritt
		2.9	William Waterfield
Ag Systems Diversity	0.1625	3.2	Gerard Dinnage
		3.7	Martin Davies
		3.2	Mike Tame

		3.8	Phil Stocker
		3.5	Phil Sumption
		2.8	Stephen Briggs
		4.3	Steve Merritt
		3.3	William Waterfield
Social Capital	0.0204	2.2	Gerard Dinnage
		3.4	Martin Davies
		2.7	Mike Tame
		3.0	Phil Stocker
		3.5	Phil Sumption
		3.1	Stephen Briggs
		3.5	Steve Merritt
		2.8	William Waterfield
Farm Business Resilience	0.0067	3.2	Gerard Dinnage
		4.3	Martin Davies
		3.9	Mike Tame
		3.75	Phil Stocker
		4.2	Phil Sumption
		3.9	Stephen Briggs
		4.4	Steve Merritt
		3.7	William Waterfield
Animal Health and Welfare	0.5903	4.0	Gerard Dinnage
		4.2	Martin Davies
		4.4	Mike Tame
		4.1	Phil Stocker
		4.3	Phil Sumption
		4.3	Stephen Briggs
		4.4	Steve Merritt
		4.0	William Waterfield

Table 11: Results of the ANOVA over tenancy status showing the p-value for each spur and the mean score per type of tenancy/ownership for each spur.

Spur	P-value	Mean for Status	Status

Biodiversity	0.72513	3.2	tenant <=5 years
		2.6	tenant >=5 years
		3.0	owner occupier
		3.0	successional tenant
Landscape & Heritage	0.0717	3.5	tenant <=5 years
		3.5	tenant >=5 years
		4.1	owner occupier
		3.6	successional tenant
Soil Management	0.7584	4.2	FBT<=5 years
		4.0	FBT>=5 years
		4.2	owner occupier
		4.2	successional tenant
Water Management	0.3144	2.4	FBT<=5 years
		2.5	FBT>=5 years
		2.9	owner occupier
		3.5	successional tenant
Nutrient Management	0.371	3.9	FBT<=5 years
		3.9	FBT>=5 years
		3.6	owner occupier
		3.8	successional tenant
Energy & Carbon	0.5553	3.0	FBT<=5 years
		2.5	FBT>=5 years
		3.0	owner occupier
		2.9	successional tenant
Food Security	0.3453	3.6	FBT<=5 years
		3.8	FBT>=5 years
		3.3	owner occupier
		3.2	successional tenant
Ag Sys Diversity	0.3067	3.6	FBT<=5 years
		2.8	FBT>=5 years
		3.6	owner occupier
		3.2	successional tenant

Social Capital	0.2828	2.5	FBT<=5 years
		3.4	FBT>=5 years
		3.0	owner occupier
		2.8	successional tenant
Farm Business Resilience	0.1048	3.6	FBT<=5 years
		4.1	FBT>=5 years
		4.0	owner occupier
		3.4	successional tenant
Animal Health & Welfare	0.2836	3.8	FBT<=5 years
		4.3	FBT>=5 years
		4.2	owner occupier
		4.3	successional tenant

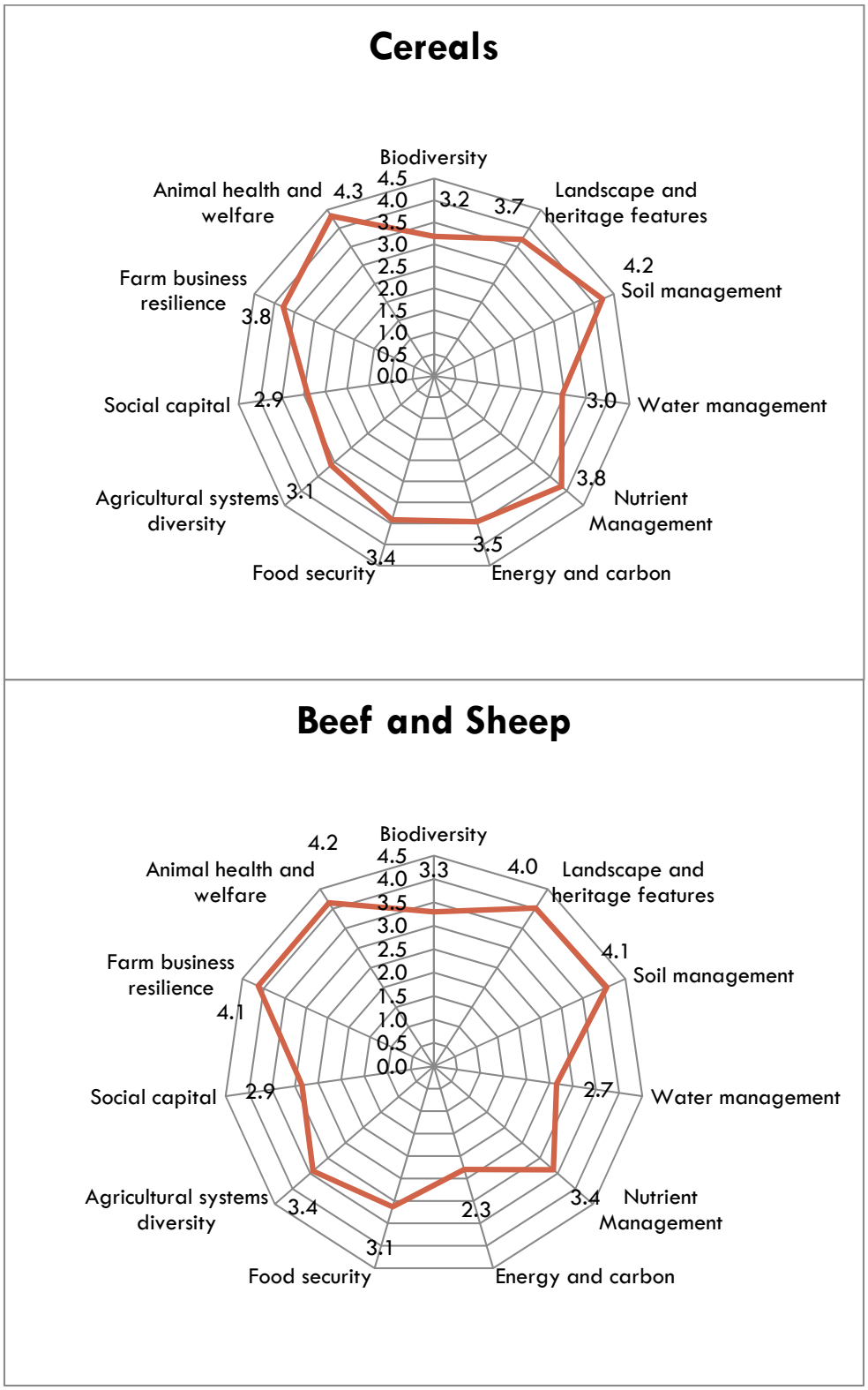
Table 12: Results of the ANOVA over how long the farm has been fully organic showing the p-values for each spur and the means for each spur for each time category.

Spur	P-value	Mean over Time	Time
Biodiversity	0.307	2.9	<=2 years
		2.8	3-4 years
		2.7	5-8 years
		3.4	9-10 years
		3.2	11-44 years
Landscape and Heritage	0.2265	3.5	<=2 years
		4.0	3-4 years
		3.9	5-8 years
		3.9	9-10 years
		4.3	11-44 years
Soil Management	0.3093	4.1	<=2 years

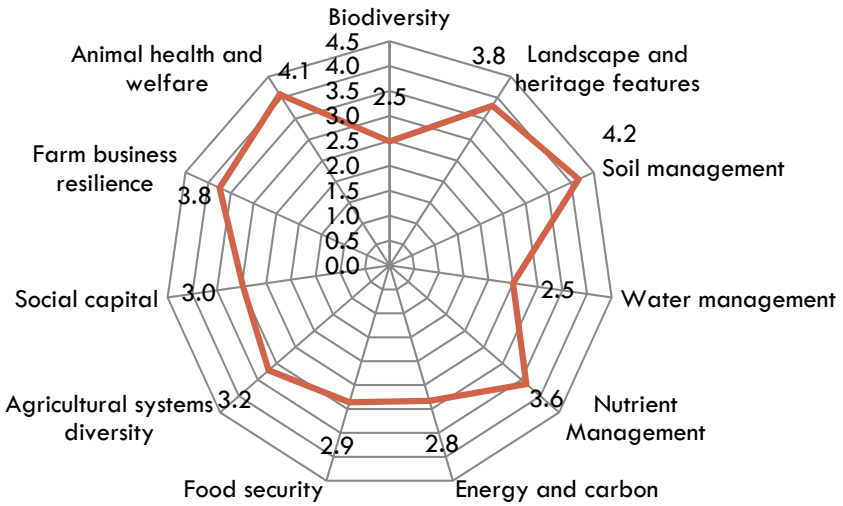
		4.4	3-4 years
		4.3	5-8 years
		4.0	9-10 years
		4.1	11-44 years
Water Management	0.0223	2.1	<=2 years
		2.8	3-4 years
		3.1	5-8 years
		2.8	9-10 years
		3.6	11-44 years
Nutrient Management	0.3907	3.7	<=2 years
		3.9	3-4 years
		3.7	5-8 years
		3.5	9-10 years
		3.5	11-44 years
Energy and Carbon	0.3967	2.7	<=2 years
		2.9	3-4 years
		3.2	5-8 years
		2.7	9-10 years
		3.3	11-44 years
Food Security	0.3195	3.4	<=2 years
		3.3	3-4 years
		3.4	5-8 years
		3.1	9-10 years
		3.8	11-44 years

Agricultural Systems Diversity	0.1238	2.9	<=2 years
		3.1	3-4 years
		3.8	5-8 years
		3.6	9-10 years
		3.7	11-44 years
Social Capital	0.7428	2.9	<=2 years
		3.1	3-4 years
		3.3	5-8 years
		2.8	9-10 years
		3.0	11-44 years
Farm Business Resilience	0.9747	3.9	<=2 years
		3.9	3-4 years
		3.8	5-8 years
		4.0	9-10 years
		3.8	11-44 years
Animal Health and Welfare	0.7254	4.0	<=2 years
		4.2	3-4 years
		4.3	5-8 years
		4.2	9-10 years
		4.1	11-44 years

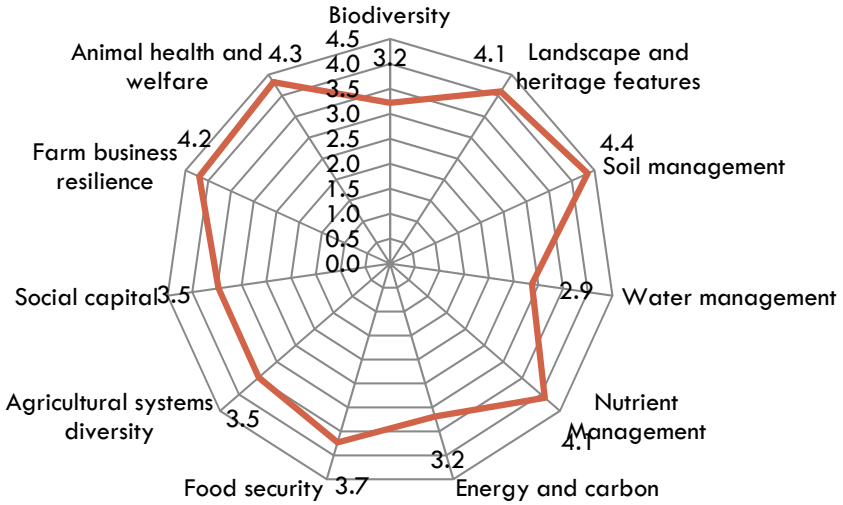
APPENDIX 5: RADAR DIAGRAMS FOR EACH FARM TYPE SHOWING THE MEAN SCORES

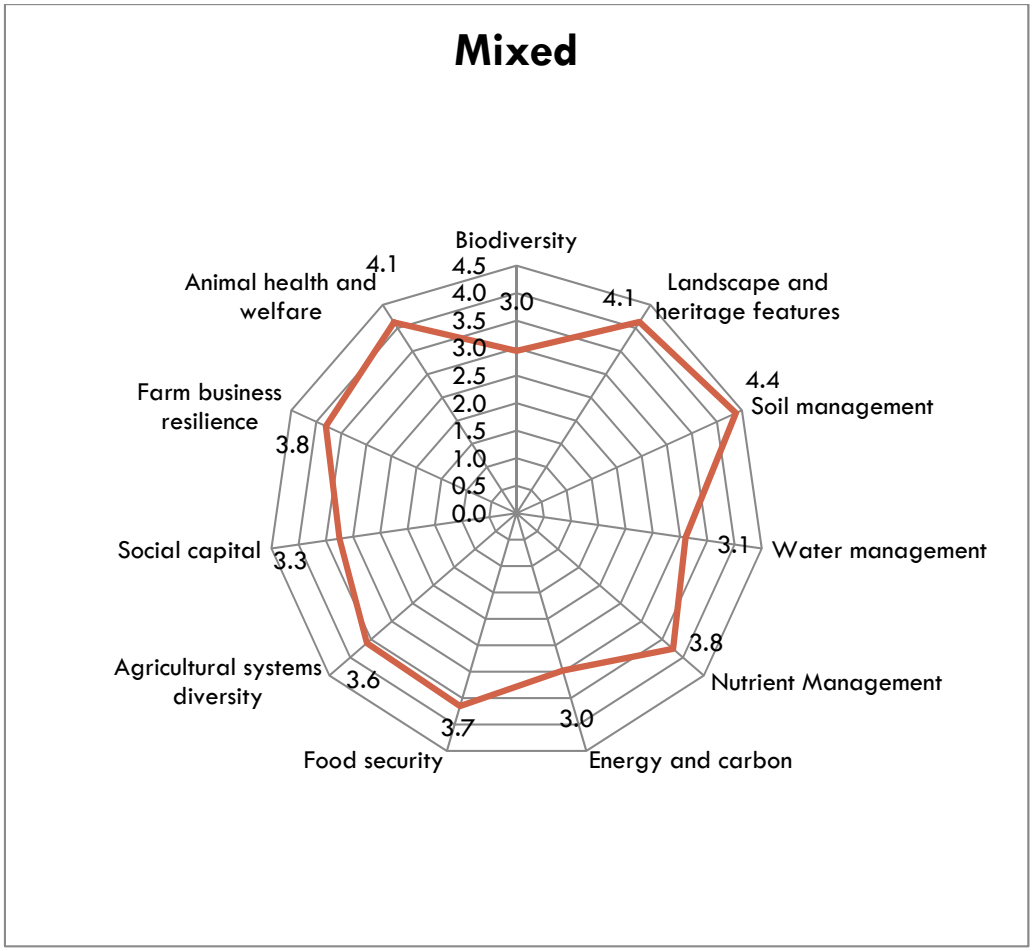


Dairy



General Cropping




Mixed
Biodiversity
3.0
Landscape and heritage features
4.1
Soil management
4.4
Water management
3.1
Nutrient Management
3.8
Energy and carbon
3.0
Food security
3.7
Agricultural systems diversity
3.6
Social capital
3.3
Farm business resilience
3.8
Animal health and welfare
4.1
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

APPENDIX 6: RESULTS OF FARMER FEEDBACK

gender	male	female	male	male	male	male		male	male	male	male	male
age range	40+	40+	40+	40+	40+	25-40		25-40	40+	40+	40+	25-40
farming activities	cattle/sheep, mixed	cattle/sheep	cattle/sheep, horses	cattle/sheep, pigs/poultry	mixed farming	horticulture	horticulture	mixed	mixed	mixed	cereals	Arable with roots
farm size	101-200	21-50	>300	>300	101-200ha	<10	10-20ha	>300	>300	101-200	101-200	101-200
land classification	lowland	lowland	lowland	lowland	lowland	lowland	lowland	lowland	lowland	lowland	lowland	
agri-env scheme	OELS	no	HLS	HLS	CSS	OELS	OELS	OELS	OELS	yes	OELS, CSS	
quality of previsit information	excellent	excellent	excellent	excellent	good	excellent	excellent	excellent	Good	good	Excellent	Excellent
ease of unerstanding of principles	good	good	good	fair	fair	excellent	good	excellent	Fair	good	Excellent	Excellent
length of time taken	good	fair	fair	fair	fair	fair	good	good	Fair	fair	good	fair
quality of questions	good	good	fair/poor	poor/excellent	good	good	fair	fair	Good	fair	fair	good
opportunity to ask questions	good	excellent	good	excellent	excellent	excellent	excellent	good	excellent	excellent	excellent	good
reporting format	good	fair	good	excellent	good	good	excellent	good	Good	good	good	good
value to business	above average	above average	below average	too soon to tell	above average	high	above average	high	below average	high	above average	above
was the information relevant	yes	partly	yes	Yes and no	partly	partly	yes	yes	Yes	partly	partly	yes
ID strong and weak	partly	partly	yes	partly	partly	partly	partly	yes	yes	yes	yes	yes

areas												
improved understanding	yes	yes	yes	partly	partly	partly	yes	yes	Yes	yes	yes	yes
increased understanding of OELS	Yes	no	yes	no	no	partly	partly	yes	Yes	yes	yes	yes
helps to demonstrate to wider community	Partly	partly	partly	of little use	yes	yes	yes	yes	No	yes	partly	yes
knowledge and understanding of Public Goods pre-assessment	4	4	5	10	9	9	7	8	2	7	7	4
knowledge and understanding of Public Goods post-assessment	6	6	9	10	9	9	8	9	8	8	9	10
would you recommend it		yes	no	not yet	yes	yes	yes	yes	Yes	yes	yes (if modified)	yes
do you think it should become web based		no	no	no	no	yes	yes	yes	yes (if streamlined)	yes	yes	yes

APPENDIX 7: CONSOLIDATED ADVISOR FEEDBACK

Initial data collection sheet

- Additional options are required for:
  - Agri-environment scheme land (ie field margins, wild bird mixtures),
  - Fallow land,
  - Game-cover/ game crop,
  - Other cereals/crops (e.g spelt, vetch),
  - Better classification of forage/green manures,
  - Feeds of different protein contents,
  - Minerals/feed-blocks.
  - Sand/lime
- Need to specify period to be covered by the assessment or leave a box for dates (ie which 12 months).
- Owner/tenant question should ask which is predominant as some farmers are both.
- Need a way of recording tack cattle/tack grazing
- May require a way of recording stock deaths.

Biodiversity

- Hedges – the question about new hedges penalises farmers who had the foresight to plant hedges some years ago and so there is a need to allow them to score highly too. Need to take into consideration in scoring hedge maintenance the fact that some hedges require to have as little interference as possible and therefore are not maintained. Also, need to consider whether hedges are inappropriate in some areas of the country and include other boundary options (here as well as in the Landscape and Heritage spur).
- Habitats – similarly to the issue with hedges, the question regarding creation of habitats needs to be extended to score highly for people who did so some time ago.
- "in-field options" – these are felt to be inappropriate for all-grass farms with species-rich permanent pasture and so a n/a option was suggested.

- Whether or not a farm has a BAP is outside its control so it is suggested that this is replaced by a question about whether the farm is undertaking measures to improve biodiversity.
- The question regarding native woodland may need to be reconsidered. At present it is scored according to the proportion of total farm area that is native woodland. It has been suggested that it may be better to score based on the proportion of woodland present that consists of native trees, allowing a n/a score for farms without woodland. This would prevent disadvantaging farms in areas, for example Norfolk, where woodland is not in keeping with the local environment.

Landscape and Heritage

- Faster access to the definition of HEV boundaries was requested – to look into providing this either as a hot link to the Natural England web page or copying the definition into a separate excel sheet within the tool.

Water Management

- To consider scoring options for fen farms whose ditches are under the control of the internal drainage board – may require n/a options to prevent low scoring for management decisions which are out of the farmer's control.
- Some advisors felt that farms that carry out no irrigation obtained lower overall scores for this spur than farms that carried out some irrigation – to consider whether, instead of using a n/a option for farms with no irrigation, a higher score for farms that do not irrigate.

Soil Management

- To look again at definitions of bare ground, in particular whether stubble does provide some protection.
- Consider providing n/a options for all-grass farms on some questions e.g erosion, soil testing.

Nutrient Management

- Additional options have been suggested for the manure storage/management/application questions.

- Need to split permanent pasture into different categories depending on the amount and type(s) of clover present as these have different nitrogen characteristics.
- Some farms appear to have a greater nitrogen surplus than they expected – to look into nutrient data to ensure figures are reasonable and consider reasons for these surpluses.

Energy and Carbon

- Set up percentages and scores to calculate automatically (using "if" functions available in excel) to remove human error.
- Add a general "estate maintenance" category if benchmark data for it can be sourced.
- Consider whether it is possible to source benchmarks for farms which process on-site.
- Consider the likely reason for the higher than benchmark energy use in organic beef and sheep farms and consider whether organic benchmarks could/should be used.
- All enterprises score equally on the benchmarking activity but some may have very little significance to the farm as a whole so it may be necessary to consider weighting towards the main farm enterprise.

Food Security

- Awards – these are seen as an unfair question by some farmers/advisors. It is required to discuss this issue further as they do give third party evidence (particularly useful in the light of the general comments on the tool regarding the temptation for farmers to manipulate their results).

Agricultural Systems Diversity

- This question is perceived as disadvantaging herds/flocks of traditional/rare/pedigree animals. Consider a way of scoring these more highly.
- Clarification is required as to whether the crop species question includes the different species within a grass seed mixture.

Social Capital

- Employment question – clarify whether the farmer is included in the labour figures and consider whether farm shop staff should be included.
- Some comments have been made suggesting that no farms hold IIP or are members of ethical trade schemes. Based on the scores for other farms within this pilot, however, some farms are members of ethical trade scheme and this may be something others should aspire towards.

Farm Business Resilience

- Include benchmarks for “contract prices” e.g for table chickens as these are usually lower.
- It has been suggested that other sources of income such as tourism, energy production, business unit lets, equine businesses should be included in this spur. To consider whether to include these as they are, for many farms, an important source of income but may not reflect the **farm** business resilience (or may suggest that there is insufficient profit for the farm to continue simply as a farm) and also they may have impact on other areas of the assessment if included here.

Animal Health and Welfare

- Look into how to remove the entire spur for livestock-less farms, in particular with regard to the spider’s web diagram on the results sheet.
- Add staffing levels for table birds as well as laying birds.
- Have the veterinary spend question input the total for the year and automatically calculate vet spend per livestock unit for scoring purposes.
- Modify the animal health plan questions so that they are less dairy-orientated and give guidance as to when the n/a option should be used in answering these questions.

APPENDIX 8: RAW DATA

Spur	**Farm1**	**Farm2**	**Farm3**	**Farm4**	**Farm5**
Biodiversity	3.3	2.5	2.0	2.8	3.7
Landscape and heritage features	2.7	4.3	3.5	4.0	3.7
Soil management	4.3	3.8	3.3	4.3	4.3
Water management	2.5	3.0	2.0	4.0	3.0
Nutrient Management	4.0	3.0	4.0	3.8	3.8
Energy and carbon	3.0	3.2	2.2	2.0	2.3
Food security	4.2	3.0	3.7	3.0	3.0
Agricultural systems diversity	4.0	3.5	2.7	2.0	3.3
Social capital	3.3	3.2	2.8	2.2	2.2
Farm business resilience	4.0	4.0	4.5	4.0	4.0
Animal health and welfare	3.8	4.0	n/a	4.5	4.3
Spur	**Farm6**	**Farm7**	**Farm8**	**Farm9**	**Farm10**
Biodiversity	2.2	3	1.5	3	1.8
Landscape and heritage features	4.5	4.5	3	3.7	4.5
Soil management	4.0	4.3	4	4	4.8
Water management	3.0	3	2	2	2.0
Nutrient Management	3.8	4.3	2.8	4	3.8
Energy and carbon	3.0	3.2	2	2.3	2.2
Food security	3.2	3.3	2.7	2.3	2.2
Agricultural systems diversity	2.8	3.3	3.3	2.8	3.3
Social capital	2.8	3.7	2.2	2.3	1.8
Farm business resilience	3.5	4	3.5	3.5	2.5
Animal health and welfare	4.3	4.2	3.8	4	4.5
Spur	**Farm11**	**Farm12**	**Farm13**	**Farm14**	**Farm15**
Biodiversity	2.6	2.8	4.5	2.3	3.5
Landscape and heritage features	5.0	3.5	4.0	3.7	4.7
Soil management	4.5	3.0	4.3	4.8	4.8
Water management	5.0	3.5	3.0	1.0	4.8
Nutrient Management	3.5	3.5	3.8	3.3	3.8
Energy and carbon	3.3	3.5	3.3	2.5	3.7

Food security	3.5	3.8	3.8	2.7	4.5
Agricultural systems diversity	2.8	4.3	3.8	3.3	5.0
Social capital	3.3	3.2	3.3	2.7	4.7
Farm business resilience	4.0	4.5	3.5	3.5	4.5
Animal health and welfare	4.5	4.3	4.3	4.0	4.3
Spur	**Farm16**	**Farm17**	**Farm18**	**Farm19**	**Farm20**
Biodiversity	2.5	3.8	3.5	3.3	2.5
Landscape and heritage features	4.5	4.3	2.5	3.0	3.0
Soil management	4.0	4.0	4.0	4.3	4.5
Water management	2.0	3.0	2.0	2.0	3.0
Nutrient Management	3.8	3.0	3.8	4.0	3.8
Energy and carbon	3.0	3.5	3.3	3.5	2.8
Food security	3.5	3.8	3.5	3.8	2.3
Agricultural systems diversity	4.0	4.3	3.3	3.0	2.8
Social capital	1.8	4.2	3.2	2.7	3.3
Farm business resilience	2.5	4.5	3.5	4.0	3.5
Animal health and welfare	3.3	4.3	n/a	n/a	4.3
Spur	**Farm21**	**Farm22**	**Farm23**	**Farm24**	**Farm25**
Biodiversity	3.5	3.0	2.3	3	4.4
Landscape and heritage features	4.5	4.0	4.0	4	4.0
Soil management	4.3	4.0	4.3	4	4.8
Water management	3.2	2.3	2.3	3.3	3.5
Nutrient Management	3.8	3.5	3.8	3.5	4.0
Energy and carbon	3.0	2.3	2.3	3.3	3.3
Food security	3.2	2.7	4.0	4.2	4.2
Agricultural systems diversity	4.3	3.3	2.0	4.8	3.3
Social capital	3.2	2.5	3.7	3.7	3.0
Farm business resilience	4.0	4.0	3.5	4	5.0
Animal health and welfare	4.0	4.2	n/a	4.5	3.7
Spur	**Farm26**	**Farm27**	**Farm28**	**Farm29**	**Farm30**
Biodiversity	3.9	3.2	2.9	3.5	3.3
Landscape and heritage features	4.3	4.5	3.7	4.7	4.3
Soil management	4.5	4.3	3.5	5.0	4.3
Water management	3.0	2.5	5.0	3.5	2.0
Nutrient Management	4.3	2.8	3.5	4.5	3.5
Energy and carbon	3.8	1.7	3.0	4.3	3.7
Food security	4.3	3.2	3.5	2.5	3.2

Agricultural systems diversity	4.8	2.0	3.0	4.8	3.5
Social capital	4.3	2.2	2.0	3.5	3.7
Farm business resilience	4.0	3.5	3.0	4.0	4.0
Animal health and welfare	4.8	3.7	n/a	4.5	4.3
Spur	**Farm31**	**Farm32**	**Farm33**	**Farm34**	**Farm35**
Biodiversity	3	2.7	2.7	4.0	3.2
Landscape and heritage features	3.7	4.0	2.7	5.0	4.0
Soil management	4	4.4	4.5	3.5	3.6
Water management	3.7	3.5	1.7	2.7	2.0
Nutrient Management	4.3	4.3	4.0	3.3	3.0
Energy and carbon	4.2	2.0	2.2	2.2	2.2
Food security	3.5	3.8	3.2	3.0	3.2
Agricultural systems diversity	1.7	3.3	4.5	4.0	4.0
Social capital	3.3	4.0	3.2	4.0	2.5
Farm business resilience	3.5	5.0	4.0	4.5	4.5
Animal health and welfare	n/a	4.3	4.2	4.5	3.5
Spur	**Farm36**	**Farm37**	**Farm38**	**Farm39**	**Farm40**
Biodiversity	2.0	4.3	2.8	2.4	2.0
Landscape and heritage features	3.7	4.3	3.7	4.3	3.0
Soil management	4.5	5.0	4.3	4.5	3.8
Water management	3.0	4.0	1.7	2.0	3.7
Nutrient Management	4.0	3.8	4.0	4.0	3.0
Energy and carbon	2.5	3.7	4.3	3.5	3.8
Food security	3.3	3.3	3.3	3.5	4.0
Agricultural systems diversity	3.3	3.5	2.3	3.8	5.0
Social capital	2.5	3.0	2.7	3.2	2.2
Farm business resilience	3.5	4.0	4.5	4.0	4.5
Animal health and welfare	4.3	4.7	n/a	4.2	n/a

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