Sustainability Assessment: The Case for Convergence

NOVEMBER 2017
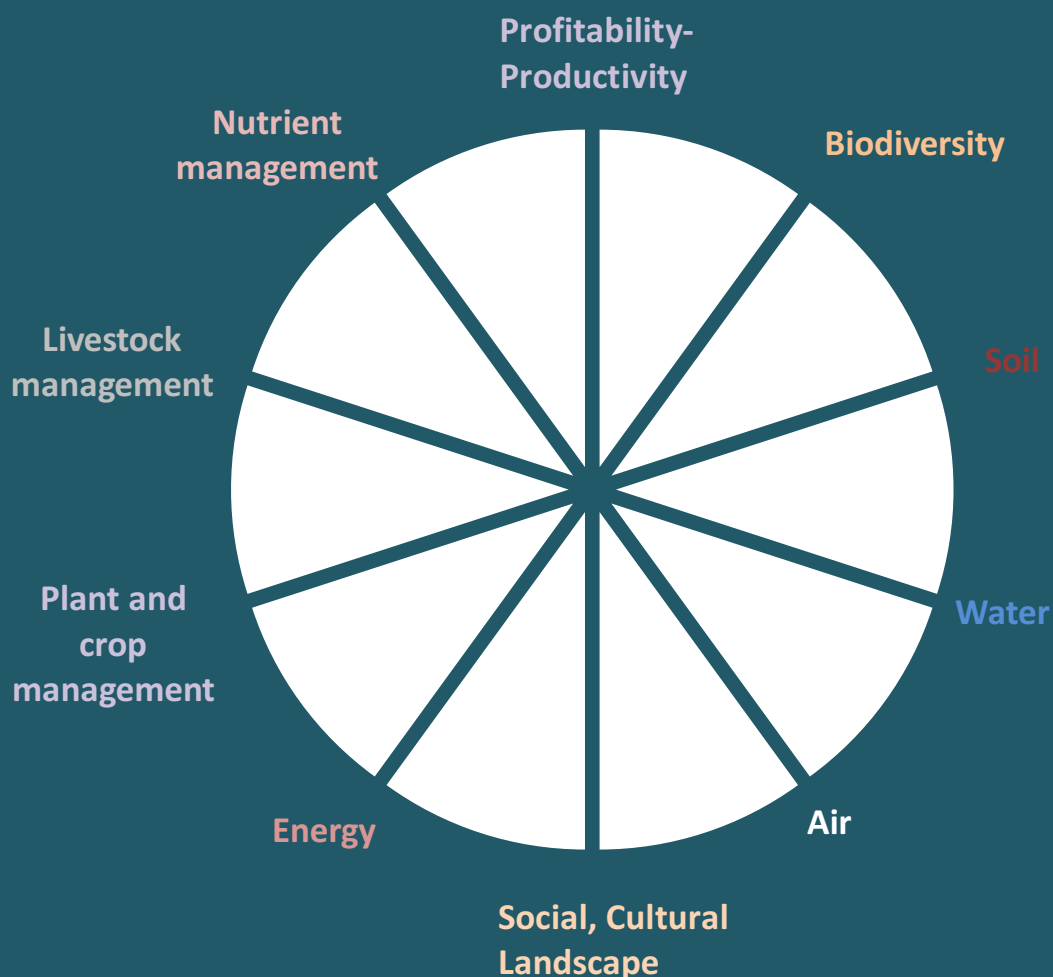
Profitability-Productivity

Nutrient management

Biodiversity

Livestock management

Soil

Plant and crop management

Water

Energy

Air

Social, Cultural Landscape

Sustainability Assessment, The Case for Convergence

Executive Summary

At present, all farmers and land managers are required to submit multiple and overlapping audits to government agencies, food companies and certifiers each year. Most of these schemes use different categories of assessment, metrics and units of measurement, and can be expensive, bureaucratic and time consuming to complete. They also make it impossible for consumers, farmers, food businesses and policymakers to gain an accurate understanding of the comparative sustainability of products resulting from different methods of production.

To address this, the Sustainable Food Trust convened a working group consisting mainly of farmers and land managers, but also including representation from government agencies, research institutions, assurance schemes and major food companies, to assess the opportunity for achieving convergence between existing sustainability assessment tools.

Our aim is to facilitate the development of an integrated sustainability and productivity assessment tool, providing common data which would allow:

- Farmers to monitor continuous environmental, social and economic performance year on year
- Governments to assess eligibility for public support payments
- Food companies to assess the sustainability of the products they source
- Citizens to better understand the story behind their food

To achieve this, we decided to commission independent research consultants to undertake a gap analysis of existing schemes, then using our own farms, assess the degree of overlap and discrepancy of the range of current sustainability tools.

The results of this analysis are presented in this report. We believe that this study demonstrates a significant opportunity for convergence by identifying the best features of the existing tools and where there is scope for further harmonisation.

Such a uniformed scheme has the potential to be used by government agencies (including Defra and the RPA), food companies, certifiers and auditors, as well as by farmers to help make management decisions. Common data could also be used to help improve transparency in the market place and empower consumers to use their buying power to support the farming systems they would like to see.

Signed by:

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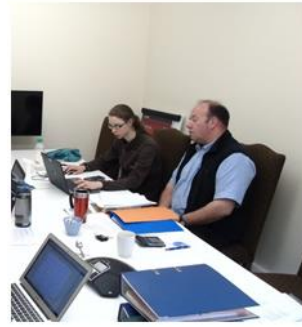Chief Executive
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Sustainability Assessment: the need for convergence

Sustainability Metrics: the case for convergence

Final project report

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Christian Schader, Moritz Teriete and Simon Moakes at FiBL (SMART)

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Jan Grenz at Bern University of Applied Sciences (RISE)

Tobias Bandel at Soil and More Foundation (Soil and More Sustainability Flower)

Report summary

A growing interest in sustainable food systems has been matched by a sharp increase in the development and application of sustainability assessment tools, designed for use within the food and farming sectors. Although the various tools can differ widely, there are considerable similarities in terms of the type(s) of tools and data collected. At the same time, farmers operating in the UK are already providing information that could feed into sustainability assessments for statutory reporting (e.g. as part of certification, basic payment or agri-environment scheme participation). Recognising the inefficiency of this approach, a group of farmers and land managers have come together with the Sustainable Food Trust to identify opportunities for convergence between multiple tools and data collection frameworks. The group aims to address the low uptake of farm-level sustainability assessment by making the evaluation process as efficient and user-friendly as possible. Unlike many other initiatives, the group holds farmer interests at its core. The recommendations therefore come from farmers and land managers directly.

The Sustainable Food Trust, with support from the Rothschild foundation, contracted the Organic Research Centre to produce a report as a foundation for their work to bring consensus in, and mainstream, sustainability in farming. This report aims to ascertain the opportunities for making farm-level sustainability assessment processes as efficient as possible. It addresses this by identifying the opportunities for convergence across various tools, indicators and data collection methods.   The report also identifies the types of data needed for the completion of farm-level sustainability assessments by comparing the requirements of a range of tools[1]. In addition, the results from on-farm trials of sustainability assessment tools are presented, with a particular focus on farmer feedback concerning the desirable/less-desirable features of each tool's approach. The report additionally determines what farmers are looking to obtain through the use of such tools. It is only by meeting such criteria that assessment processes will ever become desirable and useful and move towards becoming part of the mainstream.

Findings

- There is a **general agreement on the broad subject areas** that should be considered as part of sustainability. However, the **specific indicators used and data collected by tools varies** widely.
- Much of the **data utilised within sustainability assessments is already recorded in some form** in farm management software packages, government submissions and industry benchmarking services. The economic area overlaps with farm accounts and it is likely that data commonalities also exist with certification and audit schemes.
- **Automated data extraction and transfer is technologically feasible** and is currently being explored both in the public domain (e.g. by the Cool Farm Alliance with the SAI platform) and privately (Reed International - *pers. comm.* April 2017). However, the divergence of indicators and underlying data, and the lack of accepted definitions for data points, prevents the simple transfer of data from one tool to another. This also **restricts the application of transfer technology**. This is likely to be even more apparent when transferring across tools from different disciplines (from agronomy to accounting, for example).
- A **common protocol** for the inclusion of sustainability metrics within assessment tools would permit greater convergence and transferability.
- Most of the tools tested were not designed for self-completion. Despite this, there was a general consensus that once an initial assessment had been completed, farmers would feel **confident completing it themselves in following years**.

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[1] The Cool Farm Tool (CFT) biodiversity and greenhouse gas modules, the PG Tool, RISE, SMART and the Soil and More Sustainability Flower.

- A preference for **quantitative indicators that can be measured accurately** is apparent. There is a core underlying desire to receive comprehensive, accurate assessments of the farm, even if this would incur increased complexity and time investment.
- The desire for accurate assessment links to the wish to **compare performance with other farms and track self-improvement** year-on-year.
- The tools that had a **management perspective and provided guidelines** for improving practices were preferred, and although in some cases the reports generated were considered to be very long, the option to delve into detail was appreciated and reported as particularly useful.
- Many sustainability assessments lack **data core to the viability of the farm business** - yields, productivity, financial indicators, etc. They can miss the fundamental requirements of a farm: first to produce food (or biomass), and second to survive as a business, and can overlook an assessment of the likely implications of any changes on the business viability.
- **Transparency and relevance** is crucial if farmers are to trust and act on outputs. Ambiguity in terminology and framing of the assessments, use of language irrelevant to the farmer and a lack of justification for inclusion/exclusion of particular themes or indicators are problems found in many assessments.

In summary, although there is a general agreement in the areas that should be covered across a range of tools and frameworks, there is much opportunity for further alignment. Several initiatives addressing the 'interoperability' of tools are already underway. If interoperability could be achieved between an almost-universal tool (e.g. providing data required for subsidy applications) and other, optional assessments, uptake and use of these optional assessments could conceivably increase. The development of interoperability would, however, be facilitated through greater alignment in tool inputs and their formats.

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LIST OF ABBREVIATIONS

AHDB	Agriculture and Horticulture Development Board
CALM	Carbon Accounting for Land Managers
CAP	Common Agricultural Policy
CFT	Cool Farm Tool
CSR	Corporate Social Responsibility
ESA	Ecosystem Service Assessment
EU	European Union
FAO	Food and Agriculture Organisation
FLINT	Farm Level Indicators for New Topics in policy evaluation project
GHG	Greenhouse Gases
HSE	Health and Safety Executive
InVEST	Integrated Evaluation of Ecosystem Services and Tradeoffs
IPCC	Intergovernmental Panel on Climate Change
LCA	Lifecycle Assessment
LEAF	Linking Environment And Farming
MASC	Multi-attribute Assessment of the Sustainability of Cropping systems
MCA	Multi-Criteria Analysis
PG	Public Goods
RISE	Response Inducing Sustainability Evaluation
SAFA	Sustainability Assessment of Food and Agriculture Systems
SAI	Sustainable Agriculture Initiative
SEEA	System of Environmental-Economic Accounting
SFT	Sustainable Food Trust
SMART	Sustainability Monitoring and Assessment RouTine
SOLID	Sustainable Organic and Low Input Dairying project
TBL	Triple Bottom Line
UNSD	United Nations Statistics Division

Introduction

UK agriculture is at a point of transition. With the exit of the UK from the European Union, there is an opportunity to completely re-write domestic agricultural policy to better reflect the value provided by farming and its place within society. Rewarding and incentivising 'sustainable' agriculture is viewed as being particularly important in this context, with sustainability interpreted as "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland *et al.*, 1987). However, there are many divergent views how the concept of sustainability should be applied to agriculture.

This is reflected in the many different sustainability assessment tools and frameworks that are currently available for use within agriculture. These tools include those used for certification schemes (e.g. LEAF Marque, farm assurance), those used by retailers (e.g. for carbon footprinting and CSR purposes) and separate assessment frameworks used for subsidy qualification (cross compliance for basic payments and agri-environmental schemes). In addition, several free-to-access tools are available online for self-assessment (e.g. the CLA CALM[2] tool or the FAO SAFA app[3]). All of these approaches utilise similar sets of data, but at the moment, require separate completion.

In addition to sustainability assessment tools, a large number of farms are currently making use of farm management software. These software packages record information on a broad range of management criteria, such as stock levels, livestock medication records, field records and input applications. The information they collect is often relevant for sustainability assessments and/or statutory reporting and could theoretically feed into these outlets.

A group of farmers and land managers have recognised the opportunities for convergence that exist in this area. With the support of the Sustainable Food Trust (SFT), the farmer-led group aims to explore the potential of using of consistent reporting and the exchange of information between existing data sources. The work seeks to facilitate farmer engagement with sustainability assessment, by making the required assessment(s) as easy and efficient as possible. This goes hand in hand with increased recognition of agricultural sustainability within UK agriculture and the policy context.   The hope is that, by making the process easier, sustainability will be at the foundation of all decision-making in agriculture.

Within this report we present the outcomes from an initial scoping exercise that:

1. Assesses the data needs and the areas covered by existing sustainability assessment tools;
2. Investigates the tool characteristics that facilitate completion at a farm level;
3. Makes an initial investigation on the opportunities for data sharing between farm management software and farm-level sustainability assessment tools.

We conclude with a discussion on the possible future direction of this work, based on the results of these tasks and conclusions from an in-depth discussion with the farmer group and the Sustainable Food Trust (SFT). We also provide a brief review of existing literature and on-going initiatives in this area and some reflections on crossovers and gaps from the inter-tool comparison. In the second section of the report we explore what an ideal sustainability assessment tool could look like, based on the results from the earlier tasks. Finally, we discuss opportunities for the future.

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[2] Carbon Accounting for Land Managers (CALM):   https://www.cla.org.uk/advice/what-cla-calm-calculator
[3] Sustainability Assessment of Food and Agriculture Systems (SAFA) app:
http://www.fao.org/nr/sustainability/sustainability-assessments-safa/safa-app/en/

Assessing agricultural sustainability

Brief overview of current sustainability frameworks

Despite the Brundtland *et al.* (1987) definition (above), there are numerous interpretations of what 'sustainability' actually entails. Table 1 highlights some of the different outlooks on sustainability and its assessment. Many are not mutually exclusive and could be combined within a single assessment tool. Different frameworks also have differing perspectives on the composite components of sustainability and indicators. These depend partly on the system scale or boundaries that the framework addresses. Some aspects (food security, public health from a nutrition perspective) cannot be fully influenced on the scale of a single farm and are hence not measurable at this scale. Variation also stems from the personal perspectives of tool developers or the intended use of the outputs (farm feedback and management versus certification, for example).

Sustainability frameworks are often divided under three domains: social, environment, economics, also referred to as a people, planet, profit approach (Gibson *et al.*, 2001). These domains are applied within most sustainability frameworks, although the finer level themes and indicators vary. The UN's Agenda 21, for example, applies the three domains to sustainable agriculture and rural development (UNSD, 1992). Mason and Lang (2017), meanwhile, use this base with the addition of governance, health and quality to expand the 'sustainable food' concept to 'sustainable diets'.

Table 1 Alternative outlooks on sustainability (based on Loiseau *et al.*, 2012)

Outlooks	Definition
Human and environmental risk	Toxicity to people or environment
Ecological footprint	Operating within system carrying capacity
Material & energy flows/ input-output analysis	Stocks and flows and whether they balance
Exergy	A 'lifecycle analysis' of the energy convertible to another form. Includes the exergy of environmental remediation to a reference state
Emergy	Total energy input (in solar emjoules) to get to product's finished state (incl. labour, information etc)
Lifecycle Assessment (LCA) (linked to product 'footprints')	The impacts of a product, process or activity from the extraction of raw materials through to use and disposal. Traditionally environmental impacts and expressed in tCO_2e but now being expanded to social impacts. Links to carbon and water footprints
Natural capital	The net balance of "the elements of nature [living and non-living] that produce value (directly and indirectly) **to people**" in a system (Natural Capital Committee, 2014). Often linked to true cost accounting or environmental valuation and expressed in economic terms
Ecosystem services	The net flows of costs and benefits **to people** arising from a system. Often linked to true cost accounting or environmental valuation and expressed in economic terms
True cost accounting/ environmental valuation	Expression of wider benefits and costs (environmental, social, etc.) in economic terms and including them in conventional accounts

Existing frameworks can provide a useful starting point for the promotion of alignment and consensus. Of particular interest are frameworks adopted at a government or international level, such as the UN Sustainable Development Goals and the Natural Capital Framework.

This latter framework is of particular interest in the current UK policy environment. However, it also epitomises the confusion present in the field of sustainability assessment. Since 2012, a Natural Capital Committee has been working alongside the Office for National Statistics to develop systems of national natural capital accounts and separate corporate accounting procedures (see Philips, 2017). These draw on the UN System of Environmental-Economic Accounting (SEEA). Over a similar time-period, a separate natural capital reporting protocol was developed by the Natural Capital Coalition (http://naturalcapitalcoalition.org/protocol/). The development of multiple, competing methods to achieve the same end is a common problem in the field of sustainability assessment.

A recent FAO-led initiative aimed to provide an international reference for sustainability management, monitoring and reporting in food and agriculture. The development of the FAO SAFA (Sustainability Assessment for Food and Agriculture systems) guidelines was based on an extensive literature review combined with a global stakeholder survey and face-to-face interviews with selected experts. The SAFA Guidelines are an example of the three 'traditional' dimensions supplemented by a fourth area, in this case 'Good Governance'. 20 core themes are identified within these areas as being crucial issues for the development of sustainable agriculture:

1) **Environmental** – atmosphere, freshwater, biodiversity, land, materials and energy, animal welfare;
2) **Social** – decent livelihood, labour rights, equity, human health and safety, cultural diversity;
3) **Economic** – investment, vulnerability, product safety and quality, local economy;
4) **Governance** – governance structure, accountability, participation, rule of law, holistic management.

The FAO state that even though good governance is considered to be an underlying concept rather than a pillar of sustainability, the core issues identified therein are key components in ensuring the credibility of sustainability interventions (FAO, 2015).

The SAFA guidelines also outline a procedure for an integrated and holistic analysis of all four sustainability dimensions. This includes guidelines on the selection of appropriate indicators and the rating of sustainability performance (best, good, moderate, insufficient). As this framework now underlies a number of the most recently developed sustainability assessment tools (FAO, 2015, de Olde et al., 2016) we have adopted SAFA as a frame of reference in this work.

Sustainability tools used in agriculture

In addition to a wide range of frameworks, over 100 agricultural sustainability assessment tools have been developed in recent years with different scopes, methods and weightings. These can largely be grouped into four types (Table 2), but approaches and coverage vary even within one type. It was not possible to cover all of these tools within this project.

Table 2 Description of different types of sustainability assessments

Approach	Description
Life Cycle Assessment (LCA) e.g. SIMAPro, SALCA, Farm carbon calculator, Cool Farm Tool	Also known as life-cycle analysis/ecobalance/cradle-to-grave. Assesses environmental impacts (often GHG balance) of a product over its whole lifetime – usually interpreted as raw material extraction through to use or disposal.
Multi-Criteria Analysis (MCA) e.g. MASC, SMART, RISE, PG tool, Sustainability Flower	Indicators are scored as a weighted average of several criteria and the trade-offs between them identified. The goal is to identify the optimal system design.

Triple Bottom Line (TBL) e.g. PG Tool, SAFA tool	Also called the three pillars approach. Assesses on the basis of separate areas (traditionally environmental, social and economic sustainability), with equal weight given to each.
Ecosystem Service Assessment (ESA) e.g. Healthy Farm Index, InVEST	Evaluates the provision of ecosystem services – that is, values/detriments to people. Impacts are quantified in a common unit, often currency.
[FRAMEWORKS]	Some 'tools' are not so much ready-to-use packages but rather a framework with which to construct your own, personalised tool.

Tools used in this project

We selected five well-established tools to give an overview of the situation regarding data gaps/overlap and features of usability. The selection aimed to include major sustainability assessment tools currently being used within UK agriculture (such as the Cool Farm Tool). We were constrained by a requirement for the tool to be made openly available for use within the project and for this reason could not include the LEAF Sustainable Farming Review.   The tools selected included four MCA/triple bottom line-type approaches (RISE, SMART, PG Tool, Soil and More Sustainabilty Flower) and one LCA-type approach (Cool Farm Tool – greenhouse gases). A specialist biodiversity module of the Cool Farm Tool was also included (i.e. an Ecosystem Service Assessment/ESA tool). An overview of each tool is provided below:

a. **The Cool Farm Tool:** a greenhouse gas (GHG) and biodiversity assessment tool that can be used to measure impacts and identify areas for improvement. The two modules identify hotspots and break GHG results into emissions by source category (energy, soil, fertiliser) to encourage action planning. An online app has been developed to make the assessment process user-friendly. The tool was initially developed by Dr Jon Hillier and Prof Pete Smith at the University of Aberdeen working in conjunction with Unilever and the Sustainable Food Lab. The recent Biodiversity Module was based on the Gaia Biodiversity Yardstick developed by CLM.

b. **PG (Public Goods) Tool:** a tool developed to allow farms to identify their sustainability performance across a range of criteria. The tool is Excel based, without a separate interface, and was originally developed by the Organic Research Centre with input from Defra, farmers and agricultural advisors.

c. **Response Inducing Sustainability Evaluation (RISE):** A tool developed by the Applied University of Bern for improving farm management and strategic planning. The assessment is designed to be used in a consultancy capacity and each assessment provides an automatically generated report with spaces for a consultant to add recommendations. The tool has been used around the world, including by Nestle in the UK. Recently, the assessment has been adapted to be in-line with the SAFA framework.

d. **Sustainability Monitoring and Assessment RouTine (SMART):** a comprehensive sustainability assessment tool developed to identify areas of better/worse performance across supply chains. The tool was developed by the Swiss Institute of Organic Agriculture (FiBL) and is directly in line with the FAO SAFA guidelines. Each assessment produces an automatically generated report, which includes recommendations for improvement.

e. **Soil and More Sustainability Flower:** developed by the Soil and More Foundation for suppliers as a farmer-focussed self-assessment on a range of criteria within environmental, economic and social areas. The tool combines Sharepoint and Excel. Indicators were chosen to be in-line with internationally recognised standards, including SAFA.

All of the selected tools were developed for agricultural systems. Several are used in the UK and all have already been applied in a Northern European context, with the Cool Farm Tool in particular achieving excellent market penetration through engagement with and adoption by multinational corporations. These include Unilever and Heineken.   RISE has likewise been adopted by large companies operating within the food and farming sectors (e.g. Nestlé, Danone). The PG Tool has been applied on over 200 farms across Europe within recent research projects (e.g. the FP7 project

Sustainable, Organic and Low Input Dairying project – SOLID; Hietala *et al.*, 2015). SMART is fully SAFA compliant and attracting a great deal of interest with retailers in Austria and Switzerland (Coop, Aldi Austria, BioSuisse) and has been used for research purposes in the southern hemisphere (e.g. in Kenya and Ecuador).   In a recent project for the Swiss Agricultural Department, SMART has also been applied to investigate whether the tool could play a role in the allocation of direct support payments. RISE, SMART, the Soil and More Sustainability Flower and the PG Tool were all developed as advisor/researcher led tools (i.e. they are completed in conjunction with a trained assessor) whereas the Cool Farm Tool was developed for self-assessment and/or for benchmarking purposes.

Gaps and crossovers in concepts and data needs

Assessments can be divided into three phases: data collection, data analysis (to calculate indicators and give a score) and data interpretation (an assessment of whether the indicator or score is good or bad or is below/above a set threshold). Focusing on the first of these phases, the themes, subthemes and data collected by the selected tools were mapped and compared. This exercise allowed for identification of areas where data might be transferred from one tool to another.

To ensure a level of uniformity in the analysis, the SAFA framework was used to map the tools. The specific questions asked in each tool were mapped against the relevant indicator(s) within one of the SAFA sub-themes. Where it was felt that this would lead to mis-representation of the tool's coverage, however, the questions were mapped against multiple indicators.

It should be noted that in practice multiple sustainability criteria interact in many tools, i.e. the same question or basic data is used and influences multiple areas. On the other hand, data known to relate to multiple sustainability indicators may only be used for a single indicator (or a subset of indicators) in a particular tool. For example, soil texture is an indicator for erosion vulnerability, compaction and water retention. The former two are part of the 'land' theme, whereas the latter is part of the 'water' theme within SAFA. A tool that asks about soil texture might use the data in the calculation of one, two, or three indicators, contributing to one or both themes. The breakdown of the Cool Farm tool demonstrates this clearly: despite seemingly covering several SAFA areas, the tool only analyses data relating to the SAFA themes atmosphere (CFT GHG) or biodiversity (CFT bio.) – see Table 3. Without an analysis of the underlying calculation mechanisms – which is beyond the scope of this work – it is impossible to map which indicators are covered with complete accuracy.

Table 3 SAFA themes represented in each tool (column headings), divided by domain. ■ = represented by an indicator within SAFA; ▢ = represented by a concept not included in SAFA; ◩ = represented by both SAFA and non-SAFA indicators

	Good governance						Environmental integrity						Economic resilience				Social wellbeing					
	corporate ethics	accountability	participation	rule of law	holistic management	*innovation	atmosphere	water	land	biodiversity	materials/energy	animal welfare	investment	vulnerability	product quality and info	local economy	decent livelihood	fair trading practices	labour rights	equity, human health and safety	cultural diversity	
Cool Farm Tool (Bio.)								■	■	■	■											
Cool Farm Tool (GHG)							■	■			■											
PG Tool			■	■		▢	■	■	■	■	■	■	◩	■	■	■	■	■		■	■	
RISE	■	■	◩	■	■		■	■	■	■	■	■	■	■	■	■	■		■	■	■	
SMART	■	■	◩	■			■	■	■	■	■	■	■	■	◩	■	■	■	■	■	■	
Soil & More Flower	■	■		■		▢	■	■	■	■	◩		◩	■	■	■	■	■	■	■	■	

Even where themes and data align, many indicators are abstract concepts and highly interpretive. For example 'structural diversity of ecosystems', 'food quality' and 'fair pricing' can all mean different things to different people. In addition, there may be considerable divergence on the value or score that is deemed to be 'sustainable'. Firstly, the score's perspective may be absolute or relative, i.e. answers may be compared against a fixed desirable threshold or against a sectoral benchmark (de Olde *et al.*, 2016). The former is arguably a better indication of sustainability, but the absolute level may be unknown or disputed. Secondly, the absolute or relative score used as a reference can vary. There is also an argument for having different absolute values for different farm systems, but the divisions between system types (e.g. arable/livestock/mixed, etc.) also varies between tools.

Our analysis revealed that although the tools mostly follow different frameworks of sustainability (Appendix A), amongst the four wider-scope tools (i.e. RISE, SMART, Soil and More Flower, PG Tool) there is good coverage of the SAFA framework and a great deal of similarity (see Figures 1 to 4).

Figure 1 Number of indicators included within each tool, by SAFA theme within the Good Governance domain. The Cool Farm Tool covers only the environmental domain and is therefore excluded. * indicates subtheme or indicator not present in SAFA but included in one/more other tools. ** = maximum number of indictors including SAFA plus additonal indicators within tools.   Full themes are listed in Appendix A.
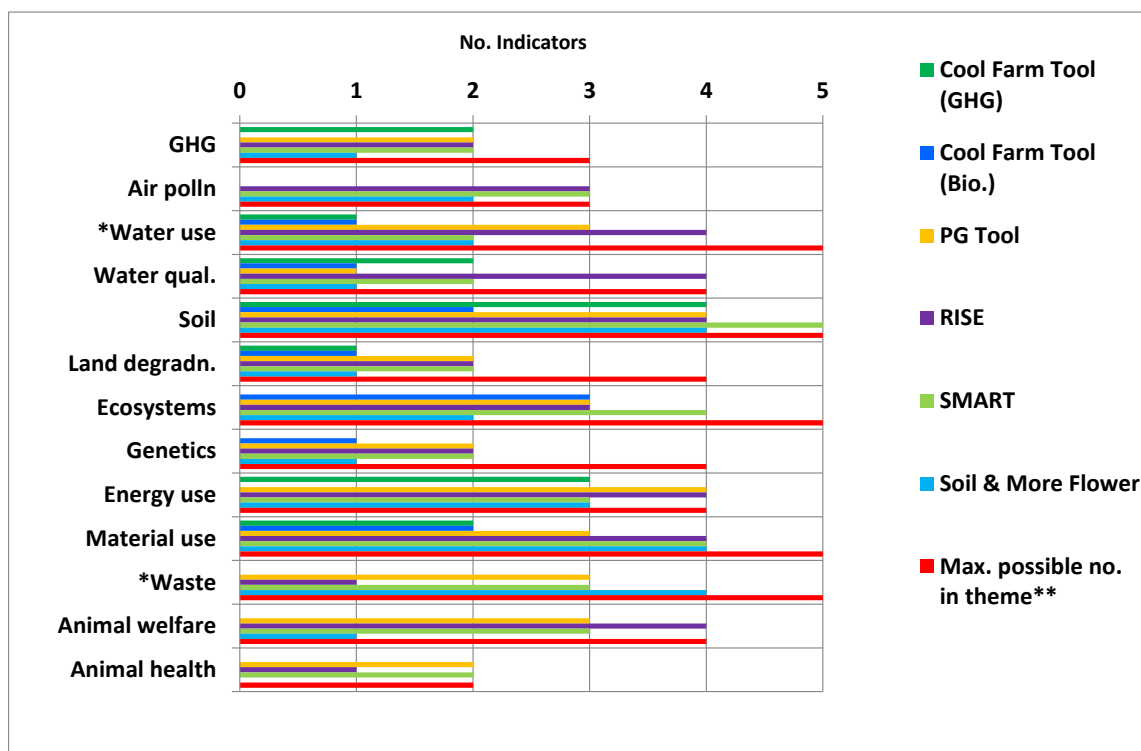
Figure 2 Number of indicators included within each tool, by SAFA theme within the Environmental Integrity domain. * indicates subtheme or indicator not present in SAFA but included in one/more other tools. ** = maximum number of indictors including SAFA plus additonal indicators within tools. Full themes are listed in Appendix A.
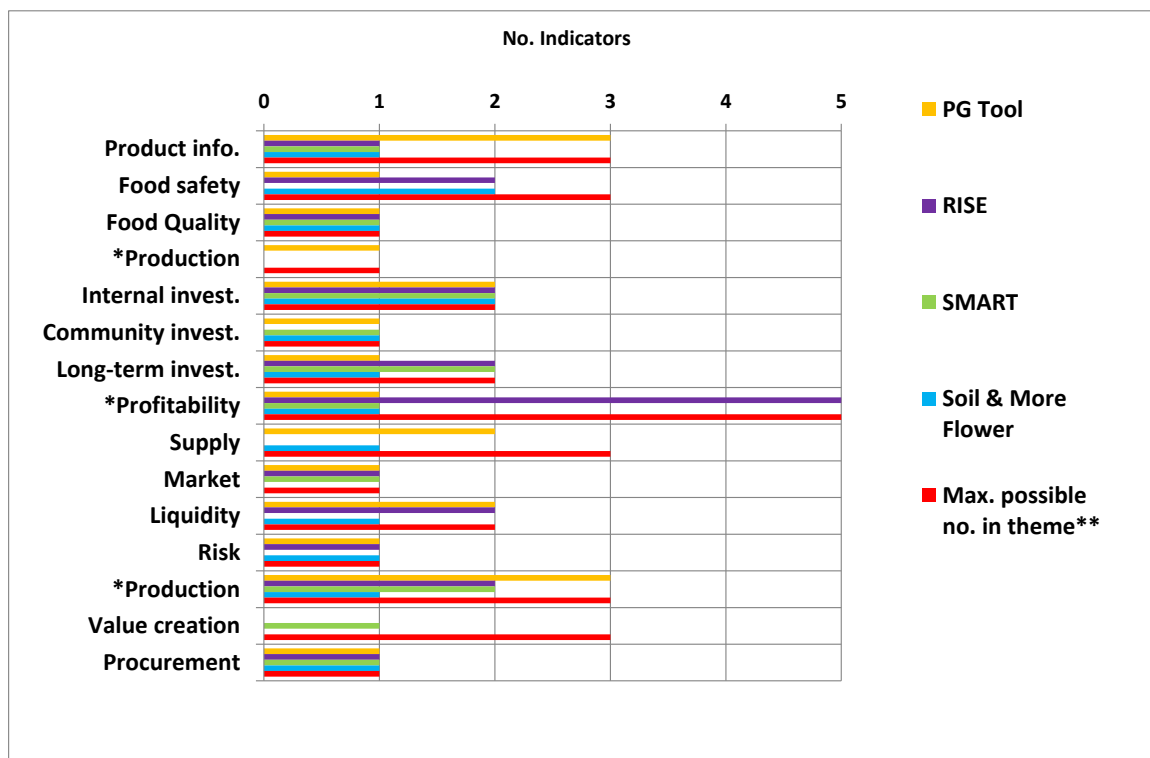
Figure 3 Number of indicators included within each tool, by SAFA theme within the Economic Resilience domain. The Cool Farm Tool covers only the environmental domain and is therefore excluded. * indicates subtheme or indicator not present in SAFA but included in one/more other tools. ** = maximum number of indictors including SAFA plus additonal indicators within tools. Full themes are listed in Appendix A.
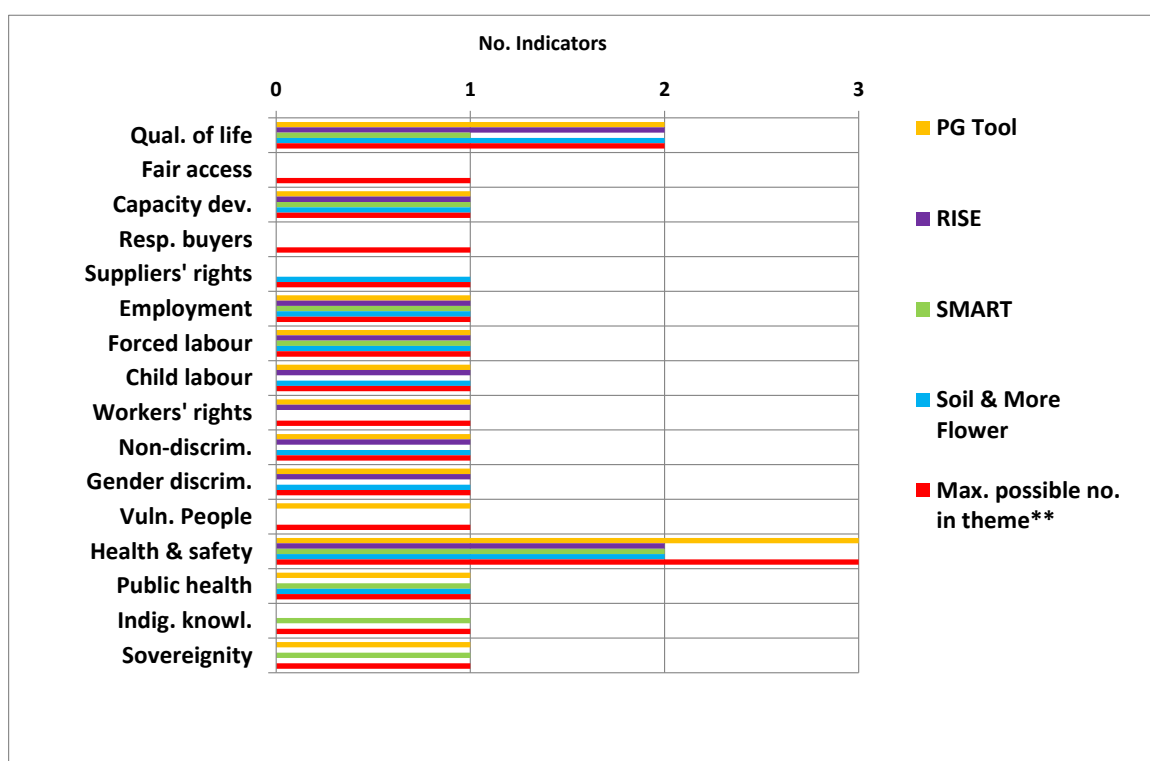
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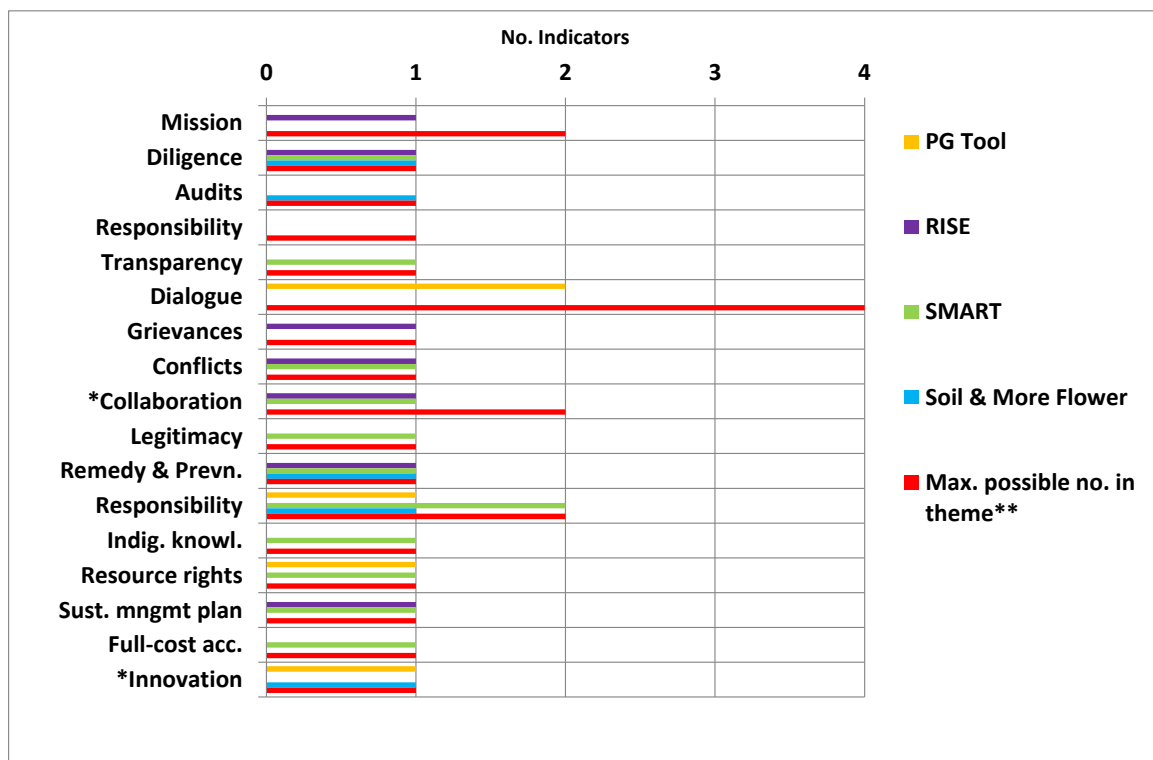**Figure 4 Number of indicators included within each tool, by SAFA theme within the Social Wellbeing domain. The Cool Farm Tool covers only the environmental domain and is therefore excluded. * indicates subtheme or indicator not present in SAFA but included in one/more other tools. ** = maximum number of indictors including SAFA plus additonal indicators within tools. Full themes are listed in Appendix A.**

A similar analysis of tool content by de Olde *et al.* (2017) also found significant differences between four multi-criteria assessment tools (Table 4). This work likewise identified a number of unique assessment categories within each tool (e.g. N and P self-sufficiency in RISE, historic land features in the PG Tool and economic transmissibility and efficiency of production in IDEA).

Table 4 % of a tool's subthemes (by domain) that had no coverage in other tools (i.e. are unique to that tool).

	RISE	SAFA	PG Tool	IDEA
Good governance	33%	71%	NA	NA
Environmental integrity	16%	7%	26%	7%
Economic resilience	39%	17%	0%	5%
Social wellbeing	15%	44%	42%	19%
Table adapted from de Olde *et al.* (2017)				

However, when looking at each tool in more detail (i.e. at the level of sub themes and the indicators used to represent them), the tools were found to be much more varied. And when looking at the actual data collected, the diversity of questions and answers varies enormously. Our analysis identified nearly 1000 different questions that would need to be answered to fill in all five tools. This diversity arises from the different metrics (e.g. qualitative versus quantitative) and units used to calculate sustainability performance. Table 5 outlines this diversity for questions asked by tools under the 'Soils' and 'Materials' areas.

With some cooperation between tool developers, the situation could be markedly improved. In many cases, slight changes to the data collected would allow the inputs collected by one sustainability assessment tool to be used directly in many others. If all five tools made such changes, the questions needed for the SAFA domains Environment and Governance would reduce by about one-quarter. Furthermore, the scope for this extends beyond sustainability assessment tools. There is similar overlap with data collection for other types of farm assessment tools. For example, it was found that the information requested by the AHDB "Stocktake Plus" tool could feed directly into the sustainability tools assessed here (AHDB, 2013) and the same is likely to be true for other benchmarking or farm planning tools.

This has two points of relevance.
- Firstly, if one wished to permit interoperability of sustainability assessment tools, this could be achieved by focusing on the data collection phase. Consensus in data collection is possible without any need for data processing or alignment of result interpretation.
- Secondly, the right framing of questions included as part of statutory assessments (e.g. for the Basic Payment Scheme - BPS) could enable some interoperability with other assessment types. This could increase the likelihood of an individual farmer completing a sustainability assessment by reducing the time required for completion.

Table 5 A small sample of the questions asked (and data collected) by the sustainability assessment tools under the soil and material areas of sustainability

	Cool Farm Tool - biodiversity	Cool Farm Tool - GHG	PG Tool	RISE	SMART	Soil and More Sustainability flower
Soil Quality						
Application of compost	used/not	mass/area	t	ha [divided by crop]	% total organic fertiliser (incl. manure-based compost)	t/ha
Soil texture		3 categories fine/medium/coarse	5 categories from sandy light to heavy and peaty	13 categories considering fractions of sand/ loam, silt, clay		3 categories fine/medium/coarse
Soil organic matter		Percentages <=1.72/-<=5.16/- <=10.32/>10.32	5 different judgement scores on change	Calculated AND used for rotation planning/not calculated	[humus only] known and increasing or stable/known and decreasing/unknown	Percentages <1.72%/1.72-5.16%/5.17-10.32%/>10.32%
Material use						
Fertiliser application based on soil analyses		Analyses used for organic fertiliser application/not	Mineral K applied with analysis and good reason/partly/no Levels of soil analysis (various options) at field level considered /not considered	Soil analyses AND used for fertilisation planning/not	-Several criteria how fertiliser amounts selected - -Information used about N, P and K content of organic manures and composts	N content of compost/other organic fertilisers [divided by type] applied - %
Pesticide type	Post-emergence/seed treatment/soil treatment	Selective crop protection products only/not	Drop down list [by active ingredient; example product names listed] Active ingredients known/partly/not	Drop-down list		Free text (active ingredient)
Pesticide application	Number of doses (can be negative?!) [divided by 'type'] Weight/ area	Use chemical protection/don't use- Only affected areas/not	% area where applied [divided by crop; herbicide/fungicide/insecticide separate]	Proportion of wooded land pesticides used on Herbicide or pesticide used on proportion of land ha treated (divided by active ingredient) No of applications (divided by active ingredient)	Used on a field scale/used, but spot treatments/not used Avoid ponds, hedgerows, woodland, rough grazing and species-rich grassland/mostly/no	Amount per ha/y Number of applications

What would make an 'ideal tool'?

In the second task, feedback from past usability studies was studied to establish the characteristics of an ideal tool. We also assessed five self-nominated farms with a range of sustainability assessment tools (CFT x2, PG Tool, RISE and SMART) to gather feedback on the approaches used. The farms covered a diverse range of types (arable, livestock and mixed; organic and non-organic) and geographic locations. Farm locations are shown in Appendix B, whilst anonymised results from the assessments are shown in Appendix C.

The multi-criteria assessments (PG Tool, SMART and RISE) were conducted with a researcher present, as these tools were designed for use by a trained assessor, although farmers and farm managers were as actively involved as possible. The order of the assessments was varied for each farm and the approximate time taken was recorded. Each farm was asked to complete the CFT online assessments independently but assistance was given when requested. Feedback on each tool was sought following each assessment visit (see Appendix D).

All of the farms found the exercise useful, worthwhile and interesting. The farmers were generally able to provide most of the data required from farm management software when these program(s) were being used. This good availability of required data was also found by de Olde *et al.* (2016). Whether the same would be true for farms with lower reporting requirements, however, cannot be determined from the small sample. It is worth noting that the smallest farm of the five did not have the same easy-access to the required data, suggesting that this would not be the case.
Table 6 below summarises the time taken for each tool and the strengths/weaknesses identified (see Appendix D for detailed feedback).

Table 6 Summary of strengths and weaknesses of the tools identified by our participants

Tool name	Strengths	Weaknesses	Time taken for assessment
CFT (GHG and Bio. combined)	Interface easy to use Easy to compare results for different products Clear figures in results page	Difficult to interpret results (GHG) Lack of detailed explanation of what the results mean	30 mins each
RISE	Useful report generated – easy to understand the results Report uses less categories so easier to look at compared to other multi-criteria assessment tools	Lengthy report (>30 pages) generated at end of assessment Qualitative economic performance assessment short on detail Quantitative economic performance assessment too detailed	3 ½ hours average (between 2h40 and 4h)
PG Tool	Easy to complete Transparent as calculations all visible in Excel Collects a lot of quantitative data for nutrient balance – more meaningful that results based on qualitative indicators	Organic focus No report generated Lots of pages when printing direct from Excel Economic performance assessment short on detail Lots of numbers to provide	2 ½ hours average (between 1h15 and 3h)
SMART	Detailed and well-presented report generated	Report very long A 'black-box' cannot see how scores are generated Economic performance assessment short on detail Some irrelevant categories (e.g. forced labour)	2 ½ hours average (including farm tour) (between 1h45 and 3h20)

With the feedback from our farm consultations and the wider literature, it is possible to draw a number of conclusions about the factors that make an assessment tool useful, easy and even enjoyable to use. These are outlined below.

General qualities

A number of evidence-based frameworks have been developed in recent years to guide the usability of tools and interfaces. Key usability criteria identified by the ISO 9241 standard (covering tools used to achieve specific goals) are:

1. Effectiveness, i.e. whether a tool gives an accurate and comprehensive output;
2. Efficiency, i.e. the resources required to complete a tool;
3. Satisfaction, i.e. whether a user has a positive attitude about the tool (Petrie and Bevan, (2009)

Other commonly cited criteria include:

- Flexibility – referring to whether a user is able to revise their answers;
- Learnability - the time and effort needed to be able to use a tool proficiently;
- Memorability - whether a user can remember how to use a tool when returning to it after a period of time;
- Accessibility - the diversity of potential user groups that can access a tool – the deaf, the blind, the less-technologically competent etc.

With regard to tool format, digital is seen as the most accessible. This format has the added benefit of allowing instant generation of results - something strongly appreciated by our farmer participants. Automated data transfer is also possible with digital tools. 'Digital' encompasses many assessment approaches, e.g. web-based platforms, downloadable software and online questionnaires. Each approach has its own advantages and disadvantages. Internet access may be limited or sporadic in some areas, for example, whilst web-based platforms and software often require specific add-ins or computing systems. This may present compatibility issues and concerns regarding ongoing support (Lindsay, 2005). Both SMART and RISE, for example, require the Silverlight add-in, which will be discontinued in the near future. As a result, both these tools will need re-writing within an alternative user interface.   Downloading software can also seem intimidating or off-putting to potential users (Lindsay, 2005). Feedback gathered in response to the farmer health and safety self-assessment eform trialled by Health and Safety Executive (HSE) in 2005 suggested that there is still a demand for paper-based and/or offline assessments (Lindsay, 2005).   A lengthy digital assessment can also become tedious, tying a farmer to a computer for a long period, and digital assessments may depend on access to a reliable/fast internet connection, something which can pose a challenge in rural areas.

Another key quality to make tools appealing is sufficient detail to show short-term improvements. A strong desire was expressed by a number of participant farms for a tool that would allow annual monitoring (Farms 1, 4 and 5) and tracking of changes over time. Such a requirement influences the indicators that can be included, as many indicators will not pick up such fine-level detail.

Wording and use of terms

Accessible wording is crucial. de Olde *et al.* (2016) found RISE to have less abstract wording than other tools in terms of themes, concepts and the text used. In our own study, the PG Tool was found to contain specialist nature conservation and organic terminology, whilst SMART was reported as 'very bureaucratic' (Farm 5). Ambiguous wording is a further issue – what defines a 'heritage

crop', a 'rare species/breed', or one that is 'locally adapted' (especially in the context of a changing climate) is by no means universally agreed. SMART was found to contain both concepts and terminology unfamiliar to the farmers, although this is partly due to limited trials in the English language (the tool was developed in Swiss German). Ambiguity in wording was not exclusive to SMART and the absence of any glossary was highlighted with particular regard to 'heritage crops' and other terminology included within the PG Tool (Farm 2). SMART and RISE recognise the need for definitions and both provide guidance for each question. However, this guidance consists of dictionary definitions of the terms used, rather than an accessible explanation of what the question is asking for. An 'applied' glossary would be even more crucial under self-assessment conditions.

The farm assessments also revealed the importance of ensuring that tool-based assessments are meaningful and not just viewed as another external audit. In this context it was recommended to avoid abrupt or "ordering" questions in any assessment tool (Farm 2). The wording must therefore frame sustainability and its assessment carefully. Likewise for the results to seem useful, they should address sustainability themes that are clearly applicable to farm management. 'Good governance' is a very abstract concept, whereas most of what is covered under this heading in-fact relates to 'Good farm management'. Renaming and regrouping terms would be key part of developing an effective and accessible self-assessment.

Accuracy and comprehensiveness

The farms assessed had a core desire to receive comprehensive, accurate assessments of their farming business, even if this resulted in an increased time investment. Similarly, farmers completing the HSE exercise mentioned above reported that the online assessment should increase the number of categories covered, despite more than a third already finding it "too long". There was a strong preference in our own work for the more comprehensive tools (Farm 1, 3) and for "more, in depth, factual questions" (Farm 2). Particular concern arose when areas considered relevant to sustainability were absent and/or if the farming system couldn't be captured precisely (through the desired livestock class being missing etc). Such omissions could lead to loss of trust, something that should be remembered going forwards, should a simplified assessment approach be considered. The recognition was that "you get out what you put in" (Farm 1). De Olde *et al.* (2016) found the same preference for in-depth, factual questions and the longest of four sustainability assessment tools was the preferred approach in their study. This was due to the greater perceived accuracy, detail and relevance. A similar preference for quantitative data also emerged, the reasoning being that qualitative questions allow the responder to influence their own results. Whether this is necessarily the case is unclear. After all, without a formal audit procedure there is no guarantee that the numbers provided for a sustainability assessment are honest. Quantitative data, however, does allow identification of smaller differences and more detailed analysis.

There is clearly a balance to be found with regard to the number of qualitative and quantitative questions included within a single tool. Farmers found it frustrating if they were unable to provide an exact answer for a quantitative question – such as water use, the number of standing trees or the length (or area) of hedges. Too many data requests considered challenging, unreasonable or irrelevant led to disengagement. An increase in comprehensiveness must therefore be countered with an ability to filter-out non-applicable questions and a desire for increased transparency.

Transparency

Increased comprehensiveness can lead to increased complexity, a concern when a commonly cited desirable feature of tools is transparency to the end-user. Indeed, a lack of transparency with regards to benchmarks was a core reason for the dislike of the CFT by Farm 3. The PG Tool's presentation in Excel was appreciated in this respect, as allowing the farmer to see which answer receives which score was considered to make the assessment process more apparent (Farm 2).

Whilst this is true, transparency in scoring does not necessarily address transparency in relation to underlying calculations and assumptions (e.g. with regard to benchmarks and divisions between scores). The accessibility of scoring information also carries a cost: particularly if conducted as a self-assessment, the visibility of scoring boundaries presents a temptation to be overly-optimistic in one's answer. This was observed during the work we conducted, despite the strong desire for accuracy amongst the participants and the anonymity of the results.

It is important to note that complexity and accuracy are often inextricably linked. To convert an indicator measurable on farm to a component of sustainability may use complex modelling, possibly requiring the user to put their trust in unknown or opaque models. Even where answers are simply judged against a benchmark, users must trust in the accuracy of the benchmark. The same complexity-accuracy-transparency nexus applies to scores and weightings. The PG Tool is simple because each question is scored on a 1–5 scale and is taken as a single indicator. Each indicator is then used in a single theme, which in turn is an unweighted arithmetic mean of the composite indicators. In RISE and SMART, on the other hand, an 'indicator' comprises many questions, and each question may contribute to many indicators. Indicators feed into multiple themes with variable weightings; sometimes an individual response may even lead to a positive score in one theme and negative score in another. Simplicity must therefore be balanced with efficiency (using one piece of data in multiple places) and accuracy, because every component related to an area of sustainability does not, realistically, have the same level of importance.

Social values

It cannot be disputed that forced labour is ethically wrong. However, along with animal welfare and several other indicators included in the social domain of sustainability, this falls outside the Brundtland definition (see 'Introduction'). Such criteria are based on value judgements, i.e. underlying social beliefs that frame any assessment. While some value judgements are universally accepted, others are not, and where the values built into a tool are not shared by a farmer, disillusionment and disinterest can result. De Olde *et al.* (2016) also found this in their work, where participants reported unhappiness with perceived value judgements in the PG Tool (landscape, heritage and nature conservation being very 'British' in context) and IDEA (perceived as being very 'French') (de Olde et al., 2016). One of our own participants indicated a similar degree of discomfort with the PG Tool, stating that was very 'organic' in its framing (Farm 1).

Such judgements may be present in tools either intentionally or unintentionally and tend to arise from deeply-held cultural beliefs. In other cases, the framing of questions leads to values being read into the questions. This is the case in SMART, where many questions are asked neutrally but are situated amongst questions with an obvious right or wrong answer. If the 'right' answer in all the previous questions is 'no', the assumption of the farmer is that the right answer to the next question is also 'no', leading to a value judgement being 'read-in'. The scoring, however, often interprets the answer positively for some indicators and negatively for others. By considering the framing and situation of questions in the assessment, and by being transparent regarding scoring procedures, this latter problem can be minimised. Meanwhile for the former, one must question whether such values are indeed 'fact' or whether alternative views are valid.

Tool output - benchmarking and comparison

A desire to compare assessment results both with other farmers and against benchmarks was strongly expressed in our own research (Farms 1- 3, 5) and other work (de Olde *et al.* 2016, Lindsay, 2005). Feedback on how to reach benchmarks was also appreciated (Lindsay, 2005), something that may have helped drive the preference for the SMART report (the only tool that breaks down performance into specific actions) over the other sustainability assessments. For comparison purposes, however, it becomes important that farmers can have confidence in the accuracy and

honesty of the answers given by others – a challenge that will need a particular focus in a self-assessment situation. Indeed, a potato farmer who was recently asked by his processor to complete the CFT said that "the most important thing was that they held our hands through it". He could have confidence that all of the growers being assessed were starting on the same level and there was no need for phone calls to help desks or time wasted in trying to figure-out any problems encountered (*pers. comm.* 16th March 2017). All five participants in this study did, however, feel that after completing one of the multi-criteria assessment tools once, they would be reasonably comfortable completing it independently in the future with telephone support.

Figure 5 The potential benefits of benchmarking workshops were strongly expressed by all participant farms, although it was recognised that encouraging participation of less pro-active producers may present a challenge

A further challenge relating to benchmarking is a desire for a context-specific comparison (de Olde *et al.*, 2016 and Farm 1). The complexities of framing an assessment to multiple contexts that 'might' be of relevance to a particular farmer or group (e.g. certification, region, production type) are significant. Such framing can additionally present constraints to the comparisons necessary for wider-scale policy decisions and food-system considerations. This links directly to the discussion of absolute versus relative scoring of indicators (see 'Gaps and crossovers in concepts and data needs') and the decision of when it is acceptable to make allowances for certain production system qualities (see the second point in '
Recognising sustainability and moving it to the 'mainstream'''). Furthermore, while an individual farm could be considered 'sustainable', where its performance sits in the context of the food system as a whole could also be considered important. Indeed, this could be seen as intrinsic to whether or not the farm in question is indeed 'sustainable'. This is part of a wider discussion surrounding the outlook taken by sustainability assessments and is discussed in more detail in '
Recognising sustainability and moving it to the 'mainstream' (see below).

Tool output – reporting format

While the farms assessed liked instant results – ideally on an ongoing basis throughout the tool (Farm 3) – there was clearly a high value placed on detail. An 80+ page report associated with SMART was identified as being very long, but other feedback indicated that this was the preferred report due to the level of detail provided. Also appreciated – and not generally offered as part of the

other tools – was the on-screen breakdown available upon completion of SMART and RISE. This displays scores by domain, colour coded by performance. These results can be expanded to a theme and subtheme level and finally to the individual questions. The answers are also shown in a colour coded format according to their effect and, in SMART, the weightings assigned to the answers are also displayed. This breakdown was admired by several of our participant farmers, and while the process as it stands is not particularly easy to interpret, the benefits of such a feedback approach are worth further investigation. De Olde *et al.* (2016) also found the use of colours to be particularly pedagogical.

Figure 6 Example output from SMART report (results are derived from an example report on the FiBL website). The use of radar diagrams was appreciated as an overview of the outputs. The use of colours (e.g. ranging from red to green) was found particularly helpful.

Specific tool/framework critiques

A common criticism of the tools was a perceived absence of any consideration of one of the core values of a farm, i.e. to be a viable food production business. To engage farmers with the concept of sustainability, assessment outputs may therefore need to be framed against an individual farm's needs and perspectives. This does not necessarily mean that assessments have to change their inputs, weightings or calculation methodologies – these can still reflect the core components of sustainability– however the outputs should be designed to make it clear how the results from an assessment relate to farm management indicators and decisions.

A further problem identified within tools was a failure to consider the farm system against its intrinsic system values. There seems to be an assumption in many tools that the farm in question is an industrial-era 'conventional' farm. The consequence of this is that the recognised 'positives' of a farm are largely add-ons – field margins, set aside land etc. A farm that manages its fields in a more environmentally-friendly way but that does not leave field margins and corners or wild flower strips can therefore receive little or no recognition of its beneficial practices, compared to a farm that has a pure monoculture in its cropped area but diverse margins. An important lesson from this is the necessity to recognise all possible farm systems and ensure that the values of each can be represented.

Where now?

Reaching a consensus

While the concept of sustainability is diverse, there is a general agreement on the areas that should be covered. A sustainability assessment can be divided into three stages: collecting data inputs, processing inputs into scores and then interpreting the scores as indicators of sustainability. For the latter two stages, different approaches have their own strengths. The 'best option' depends on the intended final use of the results and the data collected. This is perhaps most evident in the CFT versus the three multi-criteria sustainability assessments. Neither approach is an adequate replacement for the other, while to amalgamate the two would extend the assessment duration unnecessarily if the two different outputs are not required. As identified in 'Gaps and crossovers in concepts and data needs', another consideration is that sustainability assessments frame sustainability differently. They can even apply different boundaries to the 'farm-system' (in RISE for example, social obligations end at the level of direct suppliers, where in SMART they extend to the initial point of production). The desired perspective and boundaries will depend on the assessment purpose and will impose restrictions on the questions asked and the scores given.

The first stage of this work shows that, with cooperation from assessment tool developers, there is scope for a single data collection exercise to feed in to multiple tools. In common with de Olde *et al.*, (2016), we found that most of the numerical inputs required for the tools we assessed are already contained in farm management tools. Entering this information was by far the most time consuming element in the sustainability assessments we conducted. If this process could be automated, the time impositions on the farm would be substantially reduced. This is epitomised through one of our assessment visits (Farm 2) where three tools – which usually take 2-4 hours each – were completed in a single working day. This was made possible through pre-supplied data and by completing the answers to questions in multiple tools concurrently (see Figure 7).

There is a need for a much stronger integration of sustainability assessment criteria within farm management decisions and farm management tools. Linking sustainability assessment tools to existing data collection frameworks could help to encourage this. Exploring the datasets collected by farm management tools and government submissions, and how these overlap with sustainability assessments and certification schemes, would provide better guidance on metrics for which data are already gathered and available. A first attempt to explore the overlap in this area is provided in Appendix E, but more work is needed to ensure that any synergies are identified and acted on.

Some initiatives addressing the 'interoperability' of tools and data collection frameworks are already underway. The Cool Farm Alliance is currently working with the SAI platform (a multi-criteria type sustainability assessment) to allow data to be transferred between tools. Meanwhile, Reed International are developing a precision agriculture management system that, for a fee, plugs into farm management tools (including Gatekeeper and Muddy Boots) and extracts the desired data, homogenising it and identifying any outliers. It is only one step further to then feed this back into different tool(s). Such interoperability depends on clear definitions and standardisation of each data point. The EU FLINT project (http://www.flint-fp7.eu/) recognised this and the project team have developed a data-infrastructure which can be used by the agri-food sector and policy makers to provide up to date information on farm-level indicators relating to sustainability performance.

If interoperability could be achieved between a tool that is completed on almost every farm (e.g. as part of subsidy application) and other, optional assessments, the uptake and use of the optional assessment tools could feasibly increase. This is something that could be proposed to Defra and the Rural Payments Agency. Interoperability would be facilitated by ensuring that wherever-possible tool developers use similar data inputs in a common and consistent format, as the current

inconsistency restricts the application of data transfer technology across multiple tools/frameworks. Developments in this area could be driven through the release of guidelines or a recommended 'standard practice' document.

Figure 7 Provision of data on quantities in advance (e.g. land areas, livestock numbers) greatly reduced the time required for the completion of each assessment

Recognising sustainability and moving it to the 'mainstream'

The British exit from the EU and the ongoing CAP review present opportunities to push for improved support for the development of sustainable food and farming. While a number of groups have already submitted proposals to Defra regarding their vision for a "UK CAP", to our knowledge these are largely structural (i.e. relating to the proportion of funding to be allocated to each 'pillar' and outlining what these pillars should target) rather than considering the indicators that might be used to assess performance and allocate funding. To submit a proposal for sustainability in governance or to develop a tool that can be used to measure it, however, the following questions must first be addressed.

- **Where are the boundaries of farm sustainability assessments?** For some indicators this is unambiguous. For example, pollution of waterways will generally need to be considered in a societal context, as there is often no direct impact of causing pollution downstream, but the overall effect is negative at societal level. For other themes and indicators, the boundaries are less certain. Landscape diversity, for example, could be considered within a single farm or beyond the farm boundaries. Arguably the latter is more relevant, but potentially extends beyond the farmer's sphere of influence. Likewise food security is defined as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2003). Some assessments measure this by considering the ratio of food to non-food production on a single farm. However, many cultivated non-food products (cotton, timber, etc.) are critical to human society. A dietary perspective requires a consideration of the distribution of production across product types within a region to see if this meets local dietary needs. Yet this again extends beyond a farm's direct influence. While farm-level is arguably the most useful assessment boundary from a farm-business, individual practices that are considered 'sustainable' within a single farm may not be more sustainable if applied universally.

- **Is the purpose to advise on the topic of sustainability, or solely to identify/encourage areas for improvement?** There are a number of factors critical to a sustainable system but not all of these can be determined by an individual farmer. In the landscape example above, farmers can determine to a degree the landscape of their own system but cannot determine their neighbours' behaviour. To give a true indication of sustainability, such factors would have to be included, even if they fall outside a farm's direct influence. Poor scores in these areas could be disheartening. This was the case for our participant farmers in relation to 'fair trading practices', where lack of knowledge on the origin of some inputs led to low scores but the farmer could see no clear course of action. The purpose also affects the perspective taken for scoring (a discussion of absolute versus relative values can be found in 'Gaps and crossovers in concepts and data needs' above). Decisions will need to be made regarding system constraints to compensate for (e.g. limitations imposed by soil type on water and nutrient requirements, a dairy cattle farm's greater need for water than a beef cattle farm).

- **How much is it necessary to measure?** Farms indicated a willingness to spend a number of hours on an assessment (Farms 1-3) should it provide a business value and especially if there was a financial incentive. In our study, there was a preference for quantitative, data-based questions, which are more time consuming to answer (unless automated data capture is possible). When interpreting this result, though, it should be remembered that the farmers involved in our trials are all likely to be more engaged in sustainability issues than average. Assessment length could be reduced by assessing a subset of sustainability criteria, but farms are frustrated when areas perceived as relevant are left-out. Additionally, complex interactions between components of sustainability result in many trade-offs and potential synergies. Excellent performance in one area can lead to poor performance in another. For example, the organic practice of avoiding manufactured N-fertilisers may lead to savings in non-renewable resource use but can also lead to greater N leaching through a reliance on organic fertilisers (composts, manures, slurries etc). Measuring one indicator but not the other leads to an inaccurate overview of the farm system.

- **What are government priorities?** The UK subscribes to a number of treaties and agreements that impose obligations for meeting certain targets (Table 7). These are likely to inform internal priorities when revising national agricultural policies. Any proposition that conflicts with these is likely to be rejected. Conversely, should a proposal be made that is demonstrably aligned with existing priorities, it is more likely to be appealing to policy makers. These factors should be considered when putting forward proposals for the development of sustainability reporting within the UK food system.

- **What metrics does the government already collate for purposes other than farm support?** Besides treaties, the government also report on certain metrics to outside bodies. Where these align with metrics of sustainability, the data required may already be available, or there might be a desire to collect this data in the future as part of other collection procedures (e.g. for farm support allocation). Example metrics include those collected by the European Environment Agency and the UNSD Environmental Indicators.

Table 7 Treaties and agreements subscribed to by the UK of potential relevance to farming

Some of the treaties and agreements that may have relevance to farming
United Nations Framework Convention on Climate Change
Paris Agreement 2016 and the '4 per 1000' initiative
Rio Declaration on Environment and Development
Convention on Biological Diversity
UN Sustainable Development Goals (along with proposed targets and indicators)
International Treaty on Plant Genetic Resources for Food and Agriculture
Ramsar Convention on Wetlands
Convention on Migratory Species (CMS) (the Bonn Convention)
Kyoto Protocol
Stockholm Convention on Persistent Organic Pollutants

- **What wider initiatives are underway/have been performed?** There have been a number of other efforts to come up with standardised indicators for themes aligned with sustainability. A list of some of these is given in Table 8. If the aim is to bring consensus then every effort should be made to adopt existing proposals rather than adding to the mix.

Table 8 Existing initiatives to develop standardised indicators of sustainability

Area addressed	Organisation	Link to more information
Life Cycle Impact Assessment Indicators	Life Cycle Initiative	http://www.lifecycleinitiative.org/activities/phase-iii/global-guidance-on-environmental-life-cycle-impact-assessment-indicators/
Biodiversity indicators	Biodiversity Indicators Partnership	https://www.bipindicators.net/; http://www.bipnational.net/
Sustainability (all)	Global Reporting Initiative & CDP	https://www.globalreporting.org/; https://www.cdp.net/en
Natural capital (via environmental valuation)	UNSD	https://unstats.un.org/unsd/envaccounting/default.asp
Sustainability (all)	SAI Platform	http://www.saiplatform.org/pressroom/110/33/Sustainable-Performance-Assessment-2-0-Towards-Consistent-Measurement-of-Sustainability-at-Farm-Level
Biodiversity indicators	Convention on Biological Diversity	https://www.cbd.int/2010-target/framework/indicators.shtml
Other metrics and indicator initiatives		
Food waste (full cost accounting)	FAO	http://www.fao.org/publications/card/en/c/5e7c4154-2b97-4ea5-83a7-be9604925a24/
Natural Capital Protocol	Natural Capital Coalition	http://naturalcapitalcoalition.org/protocol/
25 year environment plan	UK Government (ongoing)	https://www.clientearth.org/25-year-plan-environment/
Sustainable diets and food systems	Bioversity & CIHEAM-IAMM (ongoing)	http://www.bioversityinternational.org/uploads/tx_news/Metrics_of_sustainable_diets_and_food_systems_1882.pdf

- **What social values should be recognised?** As discussed in 'What makes an ideal tool?', value judgements are intrinsic to most sustainability assessments. Careful consideration is needed as to which values are unambiguous and which carry a social or cultural framing. This links directly to the consideration of government priorities; whilst international agreements may be fairly unambiguous in their being 'right' or 'wrong', national level politics carry judgements that may be disputed. A decision will be required on whether it is necessary to align the adopted concept of 'sustainability' with these value judgements or to challenge them.
- **Tool mechanics.** Tools vary enormously in their underlying procedures. This variance relates to the indicators included in each tool and the way each tool measures performance (see 'Gaps and crossovers in concepts and data needs'). Such variation can lead to very different outcomes for the same farm (de Olde *et al.*, Bokkers and de Boer, 2017, also see 'water' results for Farm 1 in Appendix 4). Decisions will therefore need to be made concerning the following criteria:

- o Assessment scope – e.g. should a farm hold responsibility for any tenant's sustainable use of the land? Should the assessment end at the farm gate or assess impacts through to arrival at the primary buyer?
- o Assessment level – e.g. should the assessment focus on an individual farm, the entire food system or a single product?
- o The overall scoring – e.g. should the score compensate for areas of poor performance by taking an average, or take the lowest case score? Should absolute or relative scores be used?

Alternative outlooks on sustainability will also need to be considered in the development of a consistent and compatible assessment approach (see Table 1).

Conclusion

Agricultural sustainability is a complex area and the plethora of existing tools and frameworks can make the identification of common ground challenging. Voluntary sustainability assessment tools have low farmer-driven uptake and often require an assessor, while certification schemes covering elements of sustainability are burdensome, and in many cases assess sustainability concepts from a poor evidence base (Merfield *et al.*, 2015). The SFT farmer group within this study have likewise identified a number of concerns: the diversity of indicators, the extensive time requirements of certification audits and a lack of opportunities for monitoring sustainability performance on an annual basis, in a similar manner as farm profitability. The work presented above reveals a number of prospects for making improvements in this area. Key conclusions that could provide the basis for future work are:

- **Indicator selection**: many tools do not include indicators that are meaningful to farmers, representative of the farms purpose and relevant at policy level. Numeric/quantitative measurements were preferred but often represented only a small proportion of assessment inputs. The data required can be time consuming to collect, but there is a recognition that "you get out what you put in" and that quantities/measurements are potentially more useful and meaningful for benchmarking purposes than qualitative scores.
- **Transparency and understanding**: farmers appreciated transparency in the assessment and scoring process and expressed concerns when the tool was a 'black-box' (i.e. when no transparency was provided on how the results are derived).
- **Preparation in advance**: was a key element in improving the efficiency of assessments. In many cases the quantitative data required could be found in the farm's management tools. This data could, in theory, feed into multiple assessment tools (see below).
- **Graphical reporting of results** was appreciated, in particular where radar diagrams were used to provide an overview of all criteria at once. The use of graphical reporting could help to serve the desire for an easy-to-interpret comparison between years and across groups of farms.
- **Provision of recommendations was also appreciated** by the farmers participating in this study, in particular where the recommendations were tailored to the needs of the individual farm, based on the results from an individual assessment.
- Despite the divergence in questions and answers contained within a range of tools, clear **opportunities for convergence** exist between existing data collection platforms (e.g. Gatekeeper, Assured Food Standards audits) through the adoption of standardised data collection approaches, definitions and units, which would allow for the use of transfer technology. Whilst the inconsistency in this area may be difficult to address, developments in this direction could encourage data sharing and help to improve the efficiency of farm-level assessment processes.

References

AHDB (2013) Stocktake.Plus Farmer Input Booklet - All Enterprises. Available at: www.stocktakeplus.org.uk/Documents/Stocktake/FarmerPack/Stocktake FIB - All Enterprises.pdf.

Brundtland, G., Khalid, M., Agnelli, S., Al-Athel, S., Chidzero, B., Fadika, L., Hauff, V., Lang, I., Shijun, M. and de Botero, M. M. (1987) Our Common Future: Report of the World Commission on Environment and Development. Oxford University Press, USA.

de Olde, E. M., Bokkers, E. A. M. and de Boer, I. J. M. (2017) 'The Choice of the Sustainability Assessment Tool Matters: Differences in Thematic Scope and Assessment Results', Ecological Economics, 136, pp. 77–85. doi: 10.1016/j.ecolecon.2017.02.015.

de Olde, E. M., Oudshoorn, F. W., Sørensen, C. A. G., Bokkers, E. A. M. and de Boer, I. J. M. (2016) 'Assessing sustainability at farm-level: Lessons learned from a comparison of tools in practice', Ecological Indicators. Elsevier Ltd, 66(2016), pp. 391–404. doi: 10.1016/j.ecolind.2016.01.047.

Food and Agriculture Organization of the United Nations (2003) Trade and Food Security: Conceptualizing the Linkages. Rome. Available at: http://www.fao.org/docrep/005/y4671e/y4671e00.htm#Contents (Accessed: 30 May 2017).

Gibson, R. B., Agnolin, J., Hassan, S., Lawrence, D., John Robinson and Whitelaw, G. S. (2001) Specification of sustainability-based environmental assessment decision criteria and implications for determining 'significance' in environmental assessment. Canadian Environmental Assessment Agency Research and Development Programme. Available at: http://static.twoday.net/NE1BOKU0607/files/Gibson_Sustainability-EA.pdf (Accessed: 14 May 2016).

Hietala, S., Smith, L., Knudsen, M. T., Kurppa, S., Padel, S. and Hermansen, J. E. (2015) 'Carbon footprints of organic dairying in six European countries—real farm data analysis', Organic Agriculture. Springer Netherlands, 5(2), pp. 91–100. doi: 10.1007/s13165-014-0084-0.

Lindsay, J. (2005) Evaluation of HSE's farm self assessment software. 355. Norwich: Her Majesty's Stationary Office. Available at: http://www.hse.gov.uk/research/rrpdf/rr355.pdf (Accessed: 16 May 2017).

Loiseau, E., Junqua, G., Roux, P. and Bellon-Maurel, V. (2012) 'Environmental assessment of a territory: An overview of existing tools and methods', Journal of Environmental Management, 112, pp. 213–225. doi: 10.1016/j.jenvman.2012.07.024.

Mason, P. and Lang, T. (2017) Sustainable diets : how ecological nutrition can transform consumption and the food system. 1st edn. Routledge.

Merfield, C., Moller, H., Manhire, J., Rosin, C., Norton, S., Carey, P., Hunt, L., Reid, J., Fairweather, J., Benge, J., Le Quellec, I., Campbell, H., Lucock, D., Saunders, C., Macleod, C., Barber, A. and Mccarthy, A. (2015) 'Are Organic Standards Sufficient to Ensure Sustainable Agriculture? Lessons From New Zealand's ARGOS and Sustainability Dashboard Projects', Sustainable Agriculture Research, 4(3). doi: 10.5539/sar.v4n3p158.

Natural Capital Committee (2014) Towards a Framework for Defining and Measuring Changes in Natural Capital. 1. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516946/ncc-working-paper-measuring-framework.pdf (Accessed: 31 May 2017).

Our Sustainability Plan (2017). Available at: http://view.ceros.com/msl/sustainability-plan/p/1.

Petrie, H. and Bevan, N. (2009) 'The evaluation of accessibility, usability and user experience', in Stepanidis, C. (ed.) The Universal Access Handbook. CRC Press. Available at: www.crcpress.com/product/isbn/9780805862805 (Accessed: 16 May 2017).

Philips, J. (ed.) (2017) Principles of Natural Capital Accounting. Available at: https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/principlesofnaturalcapitalaccounting#basic-valuation-principles-in-natural-capital-accounting (Accessed: 31 May 2017).

Schader, C., Grenz, J., Meier, M. S. and Stolze, M. (2014) 'Scope and precision of sustainability assessment approaches to food systems', Ecology and Society, 19(3), p. 42. doi: 10.5751/ES-06866-190342.

United Nations Sustainable Development (1992) 'Promoting Sustainable Agriculture and Rural Development', in Agenda 21. Rio de Janerio, Brazil, p. 351. Available at: https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf (Accessed: 31 May 2017). United Nations Sustainable Development (no date) Sustainable Development Knowledge Platform: Sustainable Development Goals. Available at: https://sustainabledevelopment.un.org/?menu=1300 (Accessed: 31 May 2017).

Appendix A

Themes defined in the sustainability assessment tools analysed

Cool Farm Tool - biodiversity	Cool Farm Tool - GHG	PG Tool	RISE	SMART	Soil and More Sustainability Flower
• farmed products • farming practices • small habitats • large habitats • livestock, crop and variety • arable flora • wetland or aquatic flora • woodland flora • grassland flora • soil fauna • beneficial invertebrates • grassland birds • arable birds • woodland birds • aquatic fauna	GHG emissions (divided by: • land management • soil/fertilisers • pesticide • residue mgmt • energy & processing • water waste • transport)	• farm business resilience • soil mgmt • water mgmt • fertiliser mgmt • energy and carbon • food security • agri. systems diversity • animal health and welfare mgmt • social capital	• farm management • economic viability • soil use • animal husbandry • material use & environmental protection • water use • energy & climate • biodiversity • working conditions	• corporate ethics • accountability • participation • rule of law • holistic mgmt. • investment • vulnerability • product quality and information • local economy • atmosphere • water • land • biodiversity • materials/energy • animal welfare • decent livelihood • fair trading practices • labour rights • equity • human health and safety • cultural diversity	• economic life • soil • plants • animals • energy • air • water • societal life • cultural life

Appendix B

Map showing location of assessed farms

Farm 1

A

GHG emissions

Total: 3,668,889.04 kg CO2e

Per litre 1.57 CO2e

	kg CO2e
Energy & Processing	62726.38
Water waste	0.00
Transport	22977.17
Feed production	1947285.47
Manure management	104769.49
Enteric fermentation	1531130.53

Pie chart: 53.08%, 41.73%, 2.86%, others

Livestock type	cattle	Reporting year						2016
Finished product	2,337,372.00 litre							

Emissions per 1.57 kg CO2e

Summary

Total emissions 3,668,889.04 kg CO2e

Per litre 1.57 kg CO2e

kg	CO2	N2O	CH4	Total CO2eq	Per tonne
Direct energy use	62726.38			62726.38	0.03
Enteric fermentation			61245.22	1531130.53	0.66
Feed production	1947285.47			1947285.47	0.83
Manure management	104769.49			104769.49	0.04
Off-farm transport	22977.17			22977.17	0.01
Waste water			0.00	0.00	0.00
Total	2137798.51	0.00	61245.22	3668889.04	1.57

B

Farmed products: 29%   Farming practices: 44%

Small habitats: 16%   Large habitats: 0%

Land use

Pie chart:
- Grass and flower habitats 4.7 ha, 2 %
- Woody habitats 0.3 ha, 0 %
- Nature agreement in productive fields 0 ha, 0 %
- Aquatic habitats 1 ha, 0 %
- Productive (no nature management) 212.7 ha, 97 %

Species group scores

- Livestock, crop and variety (3 / 9) 33%
- Arable flora (3 / 18) 17%
- Wetland or aquatic flora (2 / 22) 9%
- Woodland flora (1 / 7) 14%
- Grassland flora (4 / 30) 13%
- Soil fauna (13 / 36) 36%
- Beneficial invertebrates (12 / 70) 17%
- Grassland birds (5 / 34) 15%
- Arable birds (4 / 38) 11%
- Woodland birds (5 / 35) 14%
- Aquatic fauna (9 / 56) 16%

C

Radar chart axes:
- Soil management, 4.8
- Water management, 2.7
- Fertiliser management, 3.2
- Energy and carbon, 2.3
- Food security, 3.2
- Agricultural systems diversity, 2.7
- Social capital, 3.0
- Farm business resilience, 3.5
- Animal health and welfare management, 4.0
- Landscape and heritage features, 3.5
- Agri-environmental management, 2.0

D

Radar chart axes:
- Materials use & environmental protection (77)
- Water use (82)
- Animal husbandry (88)
- Soil use (84)
- Farm management (86)
- Economic viability (74)
- Working conditions (90)

E

Radar chart axes:
- Energy & Climate (45)
- Holistic Management (61%)
- Atmosphere (47%)
- Water (78%)
- Land (67%)
- Biodiversity (52%)
- Materials and Energy (65%)
- Animal Welfare (81%)
- Investment (69%)
- Vulnerability (71%)
- Local Economy (49%)
- Product Quality and Information (60%)
- Decent Livelihood (93%)
- Fair Trading Practices (61%)
- Labour Rights (71%)
- Human Safety and Health (82%)
- Equity (72%)
- Cultural Diversity (82%)
- Corporate Ethics (62%)
- Accountability (48%)
- Biodiversity (18)
- Participation (93%)
- Rule of Law (69%)

A

GHG emissions

21,454.74 kg CO2e
Per acre: 498.95 kg CO2e
Per tonne: 84.14 kg CO2e

	kg CO2e
Land management	-7468.42
Soil / fertilisers	15326.89
Pesticide	2496.18
Energy & processing	7240.99
Water waste	3648.11
Transport	0.00
	0.00

62.99%
13.36%
21.07%
2.69%

winter_wheat_2017

Crop type	Winter wheat	Reporting year:	2017
Fresh product		Finished product	
Product yield:	150.00 tonne	Growing area	255.00 tonne
	5.93 tonne / acre		43.00 acres, medium, dry

Summary

Total emissions	Emissions per acre	Emissions per tonne
21,454.74 kg CO2e	498.95 kg CO2e	84.14 kg CO2e

	CO_2	N_2O	CH_4	Total CO2eq	Per acre	Per tonne	Per tree
Energy use (processing)	3,848.11			3,848.11	89.49	15.09	-
Energy use (field)	12,051.32			12,051.32	280.26	47.26	-
Fertiliser production*	3,275.57	10.99		3,275.57	76.18	12.85	-
Soil / fertiliser							-
Carbon stock changes	-7,468.42			-7,468.42	-173.68	-29.29	-
Paddy methane							-
Pesticides	2,498.18			2,498.18	58.10	9.80	-
Crop residue mgmt		24.33		7,240.99	168.60	28.43	-
Seed production							-
Off-farm transport							-
Waste water							-
Total	10,929.10	35.32		21,454.74	498.95	84.14	-

*calculated with validated default values for fertiliser production.

B

Farmed products: 65% Farming practices: 67%
Small habitats: 78% Large habitats: 86%

Land use

Grass and flower habitats 23.5 ha, 9 %
Woody habitats 41.8014 ha, 16 %
Nature agreement in productive fields 0 ha, 0 %
Aquatic habitats 4.66 ha, 2 %
Productive (no nature management) 188.0386 ha, 73 %

Species group scores

Livestock, crop and variety (5/9)	56%
Arable flora (13/18)	72%
Wetland or aquatic flora (19/22)	86%
Woodland flora (7/7)	100%
Grassland flora (20/30)	67%
Soil fauna (24/36)	67%
Beneficial invertebrates (51/70)	73%
Grassland birds (25/34)	74%
Arable birds (24/38)	63%
Woodland birds (31/35)	89%
Aquatic fauna (43/56)	77%

C

Landscape and heritage features, 4.0
Soil management, 3.8
Water management, 3.8
Fertiliser management, 3.6
Agri-environmental management, 4.0
Energy and carbon, 2.6
Soil use (79)
Food security, 3.6
Animal health and welfare management, 4.3
Agricultural systems diversity, 3.8
Farm business resilience, 4.0
Social capital, 3.3

D

Materials use & environmental protection (77)
Water use (81)
Animal husbandry (93)
Energy & Climate (90)
Farm management (73)
Economic viability (49)
Working conditions (79)

E

Holistic Management (80%)
Atmosphere (59%)
Water (77%)
Land (60%)
Biodiversity (53%)
Materials and Energy (74%)
Animal Welfare (88%)
Investment (72%)
Vulnerability (73%)
Local Economy (44%)
Decent Livelihood (92%)
Product Quality and Information (70%)
Fair Trading Practices (51%)
Labour Rights (74%)
Equity (61%)
Human Safety and Health (61%)
Cultural Diversity (78%)
Corporate Ethics (78%)
Accountability (74%)
Participation (80%)
Rule of Law (77%)
Biodiversity (78%)

Farm 2

Where A = CFT (GHG), B = CFT (Bio.), C = PG Tool, D = RISE and E = SMART

Farm 3

A

GHG emissions
474,799.77 kg CO2e
Per hectare:
1,707.91 kg CO2e
Per tonne:
184.25 kg CO2e

	kg CO2e
Land management	-530725.83
Soil / fertilisers	62229.35
Pesticide	39893.00
Residue mgmt	143719.28
Energy & processing	17995427
Water waste	0.00
Transport	17729.71

62.08%
1.76%
17.90%
4.29%

	Crop type	Reporting year	2016
	Winter wheat		
Fresh product	2,577.00 tonne	Finished product	2,577.00 tonne
Product yield	9.27 tonne / ha	Growing area	278.00 hectares, medium, moist

Summary

Total emissions	Emissions per hectare	Emissions per tonne
474,799.77 kg CO2e	1,707.91 kg co2e	184.25 kg CO2e

	CO₂	N₂O	CH₄	Total CO₂-eq	Per hectare	Per tonne	Per tree
Energy use (processing)				179,954.27	647.32	69.83	
Energy use (field)	179,954.27			246,931.90	888.24	95.82	
Fertiliser production*	246,931.90	998.61		377,297.45	1,357.19	146.41	
Soil / fertiliser	79,711.95			-530,725.83	-1,909.09	-205.95	
Carbon stock changes	-530,725.83						
Paddy methane							
Pesticides	39,893.00			39,893.00	143.50	15.48	
Crop residue mgmt		482.28		143,719.28	516.98	55.77	
Seed production							
Off-farm transport	17,729.71			17,729.71	63.78	6.88	
Waste water							
Total	33,494.99	1,480.89		474,799.77	1,707.91	184.25	

*Calculated with validated default values for fertiliser production.

B

Land use

Farmed products: 41% Farming practices: 53%
Small habitats: 71% Large habitats: 57%

Grass and flower habitats
100.520000000000001 ha, 4 %
Woody habitats
499.39325 ha, 20 %
Nature agreement in productive fields
0 ha, 0 %
Aquatic habitats
24.89 ha, 1 %
Productive (no nature management)
1925.19675 ha, 75 %

Species group scores

Livestock, crop and variety (4 / 9) 44%
Arable flora (8 / 18) 44%
Wetland or aquatic flora (17 / 22) 77%
Woodland flora (4 / 7) 57%
Grassland flora (21 / 30) 70%
Soil fauna (18 / 36) 50%
Beneficial invertebrates (41 / 70) 59%
Grassland birds (19 / 34) 56%
Arable birds (20 / 38) 53%
Woodland birds (19 / 35) 54%
Aquatic fauna (36 / 56) 64%

C

Soil management, 4.6
Water management, 3.5
Landscape and heritage features, 4.0
Fertiliser management, 4.0
Agri-environmental management, 4.0 3.8
Energy and carbon, 3.7
Animal health and welfare management, 4.0
Food security, 2.7
Agricultural systems diversity, 2.3
Farm business resilience, 4.0
Social capital, 3.0

3.0
2.0
1.0
0.0

D

Materials use & environmental protection (77)
Water use (86)
Animal husbandry (81)
Energy & Climate (89)
Farm management (79)
Economic viability (82)
Working conditions (62)
Soil use (72)
Fertiliser management (72)

E

Materials use & environmental protection (77)
Soil (72)
Biodiversity (75)
Participation (75)
Rule of Law (65)
Holistic Management (63%)
Atmosphere (60%)
Water (73%)
Land (62%)
Biodiversity (48%)
Materials and Energy (93%)
Animal Welfare (93%)
Investment (65%)
Local Economy (42%)
Product Quality and Information (54%)
Vulnerability (62%)
Decent Livelihood (82%)
Labelling Practices (48%)
Labour Rights (65%)
Equity (68%)
Human Safety and Health (72%)
Cultural Diversity (72%)
Corporate Ethics (56%)
Accountability (55%)
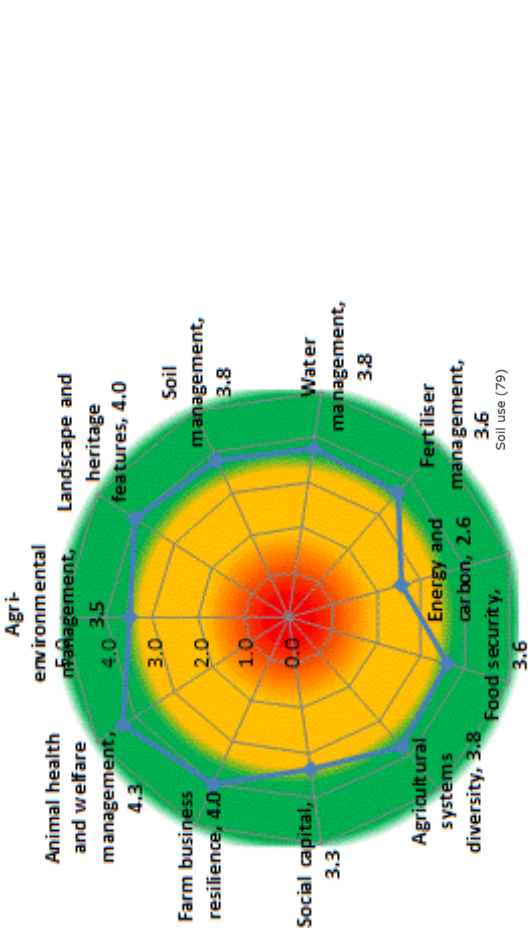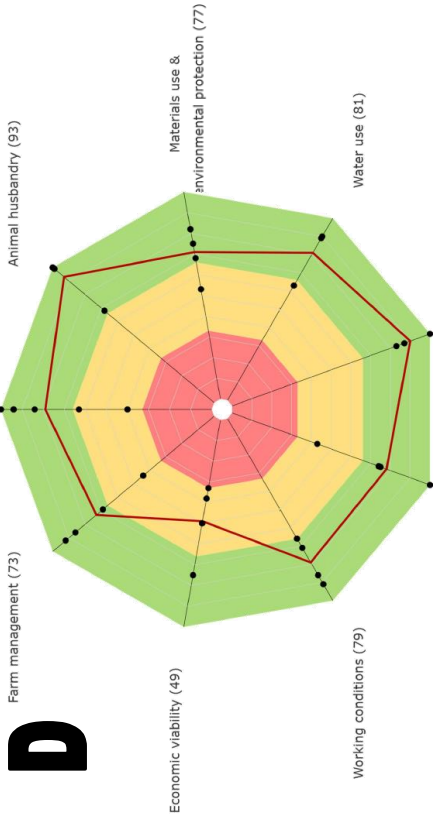
Where A = CFT (GHG), B = CFT (Bio.), C = PG Tool, D = RISE and E = SMART

A

GHG emissions
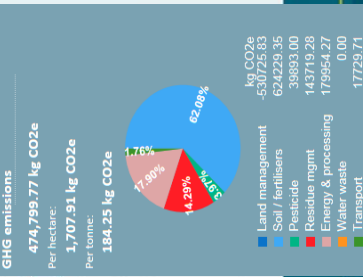3,472.30 kg CO2e
Per hectare:
347.23 kg CO2e
Per tonne:
86.81 kg CO2e

	kg CO2e
Land management	0.00
Soil / fertilisers	2486.82
Pesticide	0.00
Residue mgmt	632.19
Energy & processing	353.28
Water waste	0.00
Transport	0.01

71.62%
10.17%
18.21%

B

Livestock type: **cattle**
Finished product: **863,000.00 litre**
Reporting year: **2016**

Summary

Total emissions	Emissions per ~
1,082,966.45 kg CO2e	**1.25** kg CO2e

kg	CO2	N2O	CH4	Total CO2eq	Per tonne
Direct energy use	39445.51			39445.51	0.05
Enteric fermentation			18708.09	467702.32	0.54
Feed production	246033.92			246033.92	0.29
Manure management	85391.21			85391.21	0.10
Off-farm transport	1393.49			1393.49	0.00
Waste water			9720.00	243000.00	0.28
Total	372264.13	0.00	28428.09	1082966.45	1.25

Farmed products: **88%**   Farming practices: **85%**
Small habitats: **49%**   Large habitats: **57%**

Land use

Species group scores

Livestock, crop and variety (9/9) 100%
Arable flora (13/18) 72%
Wetland or aquatic flora (5/22) 23%
Woodland flora (4/7) 57%
Grassland flora (19/30) 63%
Soil fauna (31/36) 86%
Beneficial invertebrates (42/70) 60%
Grassland birds (26/34) 76%
Arable birds (25/38) 66%
Woodland birds (24/35) 69%
Aquatic fauna (28/56) 50%

Grass and flower habitats 0 ha, 0%
Woody habitats 37.3 ha, 4%
Nature agreement in productive fields 0 ha, 0%
Aquatic habitats 8.2 ha, 1%
Productive (no nature management) 0 ha, 0%

C

D

E

Farm 4

A

GHG emissions

Total 422,241.43 kg CO2e
Per litre 1.28 kg CO2e

	kg CO2e
Energy & Processing	40074.82
Water waste	0.00
Transport	8510.80
Feed production	34452.78
Manure management	99503.03
Enteric fermentation	239700.00

Livestock type: cattle
Reporting year

Finished product: 328,752.00 litre

Summary

Emissions per kg: 1.28 kg CO2e

Total emissions: 422,241.43 kg CO2e

	CO₂	N₂O	CH₄	Total CO₂,eq	Per litre
Direct energy use	40074.82			40074.82	0.12
Enteric fermentation			9588.00	239700.00	0.73
Feed production	34452.78			34452.78	0.10
Manure management	99503.03			99503.03	0.30
Off-farm transport	8510.80			8510.80	0.03
Waste water				-	-
Total	182541.43	-	9588.00	422241.43	1.28

B

Farmed products: **59%**   Farming practices: **66%**
Small habitats: **59%**   Large habitats: **43%**

Land use

Species group scores

Livestock, crop and variety (5/9)	56%
Arable flora (5/18)	28%
Wetland or aquatic flora (18/22)	82%
Woodland flora (4/7)	57%
Grassland flora (22/30)	73%
Soil fauna (19/36)	53%
Beneficial invertebrates (37/70)	53%
Grassland birds (25/34)	74%
Arable birds (18/38)	47%
Woodland birds (19/35)	54%
Aquatic fauna (40/56)	71%

Grass and flower habitats 19.2075 ha, 14 %
Woody habitats 22.1648 ha, 16 %
Nature agreement in productive fields 0 ha, 0 %
Aquatic habitats 3.1 ha, 2 %
Productive (no nature management) 89.8877000000002 ha, 67 %

C

Animal health and welfare management, 4.5
Agri-environmental Landscape and management, 2.6 Heritage features, 3.5
Soil management, 4.2
Water management, 4.0
Fertiliser management, 3.8
Energy and carbon, management, 2.7
Agricultural systems diversity, 4.5
Social capital, 3.7
Farm business resilience, 4.5
Food security, 4.6

D

Animal husbandry (89)
Materials use & environmental protection (73)
Energy & Climate (88)
Soil use (75)
Farm management (81)
Working conditions (74)

E

Materials use & protection (73)
Holistic Management (44%)
Atmosphere (59%)
Water (75%)
Land (64%)
Biodiversity (67%)
Materials and Energy (69%)
Animal Welfare (83%)
Investment (68%)
Vulnerability (67%)
ct Quality and Information (72%)
ocal Economy (40%)
vellihood (81%)
actices (49%)
our Rights (73%)
Human Safety and Health (85%)
Cultural Diversity (84%)
Corporate Ethics (54%)
Accountability (63%)
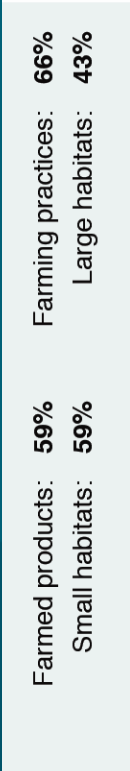Participation (78%)
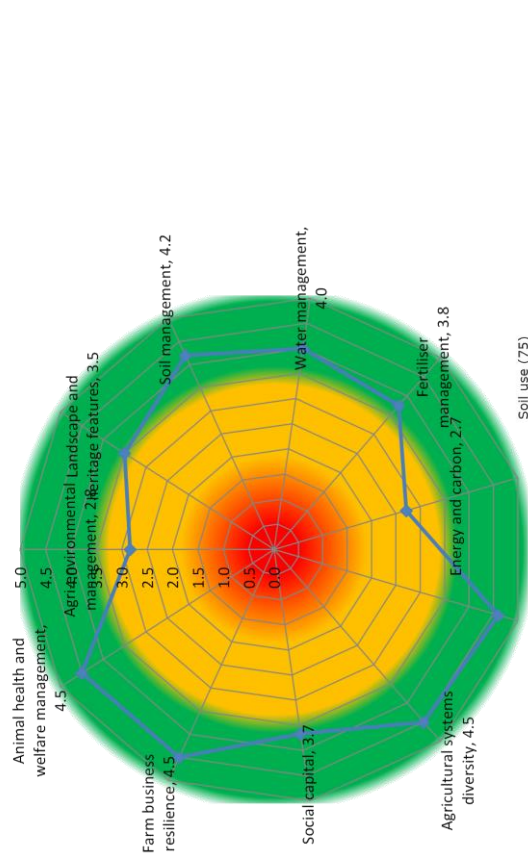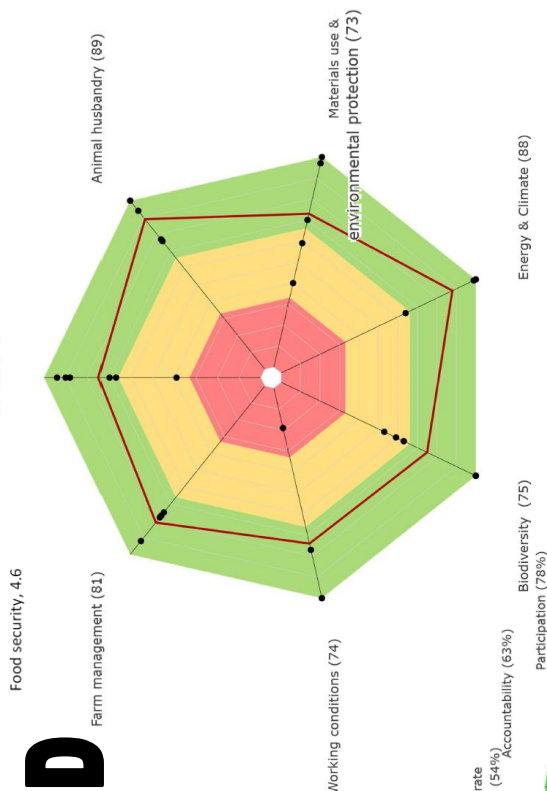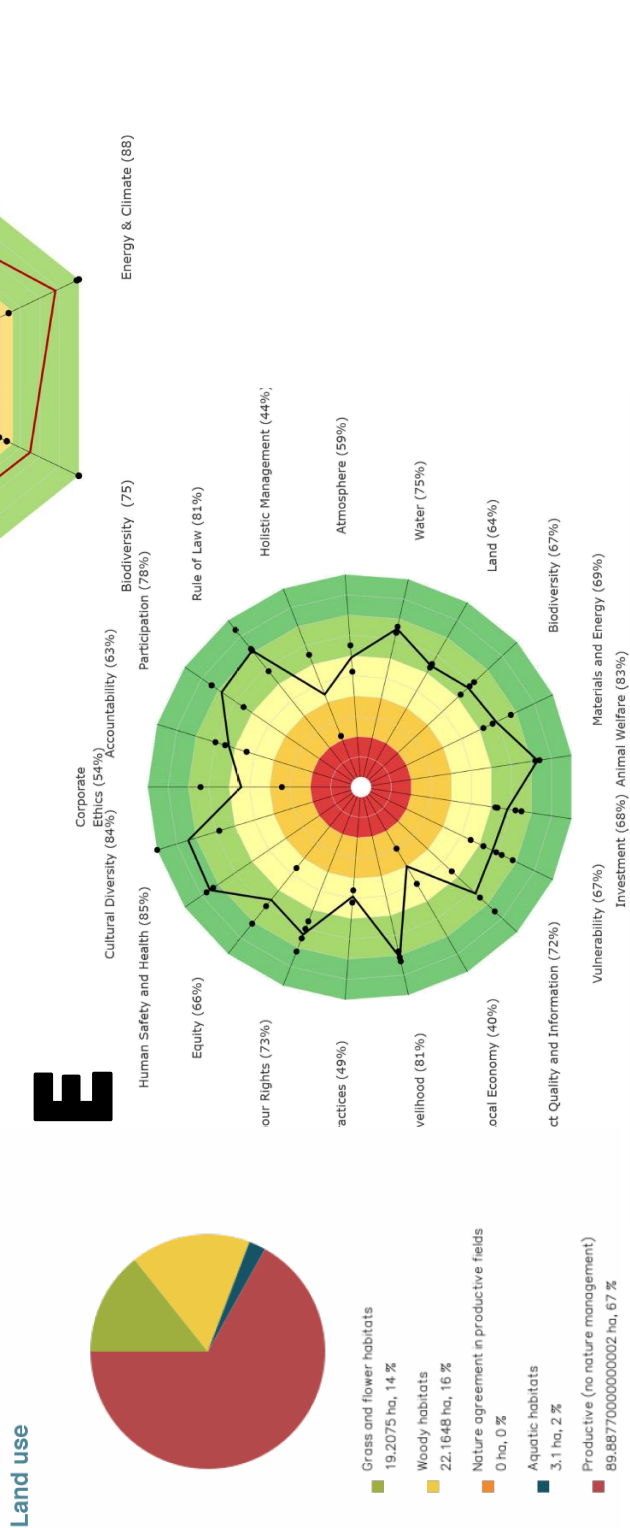Rule of Law (81%)
Biodiversity (75%)
Equity (66%)

Farm 5

Where A = CFT (GHG), B = CFT (Bio.), C = PG Tool, D = RISE and E = SMART

Appendix D

Feedback from farmers and land managers on tool usability collected in writing and/or during telephone interviews

Farm name:	**Farm 1**
Researcher name:	**Laurence Smith**

Q1a. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their usefulness (1 = most useful, 4 = least useful)?

1. **SMART**

2. **RISE**

3. **PG Tool**

4. **Cool Farm Tool**

Reasons for ranking (e.g. what features were particularly useful)

More detailed reporting with SMART – use of separate charts for all four areas of sustainability very useful

PG Tool – organic focus

Cool Farm Tool – gaps on livestock side however a new version is expected in June 2017

Q1b. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their ease of use (1 = easiest, 4 = most difficult)?

1. **Cool Farm Tool**

2. **PG Tool**

3. **SMART**

4. **RISE**

Reasons for ranking (what features made the assessment particularly easy/quick)

Cool Farm – easy and quick to use

PG Tool - simple Excel spreadsheet, easy to use and transparent

SMART & RISE – lengthy although detailed report is generated

REPORTING FORMAT QUESTIONS:

Q2a. Which elements of the reporting format(s) did you like or find particularly useful? Why?

SMART…Individual graphs for each sustainability domain (environment, economic, social, governance) ……………………………………………………………………………

RISE …Detailed report & easy to understand results……………………………………………

PG Tool….Simple and transparent…………………………………………………………

Cool Farm Tool…..Clear format……………………………………..…………………………..

Q2b. Were there elements of the reporting format(s) that you disliked? Why?

SMART……Very long report, i.e. 79 pages……………………………………..…………….

RISE …31 page report - lengthy……………………………………………………………

PG Tool …Brief report, just provides a snapshot of current performance…………………..

Cool Farm Tool…Just a statement of current performance in one area………………………

Q2c. Were there any bits of the reporting that you found confusing or struggled to understand?

SMART………………………………………………………………………………………….

RISE …………………………………………………………………………………………

PG Tool …………………………………………………………………………………..

Cool Farm Tool……………………………………………………………………………….

Q2d. Do you have any comments or suggestions for what we could do to improve the reporting formats? Any features or approaches we didn't use that you think might help?

SMART………………………………………………………………………………………….

RISE …………………………………………………………………………………………

PG Tool ……More detail and reasoning behind scores needed……………………………………

Cool Farm Tool…More detailed report……………………………………………………………..

QUESTION FORMAT:

Q3a. Which question format(s) did you prefer? (e.g. drop down lists, open questions, data entry). Why?

Data entry, more accurate. Open questions need more work as they are too subjective

Q3b. Were there any question format(s) you didn't like? Why ?

Drop down lists are ok but 3 or 4 options easiest otherwise too long

Open questions can be misinterpreted

Q3c. Do you have any comments or suggestions for what we could do to improve the question formats? Any features or approaches we didn't use that you think might help, for example?

Most of the economic sections seemed short of hard detail and were a little fluffy

ADDITIONAL QUESTIONS ON ASSESSMENT PROCESS:

Q4a. Are there any particular elements or sections of any of the tools or reports that were particularly memorable/stick in your head? What made them memorable?

SMART report – like the use of colours / graphics; makes results very easy to read

Q4b. Do you have any further comments/suggestions to help us improve the PG Tool / RISE / SMART or the Cool Farm Tool? Any features or approaches we didn't use that you think might help, for example?

SMART……Very good / report too long but detailed and readable……………………………..

RISE …Very good, fewer points than SMART so provides clear image of business

PG Tool …Clearly an organic tool

Cool Farm Tool……Needs much more work to be useful

DEVELOPMENT OF A SELF-ASSESSMENT

Q5a. If we were to develop a new self-assessment tool to feed in to the various assessments you already complete (for certifiers, retailers, government, etc.) what should we do to make the process as user-friendly as possible?

Clear list of data required at or before start. Different stages would help, i.e. ranging from Red Tractor (basic) to full sustainability audit (detailed)

Q5b. How much time would you be prepared to invest in a self-evaluation in hours / minutes?

Happy to spend 2-3 hours if the results are accurate and represent the business accurately

Q5c. How comfortable would you be in completing a self-evaluation on your own next year, with an assessor available over the phone? (please rank on scale of 1-5)

……5……… out of 5   (1 = not at all comfortable, 5 = extremely comfortable)

Provide reasons for ranking and additional details here:
All evaluations were reasonably simple / easy to fill in

Q5d. How useful would sharing results from such an assessment tin peer-to-peer groups be and would you be happy to engage with such an activity? (please rank on scale of 1-5)

……3……… out of 5   (1 = not at all useful, 5 = extremely useful)

Provide reasons for ranking and additional details here:
Some of the questions were very subjective in all tools so comparison could be misleading

Q6 Any other comments?

Should stick to things that can be measured easily rather than subjective measures that produce skewed results

Thank you for your feedback

Farm name:	**Farm 2**
Researcher name:	**Laurence Smith**

Q1a. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their usefulness (1 = most useful, 4 = least useful)?

1. **PG Tool**

2. **SMART**

3. **RISE**

4. **Cool Farm Tool**

Reasons for ranking (e.g. what features were particularly useful)

> **PG Tool = more factual, less qualitative**
>
> **SMART & RISE = good feedback report**
>
> **Cool Farm Tool = did not understand results or what to do with them**

Q1b. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their ease of use (1 = easiest, 4 = most difficult)?

1. **PG Tool**

2. **SMART**

3. **RISE**

4. **Cool Farm Tool**

Reasons for ranking (what features made the assessment particularly easy/quick)

> **Interface on PG Tool easy to use**
>
> **Took more time to work out how to use**

REPORTING FORMAT QUESTIONS:

Q2a. Which elements of the reporting format(s) did you like or find particularly useful? Why?

SMART…Useful recommendations in report……………………………………………………

RISE…Useful recommendations in report…………………………………………………….

PG Tool …………………………………………………………………………………..

Cool Farm Tool…Clear figures but did not understand them……………………………….

Q2b. Were there elements of the reporting format(s) that you disliked? Why?

SMART……………………………………………………………………………………….

RISE ………………………………………………………………………………………

PG Tool ……Limited results; a bit 'black and white'…………………………………………..

Cool Farm Tool……………………………………………………………………………….

Q2c. Were there any bits of the reporting that you found confusing or struggled to understand?

SMART……………………………………………………………………………………….

RISE ………………………………………………………………………………………..

PG Tool …Only provides indicators rather than help on how to improve……………………

Cool Farm Tool……Did not know what results meant…………………………………………

Q2d. Do you have any comments or suggestions for what we could do to improve the reporting formats? Any features or approaches we didn't use that you think might help?

SMART……………………………………………………………………………………….

RISE ………………………………………………………………………………………

PG Tool ……………………………………………………………………………………..

Cool Farm Tool……………………………………………………………………………….

QUESTION FORMAT:

Q3a. Which question format(s) did you prefer? (e.g. drop down lists, open questions, data entry). Why?

Quantitative data entry – more useful / meaningful

Q3b. Were there any question format(s) you didn't like? Why ?

Subjective / qualitative questions – unnecessary and do not really provide a true snapshot of the farm

Q3c. Do you have any comments or suggestions for what we could do to improve the question formats? Any features or approaches we didn't use that you think might help, for example?

More data collection and maybe more information required for soil / air / water areas and more financial info on how the farm is performing

ADDITIONAL QUESTIONS ON ASSESSMENT PROCESS:

Q4a. Are there any particular elements or sections of any of the tools or reports that were particularly memorable/stick in your head? What made them memorable?

It was an assessment rather than an audit and therefore the results are useful and functional in helping the business to develop

Q4b. Do you have any further comments/suggestions to help us improve the PG Tool / RISE / SMART or the Cool Farm Tool? Any features or approaches we didn't use that you think might help, for example?

SMART…Needs to be more data driven and provide more quantitative financial information……………………………………………………………………………………….

RISE … Needs to be more data driven and provide more quantitative financial information

PG Tool …Expand financial information………………………………………………………..

Cool Farm Tool……………………………………………………………………………….

DEVELOPMENT OF A SELF-ASSESSMENT

Q5a. If we were to develop a new self-assessment tool to feed in to the various assessments you already complete (for certifiers, retailers, government, etc.) what should we do to make the process as user-friendly as possible?

If you are a member of a certification body this could feed a lot of data into the tool. Having an information sheet in advance with the information required is key

Q5b. How much time would you be prepared to invest in a self-evaluation in hours / minutes?

2-3 hours – need a bit more but all time well-spent for business management

Q5c. How comfortable would you be in completing a self-evaluation on your own next year, with an assessor available over the phone? (please rank on scale of 1-5)

……4……… out of 5   (1 = not at all comfortable, 5 = extremely comfortable)

Provide reasons for ranking and additional details here:
Now that I know what data I need to gather and collect during the year

Q5d. How useful would sharing results from such an assessment tin peer-to-peer groups be and would you be happy to engage with such an activity? (please rank on scale of 1-5)

………5…… out of 5   (1 = not at all useful, 5 = extremely useful)

Provide reasons for ranking and additional details here:

Learning the process and what data is required would help improve the tools

Q6 Any other comments?

All tools could do with links to further information / guidance on where you can improve or find relevant information on how to improve

Single figure to give overall sustainability ranking would be useful which may mean adding a weight to the various sections of the tool so that a borderline economic farm that is very biodiverse will score ok, plus this can be related to the end product.

Thank you for your feedback

Farm name:	**Farm 3**
Researcher name:	**Samantha Mullender**

Q1a. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their usefulness (1 = most useful, 4 = least useful)?

1. **SMART**

2. **RISE**

3. **PG Tool**

4. **Cool Farm Tool**

Reasons for ranking (e.g. what features were particularly useful)

> **PG Tool – too many bits of paper when results are printed. Easy to fill in**
> **SMART – results look good and are easy to read, looks 'finished' and less cluttered**

Q1b. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their ease of use (1 = easiest, 4 = most difficult)?

1. **SMART**

2. **PG Tool / RISE (same)**

3. **Cool Farm Tool**

Reasons for ranking (e.g. what features made the assessment particularly easy/quick)

REPORTING FORMAT QUESTIONS:

Q2a. Which elements of the reporting format(s) did you like or find particularly useful? Why?

> **SMART: All – well laid out, inclusion of Good Governance useful**……………………………………………………………………………….
>
> **RISE: Less categories and easier to look at**………………………………………………………..
>
> **PG Tool: easy to do but report very long**………………………………………………………
>
> **Cool Farm Tool: Nice to be able to compare CO_2 impact of different products**………….

Q2b. Were there elements of the reporting format(s) that you disliked? Why?

> **SMART: Some irrelevant categories, e.g. forced labour. Confidentiality concerns in some areas, e.g. use of agricultural chemicals**………………………………………………………………
>
> **RISE: Quantitative financial aspects too detailed, qualitative financial assessment ok**
>
> **PG Tool: Lots to fill in**………………………………………………………………………….
>
> **Cool Farm Tool: Fuel use reporting seems highly inaccurate**………………………………..

Q2c. Were there any bits of the reporting that you found confusing or struggled to understand?

> **SMART**……………………………………………………………………………………….
>
> **RISE** ………………………………………………………………………………………
>
> **PG Tool** …………………………………………………………………………………..
>
> **Cool Farm Tool…Fuel use**………………………………………………………………….

Q2d. Do you have any comments or suggestions for what we could do to improve the reporting formats? Any features or approaches we didn't use that you think might help?

> **SMART**……………………………………………………………………………………….
>
> **RISE** ………………………………………………………………………………………
>
> **PG Tool** …………………………………………………………………………………..
>
> **Cool Farm Tool**………………………………………………………………………………….

QUESTION FORMAT:

Q3a. Which question format(s) did you prefer? (e.g. drop down lists, open questions, data entry). Why?

> **Drop down lists - straightforward**

Q3b. Were there any question format(s) you didn't like? Why ?

> **Agricultural chemicals use in RISE – too much detail and requires too much time. Would be much easier if same format as farm record keeping software Gatekeeper was used**

Q3c. Do you have any comments or suggestions for what we could do to improve the question formats? Any features or approaches we didn't use that you think might help, for example?

> **Like drop down lists**

ADDITIONAL QUESTIONS ON ASSESSMENT PROCESS:

Q4a. Are there any particular elements or sections of any of the tools or reports that were particularly memorable/stick in your head? What made them memorable?

> **Like the use of radar diagrams in reporting, provides a good overview of better/worse areas of performance**

Q4b. Do you have any further comments/suggestions to help us improve the PG Tool / RISE / SMART or the Cool Farm Tool? Any features or approaches we didn't use that you think might help, for example?

SMART……………………………………………………………………………………………….

RISE ………………………………………………………………………………………………

PG Tool …………………………………………………………………………………………..

Cool Farm Tool…Fuel use- want to understand where the numbers come from to help with transparency………………………………………………………………………………….

DEVELOPMENT OF A SELF-ASSESSMENT

Q5a. If we were to develop a new self-assessment tool to feed in to the various assessments you already complete (for certifiers, retailers, government, etc.) what should we do to make the process as user-friendly as possible?

Drop down lists. However be aware that farmers may tell you what you want to hear in a sustainability assessment

Q5b. How much time would you be prepared to invest in a self-evaluation in hours / minutes?

1.5 – 2 hours. Initial assessment would be difficult but follow-ups much easier

Q5c. How comfortable would you be in completing a self-evaluation on your own next year, with an assessor available over the phone? (please rank on scale of 1-5)

…3 to 3.5… out of 5   (1 = not at all comfortable, 5 = extremely comfortable)

Provide reasons for ranking and additional details here:
Gets easier the more often you complete the assessment but would only be once a year I most cases. Need to sit down and prepare yourself for visit.

Q5d. How useful would sharing results from such an assessment tin peer-to-peer groups be and would you be happy to engage with such an activity? (please rank on scale of 1-5)

…………4… out of 5   (1 = not at all useful, 5 = extremely useful)

Provide reasons for ranking and additional details re: willingness to engage here:
Useful as long as organisations were of a similar size and results were anonoymised

Q6 Any other comments?

Very worthwhile, very interesting

Thank you for your feedback

Farm name:	**Farm 4**
Researcher name:	**Laurence Smith**

Q1a. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their usefulness (1 = most useful, 4 = least useful)?

1. **PG Tool**

2. **SMART**

3. **RISE**

4. **Cool Farm Tool**

Reasons for ranking (e.g. what features were particularly useful)

PG tool was more transparent than other tools and results easier to understand.   Cool Farm Tool interface difficult to interpret

Q1b. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their ease of use (1 = easiest, 4 = most difficult)?

1. **PG Tool**

2. **SMART & RISE**

3. **Cool Farm Tool**

Reasons for ranking (what features made the assessment particularly easy/quick)

PG tool data was readily available

REPORTING FORMAT QUESTIONS:

Q2a. Which elements of the reporting format(s) did you like or find particularly useful? Why?

SMART…………………………………………………………………………………………….

RISE …………………………………………………………………………………………

PG Tool …Preferred 1 to 5 scoring approach – easier to understand compared to

other tools

Cool Farm Tool……………………………………………………………………………….

Q2b. Were there elements of the reporting format(s) that you disliked? Why?

SMART…………………………………………………………………………………………….

RISE …………………………………………………………………………………………

PG Tool ………………………………………………………………………………………..

Cool Farm Tool……Misses some important areas e.g. compound feed mix……………….

Q2c. Were there any bits of the reporting that you found confusing or struggled to understand?

SMART…………………………………………………………………………………………….

RISE …………………………………………………………………………………………

PG Tool ………………………………………………………………………………………..

Cool Farm Tool……………………………………………………………………………….

Q2d. Do you have any comments or suggestions for what we could do to improve the reporting formats? Any features or approaches we didn't use that you think might help?

SMART…………………………………………………………………………………………….

RISE …………………………………………………………………………………………

PG Tool ………………………………………………………………………………………..

Cool Farm Tool……………………………………………………………………………….

QUESTION FORMAT:

Q3a. Which question format(s) did you prefer? (e.g. drop down lists, open questions, data entry). Why?

> **Drop down lists preferred**
>
> **Hard data more useful**

Q3b. Were there any question format(s) you didn't like? Why ?

Q3c. Do you have any comments or suggestions for what we could do to improve the question formats? Any features or approaches we didn't use that you think might help, for example?

ADDITIONAL QUESTIONS ON ASSESSMENT PROCESS:

Q4a. Are there any particular elements or sections of any of the tools or reports that were particularly memorable/stick in your head? What made them memorable?

> **Found the whole process very useful**

Q4b. Do you have any further comments/suggestions to help us improve the PG Tool / RISE / SMART or the Cool Farm Tool? Any features or approaches we didn't use that you think might help, for example?

> **SMART…………………………………………………………………………………………….**
>
> **RISE ……………………………………………………………………………………………**
>
> **PG Tool …………………………………………………………………………………………..**
>
> **Cool Farm Tool………………………………………………………………………………….**

DEVELOPMENT OF A SELF-ASSESSMENT

Q5a. If we were to develop a new self-assessment tool to feed in to the various assessments you already complete

(for certifiers, retailers, government, etc.) what should we do to make the process as user-friendly as possible?

Be aware of choice of language in development of questions / responses to avoid ambiguity and make the assessment process more efficient. Also be aware that the average age of farmers is >55 in the UK and IT literacy may present an issue in some cases. Paper-based forms may therefore be needed in addition to an online assessment.

Q5b. How much time would you be prepared to invest in a self-evaluation in hours / minutes?

3 hours

Q5c. How comfortable would you be in completing a self-evaluation on your own next year, with an assessor available over the phone? (please rank on scale of 1-5)

………4…… out of 5   (1 = not at all comfortable, 5 = extremely comfortable)

Provide reasons for ranking and additional details here:
Will be much easier

Q5d. How useful would sharing results from such an assessment tin peer-to-peer groups be and would you be happy to engage with such an activity? (please rank on scale of 1-5)

…….5……… out of 5   (1 = not at all useful, 5 = extremely useful)

Provide reasons for ranking and additional details here:

Q6 Any other comments?

The favourable results for our farm may have influenced our responses on the usefulness,
Would recommend that the project engage with more farms (e.g. less intensive upland producers) to obtain more feedback. The assessments were very useful – 5 out of 5 on this front!

Thank you for your feedback

Farm name:	**Farm 5**
Researcher name:	**Laurence Smith**

Q1a. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their usefulness (1 = most useful, 4 = least useful)?

1. **PG Tool**

2. **SMART**

3. **RISE**

4. **CFT**

Reasons for ranking (e.g. what features were particularly useful)

> **All of the tools were flawed however they contain key desirable attributes relating to their design or 'architecture', categories used, user-friendliness and balance between quantitative data and opinion**

Q1b. Please rank the four assessment tools (RISE, PG Tool, Cool Farm Tool, SMART) in terms of their ease of use (1 = easiest, 4 = most difficult)?

1. **CFT**

2. **PG Tool**

3. **SMART**

4. **RISE**

Reasons for ranking (what features made the assessment particularly easy/quick)

> **CFT was easy to use because it doesn't demand enough information. PG Tool is also easy to use but captures more useful information, so better overall. SMART also provides a good, deep assessment but poor categories are used and too many questions. RISE is long and complicated but provides some good data on farm performance.**

REPORTING FORMAT QUESTIONS:

Q2a. Which elements of the reporting format(s) did you like or find particularly useful? Why?

> SMART……………………………………………………………………………………………….
>
> RISE ………………………………………………………………………………………
>
> PG Tool …………………………………………………………………………………………………
>
> Cool Farm Tool…Dashboard approach (i.e. showing results as they are derived) was useful

Q2b. Were there elements of the reporting format(s) that you disliked? Why?

> SMART……………………………………………………………………………………….
>
> RISE ………………………………………………………………………………………
>
> PG Tool …………………………………………………………………………………..
>
> Cool Farm Tool…… ……………….

Q2c. Were there any bits of the reporting that you found confusing or struggled to understand?

> SMART……………………………………………………………………………………….
>
> RISE …………………………………………………………………………………………
>
> PG Tool …………………………………………………………………………………..
>
> Cool Farm Tool……………………………………………………………………………….

Q2d. Do you have any comments or suggestions for what we could do to improve the reporting formats? Any features or approaches we didn't use that you think might help?

> For all tools: a summary page showing the results would be useful, and the primary reasons underlying the scores

QUESTION FORMAT:

Q3a. Which question format(s) did you prefer? (e.g. drop down lists, open questions, data entry). Why?

No preference – drop down and direct data entry are both required

Q3b. Were there any question format(s) you didn't like? Why ?

Inexplicable questions in some cases. Tools seem to be starting from the assumption that farming practices are bad for the environment which seems to unjustifiably penalise the farmer from the outset

Q3c. Do you have any comments or suggestions for what we could do to improve the question formats? Any features or approaches we didn't use that you think might help, for example?

Tools must become more farm-centric, i.e. looking at how an individual farm can improve performance in the context of the farm's role as a provider of food/fuel

ADDITIONAL QUESTIONS ON ASSESSMENT PROCESS:

Q4a. Are there any particular elements or sections of any of the tools or reports that were particularly memorable/stick in your head? What made them memorable?

Q4b. Do you have any further comments/suggestions to help us improve the PG Tool / RISE / SMART or the Cool Farm Tool? Any features or approaches we didn't use that you think might help, for example?

SMART……………………………………………………………………………….

RISE …………………………………………………………………………………

PG Tool ………………………………………………………………………………..

Cool Farm Tool…………………………………………………………………………….

DEVELOPMENT OF A SELF-ASSESSMENT

Q5a. If we were to develop a new self-assessment tool to feed in to the various assessments you already complete (for certifiers, retailers, government, etc.) what should we do to make the process as user-friendly as possible?

Secondary contractors would be needed to provide support (e.g. via telephone or through a farm-visit). Pop-up boxes would also help to make the assessment process smoother. Need for a central online data hub to collate data from various assessment tools / audits

Q5b. How much time would you be prepared to invest in a self-evaluation in hours / minutes?

Currently spending about 1 hour per day on data entry / recording! Anything that could reduce this would be a bonus.

Q5c. How comfortable would you be in completing a self-evaluation on your own next year, with an assessor available over the phone? (please rank on scale of 1-5)

……4…… out of 5   (1 = not at all comfortable, 5 = extremely comfortable)

Provide reasons for ranking and additional details here:
Will be much easier

Q5d. How useful would sharing results from such an assessment tin peer-to-peer groups be and would you be happy to engage with such an activity? (please rank on scale of 1-5)

……4……… out of 5   (1 = not at all useful, 5 = extremely useful)

Provide reasons for ranking and additional details here:

Q6 Any other comments?

Appendix E

Opportunities for information sharing between existing data collection activities and sustainability assessment tools

Introduction
A large number of farms are making use of farm management software and/or providing data for statutory reporting (e.g. for certification purposes). These farms are already collecting data that is required for the completion of farm-level sustainability assessments. Data sharing between farm-management software, statutory reports and sustainability assessments could help to make farm-level evaluation process(es) more efficient and appealing.

An initial investigation of the opportunities in this area was made by comparing the self-reported data collection of four farms participating in this scoping study. This allowed overlaps between the data inputs of the sustainability assessment tools and the data currently collected on each farm to be identified. It also permitted identification of occasions where farms collect the same data multiple times. The result from this work are summarised below.

General observations
- Data is being collected for 25 different sources both for compulsory/optional assessment purposes and for personal interest. There were a large number of data sources unique to Wales.
- Across the sustainability assessment tools considered in this study there were 508 'data inputs' (NOT 508 indicators). The farms covered 182-413 of these each through existing data collection platforms.
- Between the four farms, 491 of the 508 data inputs were already recorded for some purpose.
- The accuracy of the data should be taken with caution as few respondents specified what they actually recorded. This makes it impossible to establish whether tool needs would be completely met.

Areas generally accepted as necessary for sustainability assessment
The areas listed below are categories generally considered relevant in the sustainability assessment tools. **Categories highlighted in red** are already being recorded in some way by the four farms:

- **Fertilisers and pesticides – amounts used, types etc.**
- Soil qualities: texture, erosion, **pH**, testing, **Organic Matter (OM) / Organic Carbon (OC)**
- **Assets, income and costs**
- **Staff number, hours and remuneration**
- **Livestock** and **medical records**
- Animal welfare (open air, interaction etc.)
- **Land uses (including crop areas)**
- **Yield**
- Trees
- Recycling and waste
- Water – volume used, rainwater use
- Agri-environment information – species present (farm and wildlife), High Environmental Quality (HEQ) land, habitat conversion, landscape

- **Safety** and risk
- Staff training/CPD

Areas commonly recorded across the four farms

Related to the list above, this list shows the common areas of data collection across the four farms. While some areas overlap with the requirements of sustainability assessments, others are rarely used in such assessments.

- Fertilisers and pesticides
- Soil qualities: pH, OM, drainage
- Cover cropping
- Legumes
- Assets, income and costs
- Livestock. 3/4 of the farms we considered cover some medical records
- Crop areas. 3/4 of the farms we considered cover some land uses more generally
- 3/4 of the farms we considered record hedge length.
- Livestock and health practices
- Staff contracts and pay
- Safety and risk (although risk is in less detail)

Recommended focus areas

- Results from the assessments suggest that a drive for consensus in data collection should focus on the following areas:
    - Fertilisers and pesticides
    - Soil qualities: texture and OM/OC
    - Staff remuneration
    - Livestock and medical records
    - Land uses
    - Agri-environment information – species present (farm and wildlife), HEQ land, habitat conversion and landscape
- Key areas needed for an accurate sustainability assessment that are currently missing from farm records appear to be:
    - Water and rain use data
    - Agri-environment information
    - Recycling and waste data
    - Risk (business risk, as opposed to worker risk. Worker risk is already well recorded)