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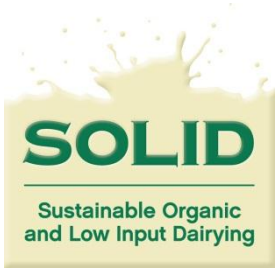
Brief description of the Deliverable A report on Case Studies involving a Rapid Assessment of Sustainability of 102 dairy cow and goat farms in 9 EU countries, and workshops held with farmers to discuss these results, leading to farmers' suggestions for research priorities to enhance the sustainability of organic and low input dairy farms in the EU.
Target audience(s) Project team, Stakeholder platform, Policymakers, Stakeholders, Researchers



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Collaborative Project

SEVENTH FRAMEWORK PROGRAMME

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Sustainable organic and low-input dairy production

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D1.1 Rapid sustainability assessment of organic and low-input farming across Europe

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Executive Summary

Introduction

The objective of this report is to present information on research needs to support improvement of sustainability of organic and low input dairy farms in the EU which could be addressed with on-farm projects. The report describes the execution and findings of two tasks in Work Package (WP) 1 of the SOLID project: 1) Case studies using a rapid sustainability assessment on a total of 70 organic and 32 low input dairy farms in nine countries across Europe and 2) a series of workshops held in these countries, designed to discover farmers' views of research needs relating to aspects of sustainability. A total of 72 dairy cow farms from Austria, Belgium, Denmark, Finland, Italy, Romania and UK, and 30 dairy goat farms from Flanders, the Netherlands, Greece, Spain and Italy were involved in the case studies. The farms were associated with the SME (Small and Medium Enterprise) partners in the project, which included co-operatives, advisory services and an organic certification body.

The case studies were intended to "set the scene" for organic or low input farms (depending on the SME involved) within each country, and encourage farmers to consider sustainability in its broadest sense, by discussing relative scores, rather than to obtain an "absolute value" for sustainability, or fully representative information for a country. The results were used to help to instigate focussed discussions in farmer workshops. Research needs identified through both steps will form the basis of plans for Participatory Research projects relevant to improving the sustainability of Low Input and Organic dairy farms in the next phase of the SOLID project in seven countries.

Methods for sustainability assessment

Sustainability was assessed using the PG (public goods) tool developed at the Organic Research Centre, after some modifications to make it more suitable for use in this task. The PG tool assesses each individual farm across 11 "spurs": Soil Management, Biodiversity, Landscape and Heritage, Water Management, Nutrient Management, Energy and Carbon, Food Security, Agricultural Systems Diversity, Social Capital, Farm Business Resilience, and Animal Health and Welfare. The tool is constructed as an excel workbook with a worksheet for each spur. It makes use of information which the farmer will already have available (e.g. farm accounts, cropping records, animal health plan) resulting in a radar diagram giving a visual impression of the stronger and weaker activities contributing to the sustainability of a farm and can be completed in approximately four hours.

National partner representatives carried out the assessments in each country.

Approximately ten farms were chosen in each country, to illustrate the range of farms connected

with the SME involved in the project, in terms of:

- Size
- Intensity/level of input use
- Commonly used breeds
- Marketing channels/type of product (e.g. milk, cheese)
- Geographical areas where these systems are found

Partners were encouraged to include up to three novel or innovative systems.

Results of Case Studies of Sustainability Assessment

As an illustration of the great diversity, overall, farms included landless dairy goat farms in Spain and Flanders, goats that ranged over more than 300 ha of common land in Spain and Greece, and dairy cow farms above 200 ha in Denmark and UK. Herd sizes ranged from nine cows (Finland) to over 300 cows (Italy, Denmark, UK) and 22 goats (Spain) to 1150 goats (Flanders), with milk sales for cows both under 3000 l/year (where cheese is also made) and over 10000 l/year, and for goats between 117 and 900 l/year.

The assessment exercise was largely viewed positively by the farmers and researchers but some questions and concerns about certain parts of it, and specific data that the tool requires, were also expressed. The output of the tool was able to illustrate differences between countries, and between cow and goat enterprises. Strengths revealed were more consistent between countries than weaknesses. The most variable spur across countries was “Water Management”. Low scores occurred both in regions where precipitation is high (e.g. Austrian mountains) and where irrigation is needed (Italy).

The highest scoring spur was consistently “Animal Health and Welfare”. This finding should be treated with some reservation because the nature of the assessment relied to a large extent upon the existence of herd health plans and farmers’ subjective opinions of their animals’ facilities and freedoms. Scores for goat farms were lower than for cow farms on this spur. The next highest scoring spurs overall (for both cows and goats) were “Farm Business Resilience” and “Soil Management”. Both were quite varied between countries. “Farm Business Resilience” was on average lowest in Italy and highest in Finland, but the country averages conceal considerable differences between farms, particularly in Romania (with a wide range of flexibility and risk management) and Finland (where financial viability, vision and strategy were quite variable).The lowest scoring spur for cow farms overall was “Biodiversity”. This may be influenced partly by the design of the tool which focuses on agri-environmental management rather than directly measuring biodiversity indicators, and partly by the fact that farmers do not have the opportunity, finance or perception of importance, to invest much time and money in supporting biodiversity. For goat farms the lowest scoring spur was “Agricultural Systems Diversity”, indicating that these were generally very specialised farms. The “classical” indicators of environmental sustainability: management of soil, water and nutrients, and energy and carbon resources, all show considerable variation in the majority of countries, indicating that there is the

capability for poorer performing farms to improve. In particular, farmers' attitudes to water management may need to be altered: even in dry areas there was need for a greater understanding of the importance of water management. In some countries it appeared that national legislation directed, but perhaps also restricted, farmers' concepts of sustainable practices, particularly with regard to nutrient use. Efficient energy use or reduction of fossil fuels received varying degrees of interest – e.g. very little in Greece where goat farms without electricity exist, and more in the UK where farmers have been made aware of "carbon footprint" or Greenhouse Gas emissions by government and industry activity.

Farmer Workshops

To maintain consistency between countries the workshops held to discuss research priorities followed a set protocol which included presentation and discussion of the results of the sustainability assessment. The ultimate aim of the workshop was to identify suitable topics for on-farm participatory research. Inevitably, discussions included topics that could not be solved with this type of work, and some cases where information is already available, but these contributed to understanding farmers' needs.

Research Themes Proposed

Overall, farmers felt that research specifically designed to provide answers for organic /extensive / low input production was lacking and they welcomed the opportunity to be involved.

Across all countries, topics suggested can be summarised under the headings of: Feeding (including protein sources, forage production, feeding of forage and concentrate), Soil and Nutrient Management, Breeds and Breeding, Animal Health and Welfare, Product Differentiation and Marketing, and Environmental Issues. Although there was some variation between countries, there were many common themes.

Feeding

This topic was mentioned in all countries, particularly regarding improving the productivity, reliability and utilisation of forage, and producing as much feed as possible on the farm. Increasing the capacity for production of homegrown protein was always featured, with suggestions of learning more about the cultivation and feed value of protein rich feeds and forages such as lupins, beans, and lucerne. Despite existing information many dairy farmers are not confident about growing these crops themselves. Other aspects included investigating equipment and energy for drying forage (Austria), plants as sources of minerals (Belgium and Romania), and drought resistant plants (Italy, Romania, Spain and even parts of the UK). There was also an interest in the nutritional value of diverse pasture and analyses of the plants that are eaten in the pasture or when goats are browsing (Italy, Greece, UK, Austria).

Interest in diverse pasture was also linked to market opportunities, through implications for product composition, particularly in Austria and Italy, and animal health, through the medicinal

properties of herbs and concentration of minerals in deep-rooting plants.

Soil and Nutrient Management

In some countries, farmers considered that a better understanding of the soil was needed to support better feed and forage production, and suggested research into topics of increasing soil carbon and organic matter, addressing the depletion of available P, and rapid soil analyses (UK). Austrian farmers discussed the nutrient value and optimal use of manure, but it is considered that there is a considerable body of information available on this.

Breeds and Breeding

Despite considerable ongoing research, breeding for animals best suited to low input and/or organic systems was raised in Denmark and Austria. There was an interest in cross-breeding in Italy, and in the UK, in investigating whether specific breeds/cross breeds have greater longevity. Goat breeding was also mentioned with Greek farmers suggesting making the genetic improvement of goat breeds more efficient and investigating the link between milk quantity and quality and goat breed.

Animal Health and Welfare

Despite high scores for the animal health and welfare spur, many workshops identified at least one health or welfare issue where farmers felt a need for further research. The areas, however, differed between countries, including, for cows, mastitis control using fewer antibiotics (UK), improving health and longevity (Finland), and parasite control (Flanders/Netherlands). For goats, topics included optimal vaccination programmes and housing to allow natural behaviour, with an interest in the consequences for productivity (Flanders/Netherlands), assessing the parasitological status of extensive herds, and determining risk factors for neonatal losses and sub-clinical mastitis (Greece). In many of these subjects, information is available and knowledge transfer within and between countries is clearly needed.

Environmental Issues

Denmark and Finland showed the greatest concern about issues related to energy, the physical environment and aspects of climate change, perhaps as a result of awareness raised by national policies and legislation. Suggestions made were demonstrations of energy saving practices, and ways of re-using water (Belgium and Denmark).

Product Differentiation and Marketing

Farmers were also interested in developing the market for their products. Among Dutch goat farmers there was interest in how best to communicate with consumers regarding the premium on their products whereas in Finland there was concern about the lack of an organic beef market. Greek goat farmers in common with Romanian cow farmers expressed an interest in adding value

to the market product and in novel approaches to the supply chain. Some good examples existed in most countries.

Conclusions

These case study farms illustrate the enormous diversity in organic and low input dairy systems in the EU. Farmers' considerations of sustainability generally begin with economic sustainability. The most valuable outcome of using the sustainability assessment tool was that it encouraged farmers to think about wider aspects.

The sustainability assessment indicated that the organic and low input dairy systems studied have one of their greatest and most consistent strengths in terms of farm business resilience. This is helped by diversification, and a specialist market for the product (either as an organic product or with another specialist feature, e.g. traditional, locally produced). On farm processing and marketing are beneficial to both organic and low input dairying, but need more support in most countries. Profitability can be improved by cutting costs and examples of farmers seeking to do this in innovative ways were reported. These included extending lactations (mainly on goat farms) and moving to once a day milking. Examples of improving self-sufficiency in terms of both feed and energy production were seen.

The weaknesses in sustainability as identified by the tool vary more between countries than the strengths. Water management appeared as a weakness of some systems, both in regions where water is plentiful, and also in some areas dependent on irrigation. Low scores in the biodiversity spur can partly be explained by the way the tool assesses grassland systems, and improvements in the assessment could be made. The "classical" indicators of environmental sustainability: management of soil, water and nutrients, and energy and carbon resources, all show considerable variation in the majority of countries, indicating that there is the capability for poorer performing farms to improve.

The research topics arising across all countries can be summarised under the headings of: Feeding (including protein sources, forage production, feeding forage and concentrate), Soil and nutrient management, Breeds and breeding, Animal health and welfare, Product differentiation and marketing, Energy use and Water management. In many of the areas mentioned by farmers there is considerable existing knowledge and/or ongoing research, but knowledge transfer is clearly needed.

More specific topics mentioned in more than one country include:

- Self-sufficiency in protein – growing protein-rich crops
- Grass and clover varieties for grazing and organic systems
- Increasing persistency of clover
- Home-grown feeds and forages for drought conditions and supplementing grazing during drought
- Feeding by-products

- Rapid evaluation of feed value
- Milk production from diverse, herb-rich swards – including productivity, animal health, soil health and product quality
- Maintaining soil fertility in organic systems
- Breeding animals for low input systems and longevity
- Reducing (subclinical) mastitis and neonate losses
- Controlling parasites
- Developing new products and markets
- Alternative energy sources

Farmers' discussions and research suggestions show that forage remains the basis and centre of organic and low-input milk production systems. Farmers know that good use of forage is of vital importance for low-input and organic dairy farms; however, there is lack of confidence in the reliability of forage production systems, both in quantity and quality. There is a need for a greater understanding of soil processes, and how to maintain soil fertility, particularly in organic systems. Although the animal health and welfare spur of the tool scored highly, the farmers indicated knowledge gaps and research needs in this area, which is important for productivity and consumer image, as well as for the animals themselves. It should be noted that some of these gaps in each topic can be filled by knowledge transfer. The overlap of interests between countries means that there is great opportunity for exchange of information and ideas. This applies not only to new knowledge to be generated by SOLID but also to transfer of existing knowledge. Greece and Romania in particular need more information in their native language.

Potential Stakeholder impact(s)

- Guidance for members of the supply chain, researchers and policy makers on aspects of dairy farming where research can make a difference and improve sustainability of dairy farms.
- Information on novel and best practices that can be shared between countries.

Interactions with other WPs Deliverables / joint outputs

WP no.	Relevant tasks	Partner(s) involved	Context of interaction
6	6.1.1	ABER, ILVO	Comparing selected farms with the "Low-input " threshold developed in Task 6.1.1
3	3.1	MTT, CSISC, INCDBNA	Information on current use of novel forages and farmers' interests in experimenting with these
6	6.2.2	EV-ILVO	Information from Case Studies to build into the model
6	6.2.3	EV-ILVO	Farmers' opinions on design of the participative model, what should be included, how it should be designed
2	2.3	DAPVET	Initial contacts with goat farms made in WP1.

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1 Overall Introduction

The objective of this report is to present information on the current sustainability, and research needs to support improvement of sustainability, of organic and low input dairy farms in the EU. The report describes the execution and findings of two tasks in Work Package 1 of the SOLID project which aimed ultimately to identify research needs that could be addressed with on-farm projects and inform the activities in other work packages.

The overall aims of this work package are to actively involve farming stakeholders (organic and low-input conventional dairy farmers, farmer groups, farm advisors) and stakeholder partners in the project in a co-ordinated participatory approach; to identify research needs; to engage producer innovation in the development and implementation of research projects; to assess stakeholder-led novel strategies at the farm level and to contribute stakeholder perspectives to other work packages. The work is broken down into several tasks, two of which are covered by this report.

These tasks were:

1. Case studies using a rapid sustainability assessment carried out on a total of 70 organic and 32 low input dairy farms in nine countries across Europe with the aims of describing the systems and identifying strengths and weaknesses with respect to productivity and economic and environmental sustainability in order to inform research needs. (Task 1.2)
2. A series of workshops held in these countries, designed to discover farmers' views of research needs relating to aspects of sustainability (with the aim of identifying stakeholder-led innovations and best practice examples), determine research priorities and to provide feedback on the work being undertaken in other parts of the projects (Task 1.3)

There are many definitions of sustainability and we do not intend to discuss them all again here. We align our approach with the views of Lebacq et al (2012[1]), who suggest that "sustainable livestock systems should be environmentally friendly, economically viable for farmers, and socially acceptable, notably for animal welfare", and with the dictionary definition of sustainability as a state of being "able to be maintained at a certain rate or level" e.g. a farm should have sufficient financial resources to continue in business and should be using physical resources such as water in such a way that they will continue to be available in the future.

The case studies formed a step towards identifying topics for farm based research that will help to increase sustainability of organic and low input farming systems in the future. For this a broad perspective of 11 aspects of sustainability was gathered, on a selection of farms across the range of types and systems associated with the SME (Small and Medium Enterprise) partners in the SOLID project. The farms included some with unusual or innovative practices or approaches.

[1] Drawing on Boogard et al (2011) and ten Napel et al (2011)

Regarding what constitutes an "innovative practice" we include the two types of innovation distinguished by Li et al (2008):

- "**Exploitative innovation** is related to increased resource use efficiency, and refining and leveraging existing knowledge as well as familiar, mature, current or proximate knowledge. It includes such things as refinement and extension of existing competences, technologies and paradigms.
- **Explorative innovation** is related to searching for new alternatives or unfamiliar, distant and remote knowledge".

Mytelka (2000) explains the distinction between invention and innovation as follows:

"*Invention culminates in the supply of knowledge. Innovation encompasses the factors affecting demand and use of knowledge in novel and useful ways. The notion of* ***novelty*** *is fundamental to* ***invention****, but the notion of process of creating local change,* ***new to the user****, is fundamental to* ***innovation****, specifically, the process by which organisations master and implement the design and the production of goods and services that are new to them,* ***irrespective of whether they are new to their competitors, their country****"* (Mytelka, 2000).

This means that we have included as "innovations" practices that are not common currently among the geographical group of farms under consideration, but may be used in other areas, or have been common in the past. Innovations may be technical, organisational, or institutional. This "interactive model of innovation" is reflected in the approach of the new European Innovation Partnership (EIP) on "Agricultural Productivity and Sustainability" (COM(2012) 79) which aims to provide a working interface between agriculture, bio-economy, science and others at EU, national and regional level. This model goes far beyond speeding up transfer from laboratory to practice through diffusion of new scientific knowledge (referred to as a "linear innovation model). Under its remit of innovation, this partnership includes encouraging the sharing of knowledge and experience (linking farmers, advisors, researchers, businesses, and other actors in Operational Groups), and ensuring feedback about needs from practice to the scientific community. This implies that innovation is a broad concept, covering the implementation of various new or improved practices, processes or products into business practice through shared learning. The OECD Innovation Strategy (2010) highlights that policy support should not focus on innovation as such, but application of innovation which makes life better for individuals and society at large. Innovation thereby is not restricted to major inventions but small changes can generate innovation if they can be embedded successfully in a larger community. This SOLID work package sees the farmers as important contributors to innovation for agricultural sustainability and is designed to support this process through the involvement reported here and the participatory research that is to follow.

The case study approach was chosen as a way of providing a relatively detailed amount of information about a small number of farms in each country. Within the scale and scope of the project, the sample of ten farms per country was feasible. For the purposes required, a deeper and more descriptive investigation of a small number of farms was appropriate, rather than a more superficial exercise with a large number of farms. Qualitative assessment was more valuable than

quantitative in this instance. The assessment is not intended to be fully quantitative, and the farms cannot be claimed to be representative of their countries, but rather illustrative. The exercise aimed to determine the range of scores of sustainability for various component aspects, both within and between countries, and to raise participating farmers' awareness of the broadest aspects of sustainability, as a step towards involving them and other farmers further in discussions about research that would help to increase sustainability of their farming system. The work did not aim to determine an absolute value for the sustainability of the farms included, but rather, to identify areas where efforts towards improving sustainability would be well employed.

The report also includes descriptions and outcomes of national producer workshops at which the results of the rapid sustainability assessment were presented and used to identify and explore possible research topics with farmers. These outcomes will form the basis of plans for Participatory Research projects relevant to low input and organic dairy farmers, with the aim of the research being to enhance the sustainability of their systems. Partners in nine countries were involved in the sustainability assessments and workshops. Austria, Denmark, Finland, Romania and UK (England and Wales) involved only dairy cow farms. Greece and Spain involved only dairy goat farms. Belgium involved five cow farms and five goat farms located in Flanders and the Netherlands, and Italy considered two goat farms in addition to seven cow farms. The SME's included milk buyers (Denmark, Finland, Romania), farmer co-operatives (Greece, Austria, England, Wales), a livestock breeding organisation (Spain), an organic certification body (Italy) and an advisory service (Belgium). Further details are given in sections relating to specific countries.

In the next section (2) of the report there is an introduction to the rapid sustainability assessment followed by a description of the methods used including a brief description of the rapid sustainability assessment tool (2.1), the guidelines for selecting farms to participate in the exercise (2.2) and a description of how the assessments were carried out (2.3). Sections 3.1 - 3.9 give, for each country, some background information on the dairy sector, and place the farms selected for the case studies in this context. The results of the exercise in that country then follow. The results across the countries are summarised in section 3.10.1 and some reference is made to other sources of relevant information. Discussion of the farmers' views on the sustainability assessment is found in 3.10.2. The focus of the report then moves to the workshops. There is an introduction of the methods used in Section 4.1. The outcomes of the workshop discussions in all countries are summarised in sections 4.2 and 4.3. Section 4.4 summarises the innovations that were mentioned. Finally section 5 draws together the results of the sustainability assessment and the workshops. The strengths and weaknesses of the systems studied are summarised in 5.1, section 5.2 covers farmers' views of sustainability, and 5.3 indicates topics requiring further research or knowledge transfer (linked to the findings of other consultations and availability of existing information).

2 Sustainability assessment method used

The objective of the Rapid Sustainability Assessment Case Studies was to describe the overall management, practices and characteristics of organic and low-input dairy herds associated with the SME's involved, and to evaluate 11 aspects of their sustainability. A rapid assessment tool was

needed that could work for low-input and organic farms, and was suitable for use in different geographical regions and farm systems and that would stimulate reflection and discussion about the farms' activities and their impact on different aspects of sustainability. The tool used is described below. Since it is considered impossible, misleading or even dangerous to see "sustainability" as an absolute, the intention was not to define an absolute value for the highly contentious measure "overall sustainability", but rather to indicate in which areas efforts could be made to improve the sustainability. The emphasis of the exercise was on stimulating discussion, using the tool to identify areas for improvement and activities that would be relevant to increasing the sustainability.

2.1 The sustainability assessment tool used

Three tools, two of which were developed by partners of the SOLID project, were considered for the case studies of sustainability assessment: the Monitoring Tool for Integrated Farm Sustainability (MOTIFS) developed by EV-ILVO (Meul et al, 2010), the PG (public good) tool developed by ORC (Gerrard et al, 2012) and the Response Inducing Sustainability Assessment (RISE), developed by the Swiss College of Agriculture and University of Guelph (Häni et al, 2003). MOTIFS is a generic, visual tool balancing the three sustainability dimensions (economic, environmental and social), applied successfully on pilot networks of dairy farms in Belgium (De Mey *et al*., 2010). The ORC PG tool was developed as a 'quality and environmental benchmarking' tool to provide farmers with a means of identifying areas of lower environmental performance and public good delivery which could be improved by providing a visual impression of stronger and weaker aspects on a farm (Gerrard *et al.*, 2012). RISE is a system-oriented tool also covering the three dimensions of sustainability by defining 12 indicators.The tool evaluates the current condition of each indicator, and estimates the pressure the system puts on the indicator. A strength/weakness profile is determined.

The tools were compared In collaboration with workers in the SOLID work package on "Socioeconomic evaluation of novel strategies in organic and low input dairy farming" (WP6). The goal was to be able to collect economic data needed for the economic work package, and Work Package 4 on environmental assessment, in the same exercise as the sustainability assessment. The ORC Public Good tool is the most recently developed tool, building upon previous projects. It is written in English. One concern was that the tool was initially built for a rather specific purpose – benchmarking on environmental and public goods- but it covered the issues relevant to sustainability analysis, and with some minor modifications would be suitable. The Belgian tool incorporated less economic analysis as it had only been used on farms with FADN data, while the PG tool already included a wider economic section. At the time of selection, the MOTIF tool was not available in English so more countries would need it to be translated .Although the RISE tool was the most widely used and tested, its recent use has been mainly in developing countries andit was less specifically orientated to the European situation than the other two tools. There would be a cost involved in its use since the developers were not project members. It also requires regional reference data that might not be available or would at least require time to research and enter for some countries. Following these considerations, the PG (public goods) tool developed at the Organic Research Centre was selected for the rapid sustainability assessment in this project, since it would not need translation, there would not be a charge for its use, and it could be suitably adapted, with

relatively small alterations, to provide the necessary information for the sustainability assessment , the economic assessment in WP6, and the environmental assessment in WP4

Tool description

The PG tool assesses each individual farm across a number of "spurs": Soil Management, Biodiversity, Landscape and Heritage, Water Management, Nutrient Management, Energy and Carbon, Food Security, Agricultural Systems Diversity, Social Capital, Farm Business Resilience, and Animal Health and Welfare (Gerrard *et al.*, 2012). These areas were chosen to account for a range of benefits - social, environmental and economic- which may be provided by farming systems. These public goods are known as "spurs" for the purpose of the PG Tool.

The tool is constructed as an excel workbook with a worksheet for each spur. It makes use of information which the farmer will already have available (e.g. farm accounts, cropping records, animal health plan) resulting in a radar diagram giving a visual impression of the various activities contributing to the sustainability of a farm and can be completed in approximately four hours. In addition, there is an initial data sheet collecting general farm information used in multiple spurs and a final results sheet. This provides graphical representations of the farm's assessment as soon as the interview is completed and can be printed easily, thus providing instant feedback to the farmer and an opportunity to discuss the results.

Each spur is assessed by asking questions based on a number of key "activities". Each activity has at least one corresponding question and these allow the person carrying out the assessment to evaluate the detailed ways in which the farm activities contribute. The choice of activities was influenced by a desire to use mainly existing farm records and to have a balance of quantitative and qualitative activities.

Each answer to a question is marked with scores between one and five. One is the lowest mark, indicating that no benefit is being provided and five is the highest score. Some questions have a "not applicable" (n/a) option. This is used in a situation where the farmer cannot possibly provide that benefit.

Some activities are assessed using several questions while others require only one. Where multiple questions are asked their scores are averaged and rounded to the nearest whole number to give the score for that activity. Thus an activity requiring several questions is not weighted more heavily than one requiring only one question. The scores across all the activities are unweighted. This is due to the fact that applying a weighting to such diverse questions as, for example, "How would you describe mastitis incidence in your herd", "Do you use several information sources (e.g. farming press, consultants, research institutions, fellow farmers, training courses, customers) when making decisions regarding the management of the farm?" and "How often do you completely empty and inspect manure/slurry storage facilities?" would require a level of subjective judgement. In different countries/ regions/ environments then certain activities will appear more important than others e.g. in Greece activities which help in conserving water may be seen as important due to the low rainfall whereas in Wales with much higher rainfall these are much less likely to be given strong emphasis

by the participating farmer. As the purpose of the tool is to encourage farmers to think about sustainability rather than to give a definitive, absolute sustainability score such weighting is, as well as being subjective, superfluous.

The scores for each spur are obtained by averaging the scores for all its activities. These are then shown on a radar diagram, allowing farmers to see in which areas they perform well and which areas could be improved. There is no baseline provided for comparison. In some countries scores are generally lower due to legislative, environmental or other restrictions on management approaches. In general the tool can be used to encourage farmers to think about sustainability and recognise management changes that they can make to improve their score. A baseline might be demoralizingly unachievable for some farmers and too easy to achieve for others thus allowing a sense of complacency. However, in the course of the project farmers were given the chance to see how their scores compared with the mean for their country. A bar chart showing the activities on each spur gives more detailed information on the scores for each activity (e.g. Figure 2). It is also possible to extract from the tool various quantitative data which are recorded during the course of the assessment. These include milk yields, numbers of dairy cows, land areas, and nitrogen, phosphorus, and potassium (N,P,K) balances.

Once the tool had been selected for use in the rapid sustainability assessment, it was reviewed by the WP1 partners and suggestions were made for changes/improvements to ensure that it was adapted to the purpose of this project. The changes were mainly small additions/adaptations and included:

- Replacing UK-specific names for various agri-environment schemes with their EU counterparts
- Additional questions on landscape and heritage and financial business resilience suggested by EV-ILVO partners based on their expertise in these areas
- Additional questions on water management specific to dairy farms
- Additional questions on animal health and welfare specific to dairy farms
- Inclusion of goats (previously treated under “other livestock”)
- Accounting for common land as part of the farm

The final version after the changes were made was tested in the UK and sent to the project partners for a final review before being issued for use in the rapid assessments.

2.1.1 Tool use

The tool was designed as an Excel spreadsheet and so could be taken on farm by an advisor/researcher and filled in over 2-4 hours depending on the size and complexity of the farm being assessed . The results sheet automatically populates as the assessment is carried out. It can be shown to the farmer immediately at the end of the assessment so that the results can be discussed. In some countries, however, it was felt that farmers might be made uncomfortable by the use of the computer and so there was also the option to print out the questions and carry out the assessment without the computer and then enter the data after the farm visit.

Assessments were carried out in each country involved in this work-package (between 7 and 14 assessments per country) and then were sent to the Organic Research Centre for central data processing. The spread sheets were returned to the research partners, with summaries of the data collected and the results for each country.

2.2 Selection of case study farms

A protocol for farm selection was drawn up as a result of discussions between the Work Package leader, colleagues in WP6, and representatives of Research Partners in each country. The aim was to cover the range of farm types associated with each SME. Clearly ten farms could only provide an illustration of the different types of farms, rather than a representative sample. Specifically, in view of the search for innovative systems and methods, the partners were advised to include up to three farms with an unusual or innovative component compared with other farms in their region. ”Unusual or innovative” was understood as being a different way of thinking or doing things under the specific conditions or in the region, but not necessarily as being limited to the invention of a new product or technology which has never been used before (Dockes et al., 2012).

The research partners first described as far as possible the range of organic/low input systems found in the country, or among the farms involved with the SME if all the Case Study Farms were to be provided through the SME. Once the description had been made research partners, in consultation with the SME representatives, selected 10 farms to be used as Case Studies, illustrating the range within the organic/low input systems in the country, in terms of:

- Size
- Intensity/level of input use (within the “organic/low input” population)
- Commonly used breeds
- Marketing channels/type of product (eg milk, cheese)
- Geographical areas where these systems are found

The balance between organic and low input chosen depended on the SME involved, and the extent to which the SME was involved. The availability of data required for the Rapid Assessment also determined the suitability of farms.

In all countries but Austria, the farm types in the SME population consisted of a heterogeneous group. In particular, Italian and Romanian farms covered a very broad diversity of geographical areas and locations. Spanish goat farms were located in two distinct regions. In the UK, the dairy farming population is slightly more concentrated in the Western part and the selection of farms reflected this. Two SME’s were involved so the case studies comprise 10 from England and 7 from Wales. In Denmark, farmer members of an organic co-operative in Jutland were included, and in Finland members of a small organic dairy company in the East of the country were involved. Belgian partners studied five cow dairy farms and two goat farms in Flanders, and three goat farms in the Netherlands, as a result of the contacts available through the SME. In Austria the focus was a homogenous group of Alpine farms supplying one specific, very localised co-operative. The balance

between organic and low input farms in the sample depended on the SME involved, and the extent to which they helped with recruitment of farms. When the selection criteria were developed, the WP6 definition of “low input” farms had not been finalised. The low input farms studied in Romania, Spain and Greece were considered as “low input” based on the knowledge of the SME contacts.

In the following Chapter 3, there is a brief description of the dairy sector in each country, including detail as available on the subpopulation (eg organic sector or SME) from which the case study farms were selected. The selection of farms in each country is explained in more detail. Where possible, data are presented that illustrate how the farms selected compare with or illustrate the overall population of organic and/or low input farms that are in contact with the SME. However, the data available for such descriptive statistics are very variable between countries. The number and type of farms studied is summarised in Table 1.

Table 1 Number and type of farms studied in each country

	Cow farms		**Goat farms**		**Total**
	Organic	"Low input"	Organic	"Low input"	
Austria	12	0	0	0	12
Belgium	5	0	5	0	10
Denmark	10	0	0	0	10
Finland	7	0	0	0	7
Greece	0	0	6	7	13
Italy	6	1	1	1	9
Romania	0	14	0	0	14
Spain	0	0	1	9	*10
UK	17	0	0	0	17
Total	57	15	13	17	102

*only 7 with complete data sets

2.3 How the interviews were carried out

Members of partner organisations visited the farms to carry out the assessments. In Finland, Greece, Italy, Spain and Austria all the visits were carried out by one person. Two different members of the Belgian research organisation visited the cow and goat farms, each accompanied by an advisor from the SME, while in the UK an advisor visited the English farms and a researcher the Welsh farms. In Denmark and Romania two people were involved in data collection, initially visiting farms together, and dividing once they had gained experience. Data were entered directly into the computer in all countries apart from Greece and Romania where the collection of data on paper was more acceptable to farmers. In Italy some data were available through the SME partner prior to the visit, while in Flanders/the Netherlands, Spain and Romania some data were not available on the farm and had to be added later. For example, milk production data for Spanish goats were obtained from

the milk buyer. Where the data were fully entered into the computer on farm, the results were immediately shown to the farmer and there was opportunity for discussion. In all cases, farmers later received a paper copy of the results for their own farm and summary statistics for the other farms in the country.

3 Outcome of the sustainability assessment

This chapter presents the outcome of the sustainability assessment for each country and across countries. First a brief description of the dairy sector of each country involved in the sustainability assessment is included to provide some context. This is followed by a brief description of the choice of farms. These descriptions demonstrate the range and diversity of dairy systems between the countries studied, and give an introduction to the farms which participated in the sustainability assessment, before the results of the assessment in the country are presented. A subsequent section draws together findings from the different countries.

It should be noted that, in the descriptive statistics for the farms, the figure for purchased concentrate per milking animal generated is not always directly comparable with the figure available for the main population. From the data entered in the tool it was not always possible to distinguish the distribution of total concentrate between different groups of livestock on the farm. If figures are known to be affected by large numbers of animals other than dairy cows, this is pointed out.

3.1 **Austria** (Roswitha Weißensteiner)

In Austria, grassland is mainly situated in mountain areas. Therefore 70 % of all Austrian dairy farms are in disadvantaged areas and 2/3 of milk is produced there. For the rapid sustainability assessment, farms were chosen that represent the traditional alpine dairy production in this area. All farmers were members of the organic dairy cooperative “Sennerei Hatzenstädt”. The cooperative is

situated in Tyrol, an alpine province in the West of Austria. It has about 40 members, which deliver their milk to the cooperative dairy plant where it is processed into hard cheese and other dairy products.

3.1.1 Characteristics of the case study farms

Twelve farms were selected for the rapid sustainability assessment. The farms were relatively homogeneous in their structures; they were small in size and were managed as typical low input systems with relatively low milk yield, but also with low concentrate use (see Table 2).

The farms had a long history of organic production with a mean of 23 years. Farm size was typical for Austrian organic farms with the majority of the area in permanent pasture (62 – 100% of the farm area). Herd size and stocking rate were also typical. Labour units per animal and per 100ha were high compared with other countries. Liquid milk sales per cow per year were relatively low, because on some farms much of the milk was made into cheese. Total concentrates purchased were very low.

Farms were managed by the farmer´s family, which typically consisted of the members of three generations and therefore no further staff were employed. The on-site conditions were characterised by steep slopes, a short growing season and an annual precipitation of 1200 to 1800 mm. Only permanent grassland (no arable land) was farmed. All farms have several economic cornerstones: the main source of income is dairy production, in addition to incomes from forestry, direct marketing of meat, agro-tourism and other non-farm incomes. The herds consisted mainly of Brown Swiss or dual-purpose Simmental cattle, but one herd consisted of Jersey cattle. Two farms produced milk with cows from the local Pinzgauer breed.

Table 2 Characteristics of Austrian organic dairy farms and the farms selected for assessment

	Unit	Organic farms population mean	Mean of farms selected	Range of farms selected
Farm size	ha	20.1[2]	22.7	12.0 – 40.5
Herd size	No. of adult cows	10[3]	13	10 – 17
Stocking rate	Livestock units/ha	1.1[4]	1.0	0.6 – 1.7
	Grazing livestock units/forage ha		0.95	0.57 – 1.35
Milk sales	l/cow/year	6200[5]	5122	4500 – 7000
Concentrate fed to milking animals	kg/cow/year	1200[6]	247	0 – 750
Total purchased concentrate per cow [1]	kg/ cow/year		420	0 - 1460
Milking cows per Annual Labour	Milking cows/ Annual Labour		19	12 – 30

Unit	Unit			
Labour input per area	Annual Labour Units/100 ha		3.8	2.0 – 6.9

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above
[2] Data from INVEKOS 2009
[3] Data from BMLFUW (2010): Grüner Bericht 2010 - Table 3.1.28a and 3.1.28i. http://www.awi.bmlfuw.gv.at/gb (accessed 21.6.2011)
[4] Data from BMLFUW (2010): Grüner Bericht 2010 - Table 4.4.2. http://www.awi.bmlfuw.gv.at/gb (accessed 21.6.2011)
[5] Estimates of data from: ZAR (2011): Rinderzucht Austria - Jahresbericht. Die österreichische Rinderzucht 2010. Zentrale Arbeitsgemeinschaft österreichiser Rinderzuchter. Wien
[6] Data from Kirner (2009): Wettbewerbsfähigkeit von Vollweidesystemen in der Milchviehhaltung. Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie. Band 18(3). p 87-96 Steinwidder A. (2011) personal communication.

All farms had a very low concentrate input for feeding the cows, so the quality of forage played an important role. Winter feeding in particular is a challenge: only hay (no silage) is fed to the cows in order to be able to produce hard cheese. Due to the climatic conditions of this region, farms often use indoor drying installations to achieve a short drying time for hay. Two farmers operated these installations with energy from wood chip biomass. Some farms explicitly aimed to produce milk with zero input of concentrates and therefore they used grass cobs processed from their own forage.

Many farms practised agro-tourism giving them contact with people who had no knowledge about agriculture. They opened their farms to them and thereby brought agriculture closer to the consumers.

Example of innovative or best practice examples on participating farms included:

- Using grass cobs made from their own forage to replace concentrates
- Well-functioning direct marketing of all farm-products (milk, cheese, processed meat, eggs) and the use of a special breed (Jersey) for increasing milk solids.
- Use of biomass from the farm's own forest for the hay drying installation.

3.1.2 Results of the sustainability assessment

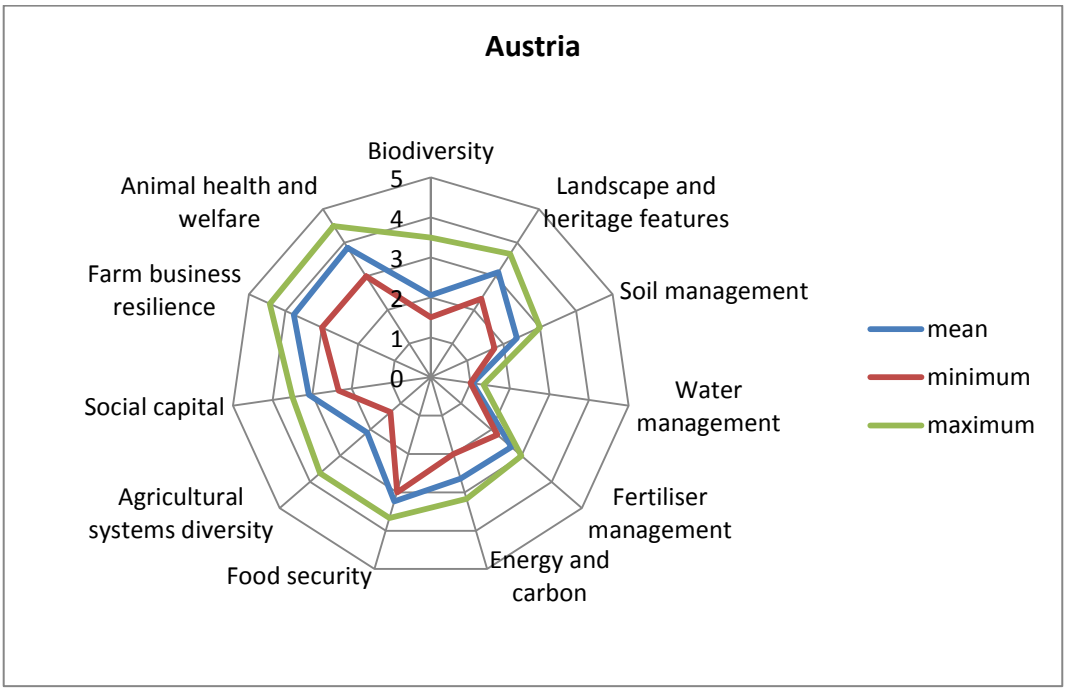

Figure 1 Spur diagram for Austria

In Austria, variation in the spur "Agricultural Systems Diversity" (Figure 1) reflected the marketing channels of the farms: some of the farms produced milk for the dairy cooperative only, so they kept only dairy cattle, while some farmers were involved in direct marketing. To be able to offer more products these farms kept several livestock species, such as hens or pigs. These farmers also used more marketing channels, e.g. farmers' markets and farm shops.

Farms scored relatively highly on "Farm Business Resilience". The main explanation for this was the several economic cornerstones of each farm, often including forestry or agro-tourism. This is in agreement with the findings of Kirner et al (2007) who investigated the effects of farming system on some aspects of sustainability of dairy farming in Austria and found that organic farms obtained higher income from agriculture and forestry than conventional farms.

"Animal Health and Welfare" also scored well because of low costs for veterinarians (mean veterinary expenditure per head was 33.74 Euros) and a relatively long grazing period, but farmers' positive perceptions of cows' freedom are questionable, as half of the cows were kept in tether barns during the winter period.

"Water Management" showed a very low score which reflects the local climatic conditions: annual precipitation is high in the region; therefore water conservation does not seem important to the farmers. They had enough water at all times, and relatively low water consumption (only for animals and cleaning; no irrigation).

In this region trees and hedges are structural elements of the landscape and the farms are managed at a rather extensive level. In the light of this, the low score for “Biodiversity” was surprising. There were two main explanations for this: firstly, it appeared that farmers may have underestimated the level of biodiversity on their farms. For all of them grassland management was low intensity (2 cuttings, no mineral fertilizer applied) and hedges were maintained. Secondly, farmers could not receive payments for the maintenance of these landscape elements from the Austrian agri-environmental program (ÖPUL). Therefore farmers probably did not consider these in the interviews. Kirner et al (2007) found that that smaller holdings, mountain farms and organic farms tended to provide greater environmental services than larger, lowland and conventional farms.

The scores for “Fertilizer management” were relatively homogeneous because of strict legislative constraints. The mean N balance was 95 kg/ha and P and K balances were generally close to zero (ranges: P balance -3.4 to +8.0 kg/ha and K balance 0.3 to 24.8 kg/ha). This contributed towards reasonable scores for the activity “Nutrient Use Efficiency”. Nitrogen input by fixation was estimated to average 72 kg/ha.

The farms had no arable land, only permanent grassland, so there was no risk of erosion or major leaching of nutrients and no pronounced soil management was carried out. Farmers did, however, mention a lack of soil analyses and this point seemed to be important to them.

Figure 2 shows the mean values for individual activities contributing to the overall scores for spurs. In the spur “Energy and Carbon”, the use of renewable energy received a high score because most of farms used solar panels for producing hot water. It was very difficult to collect hard data for this spur, because none of the farmers kept separate records of energy use for household and farm so these values were often estimated.

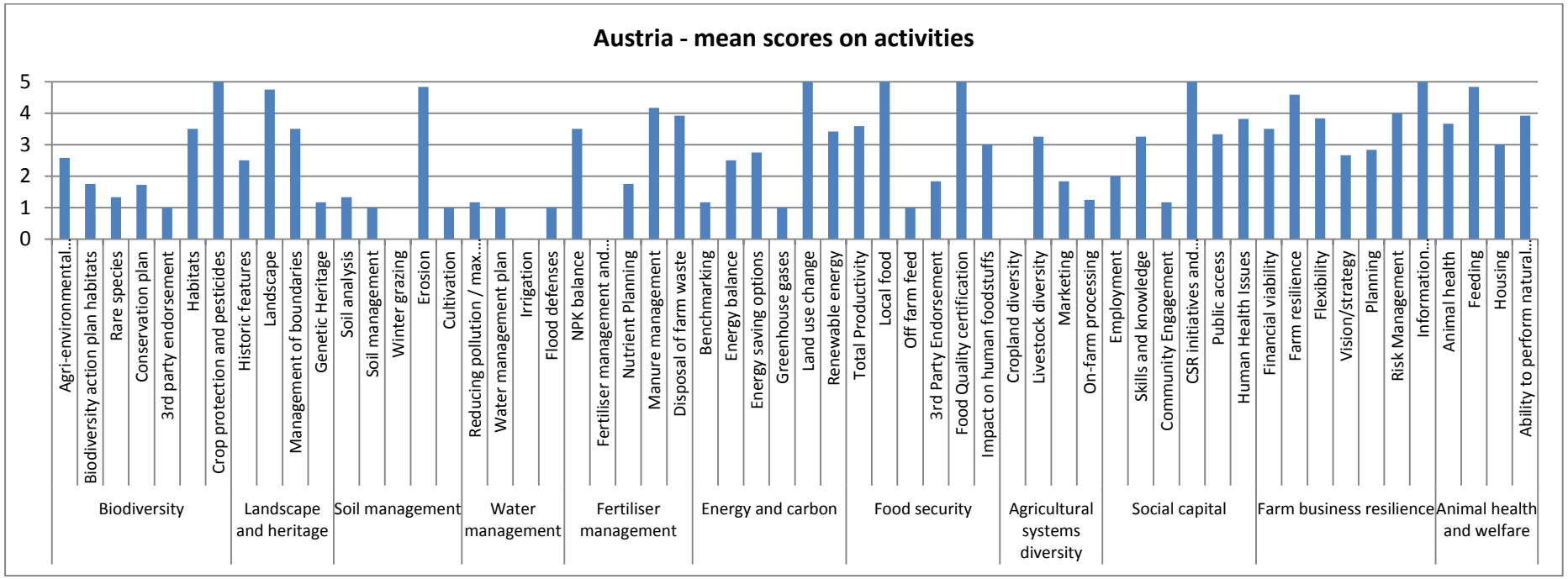

Figure 2 Mean scores for activities for Austria.

3.2 **Belgium** (Lies Debruyne, Fleur Marchand)

The Belgian dairy sector consists of both cow and goat dairy farms and five farms of each type were selected for the rapid sustainability assessment. The discussion below is therefore split into a discussion of dairy cow farming and a discussion of dairy goat farming in Belgium. The SME involved works mainly in Flanders (northern region of Belgium), and, to a lesser extent, The Netherlands, so only information about organic dairy farming in Flanders is included (no information on Wallonia).

Dairy cow farms in Flanders

The number of organic dairy farms in Flanders has increased reaching about 50 in 2012. In this section, the population of organic dairy farming is described based on data from 2008 in a study of 18 organic dairy farms in Flanders (De Vliegher *et al*., 2008).

In general, the size of the farm and number of dairy cows on Flemish organic dairy farms are highly variable. The Utilisable Agricultural Area (UAA) ranges from under 20ha to 100ha. The mean land area for production of roughage is 46ha. All farms have grassland and in general this makes up 75% of the UAA. An average of 20% of this area is cropped under conservation measures. Maize and fodder beet are seldom cultivated on organic dairy farms compared with conventional dairy farms as weed control is rather difficult (Table A1.1 in Appendix 1 gives more detail of crops grown on organic dairy farms).

The mean herd size is 49 dairy cows and the mean number of lactations is 4.2. The mean milk production is 6160 l/cow/year (ranging from 3500 to 8800 l/cow/year). The mean use of concentrates is 870 kg/cow/year and is much lower than on conventional farms. As expected, there is a positive correlation between concentrates fed and milk production. (Table A1.2 in Appendix 1 gives further details of organic dairy herd characteristics).

The mean stocking rate for dairy cows is 1.1 LU/ha with a minimum of 0.2 and a maximum of 1.6 LU/ha. Young stock and non-lactating cows are not included in this figure.

The ration fed to the dairy cows on organic farms varies between farms and between seasons, however, there are some general tendencies. Grass is the main roughage, both in winter and summer. Brewers' and distillers' grains which are very popular protein sources in conventional farming, are not easily available in organic production. In contrast to conventional farms, grains such as barley and wheat rather than maize are the main sources of energy in the ration.

The commonly used breeds are Holstein crossed with Brown Swiss or Montbéliarde and less often crossed with Jersey, the Normande breed or Belgian Blue. Organic farmers want to have a robust animal, with a high potential forage intake and a high production of milk from forage, and believe that cross-breeds will provide this.

Farmers mainly produce milk which is marketed through a cooperative, Biomelk Vlaanderen. Diversification occurs mainly through processing milk on the farm and selling products through a farm shop. Also a few cooperatives (e.g. Hinkelspel, Biole) exist which produce cheese.

Goat farms in Flanders

The number of organic dairy goat farms in Flanders was eight in 2011, with a little over 4000 dairy goats in total.

As this is a very small agricultural sector, limited data are available. The following results are based on data from 2009 from a group of eight dairy goat farmers in the Netherlands (which has a comparable dairy goat production system to Flanders). These eight farms do not represent the average organic dairy farm, but are considered to be larger than the average (Govaerts & van Eekeren, 2010).

The average UAA for production of roughage is 1ha per 29 dairy goats (1ha per 15 goats, when 'coupled' hectares are included in this calculation). 'Coupled hectares' take into account roughage produced off farm, under contract by arable farmers. Grassland composes the majority of the area, often with mixtures of different grass, clover and herb species.

On average there are 641 dairy goats per farm, producing nearly 600,000 litres of milk. The average production of the 8 farms was 852 l/goat/year, at 37.3 g/l fat and 34.5 g/l protein. Labour input is 1.5 FTE (full-time equivalents) per farm.

Alfalfa, peas and lupins are fed as important protein sources. Grains like barley and wheat, and to a lesser extent, maize (mainly early on in the lactation period) are sources of energy in the ration. The use of concentrates is much lower on organic farms, compared with conventional farms.

The commonly used breeds are White Saanen, Nubians & Toggenburger, often crossbred. Again, crossbreeding is carried out with the aim of producing a robust animal, with a high milk production from forage.

The majority of Flemish dairy goat farmers deliver their milk to a Dutch cooperative, OGC (Organic Goatmilk Cooperative). This cooperative was founded in 2009 and has about 25 members across Flanders and The Netherlands. The cooperative collects the milk and delivers to both national and international processors (approx. 8 million litres in 2011). A significant part of the produced goats milk is processed to cheese (e.g. Le Larry, Capra, Het Hinkelspel, 't Reigershof). There is no tradition of goat's meat consumption in Flanders and the Netherlands, so the majority of young (male) animals are transported to the south of Europe. However, in the Netherlands a small scale initiative has been set-up to promote the consumption of organic goat meat (Verbeke, 2011).

3.2.1 Characteristics of the cow and goat case study farms

All farms assessed were clients of the SME partner Wim Govaerts & Co, active in advisory services for dairy farms (cows, goats, sheep) in Belgium, the Netherlands and France. The 10 farms were selected by the SME partner, with the aim to cover the range within the organic/low input systems, in terms of size, intensity/level of input use (within the "organic/low input" population), commonly used breeds, marketing channels/type of product (e.g. milk, cheese) and geographical areas. Table 3 (dairy farms) and Table 4 (goat farms) give an overview of the spread.

In addition, "innovative" systems were also selected, which are less common but contain novel aspects such as:

- The use of herbs in the diet (sown in the pasture)
- Combination of different breeds
- prolonged lactation
- Very large goat farm (> 1000 goats)
- Industry by-products as extra feeding products (e.g. the use of residue of a muesli factory with very good results)
- Hemp as an alternative feed

The use of prolonged lactations in goats on a farm in the Netherlands was particularly interesting. This results in fewer sick and dead animals, less labour, more milk and no reduction in production (Govaerts et al., 2010) and fewer male goats (which incur a surcharge of 6 Euro/goat in the Netherlands).

Examples of good practice included:

- Optimization of the price through high fat and protein content (goat milk)
- Marketing channels for milk: specialisation e.g. cheese cooperative Hinkelspel gives a higher price for the milk
- Alternative marketing channels for the goat meat

Table 3 Characteristics of the cow farms in Flanders and the farms selected for assessment

	Unit	**Population mean (De Vliegher *et al.*, 2008)**	**Mean of farms selected**	**Range of farms selected**
Farm size	ha	46	55.7	30 – 102.7
Herd size	No. of adult cows	49	54.4	23 - 101
Stocking rate	(Livestock units/ha	1.1		
	Grazing livestock units/forage ha		1.87	0.39 – 3.35
Yield	l/cow/year	6160	5751	4872 - 7762

Level of concentrate	kg/cow/year	870		
Total purchased concentrate [1]	kg/milking cow/year		3695[2]	260-10000[2,3]
- excluding farm with pig enterprise:			840	260-1470
Milking cows per Annual Labour Unit	Milking cows/ ALU		56	29 - 72
Labour input per area	Annual labour units/100 ha		1.85	1.36 – 2.64

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above

[2] Definition of concentrate is different for the selected farms, and population mean. Also, no clear allocation of the different types of feed was requested on the mixed farms (other animals were also accounted for in the nutrient balance, but not in the concentrate/cow, leading to very high levels of concentrate/cow

[3] the highest level is from a farm where pigs are also reared

Table 4 Characteristics of the goat farms in Flanders and the farms selected for assessment

		Population mean (Govaerts and Van Eekeren, 2010)	**Mean of farms selected**	**Range of farms selected**
Farm size	ha	Unavailable	22.1	0-55
Herd size	No. of adult goats	641	446	21-1150
Stocking rate	(Livestock units/ha	15	20.2	
	Grazing livestock units/forage ha	Unavailable	Unavailable	Unavailable
Yield	l/goat/year	852	870.25	826-900
Level of concentrate fed to milking animals	kg/goat/year	Unavailable		
Total purchased concentrate [1]	kg/milking goat/year	Unavailable	450	190-900
Milking goats per ALU	Milking goats / ALU	427	323	21 - 700
Annual labour units/100 ha	Annual labour units/100 ha	Unavailable	2.45	0.26 – 7.27

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above

3.2.2 Results of the sustainability assessment

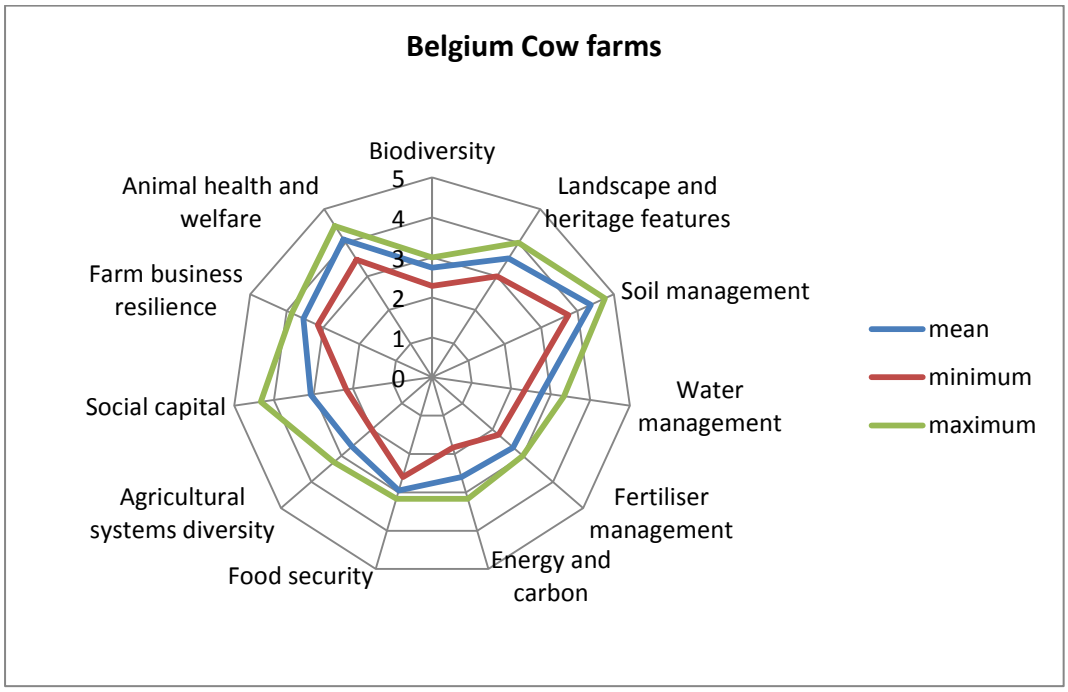

Figure 3 Spur diagram for Belgian cow farms

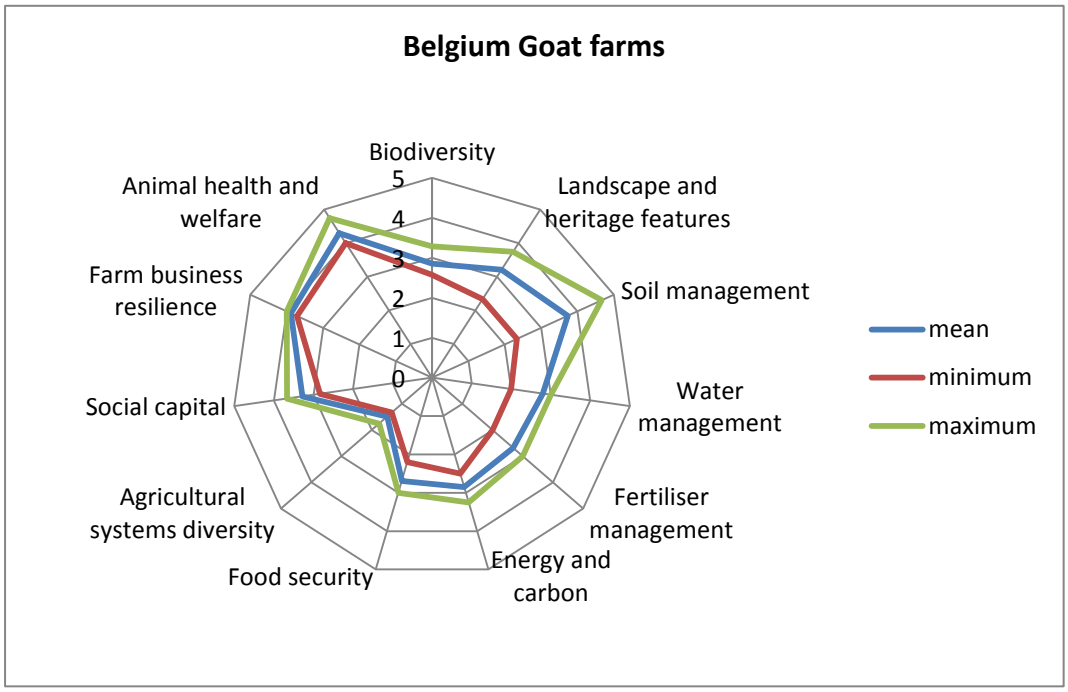

Figure 4 Spur diagram for goat farms studied by the Belgian partners (in Flanders/The Netherlands)

In general, the farms score the best for the “Soil Management” and “Animal Health and Welfare” spurs (Figure 3 and Figure 4). This results from both the strong regulatory policy and high societal

demand. As productivity is very dependent on the health of the animals, farmers and advisors show a great deal of interest in and pay a lot of attention to these aspects when deciding on management actions. This is especially the case for the goats, resulting in slightly higher scores for animal health and welfare and farm business resilience for these farms. However, we notice a wide range of scores in the “Soil Management” spur for the goat farms, probably originating from diversity in farm size.

The spurs “Water Management”, “Fertilizer Management” and “Energy and Carbon” achieved an average score, meaning that the farms have potential for improvement in these areas. N balance was very high and covered a wide range on cow farms, from 73 to 533 kg/ha (mean 206), N use efficiency averaged 24%. The largest balance occurred on a farm where there was also a pig enterprise and pig slurry was exported. P and K balances averaged 20 and 25 kg/ha respectively, and these figures limited the activity score for nutrient use efficiency. The N balances for goat farms were also relatively high, influenced by the small land area in some cases (N balance: mean 197 (75 – 316), P balance: mean -15 kg/ha, (-48 to +5), K balance mean 38 kg/ha (17 - 58); often goat farms were exporting manure.

Low scores for “Agricultural Systems Diversity” (especially for specialized dairy goat farms [Figure 4]) and relatively low scores for “Biodiversity” are related to the general strategy of the Flemish farms which is highly specialized in milk production. Neither of these aspects is an objective for either the farmers or the SME, as such.

Only two farms focused on selling or processing products on the farm. A general comment from the farmers was on the limited distribution channels. However, not all of them perceived this as a problem as most cooperatives are functioning well and have a strong involvement with the farmers. Some mentioned that the cooperatives are searching for niches for their products resulting in diversification and in a higher (or at least a more stable) price. These aspects are also included in the “Farm Business Resilience” spur, which scores 3.8 on average among cow farms, while the goat farms’ mean score was 4. Goat farms obtain their resilience from different distribution channels, even if the search for these is still ongoing.

The advisors remarked that the resulting sustainability assessment graphs are very alike within the two groups and even more so within the goat farm group. These similar sustainability assessment graphs are a direct result of similar farm management strategies within the goat group, which in turn is the result of a rather small and closed network.

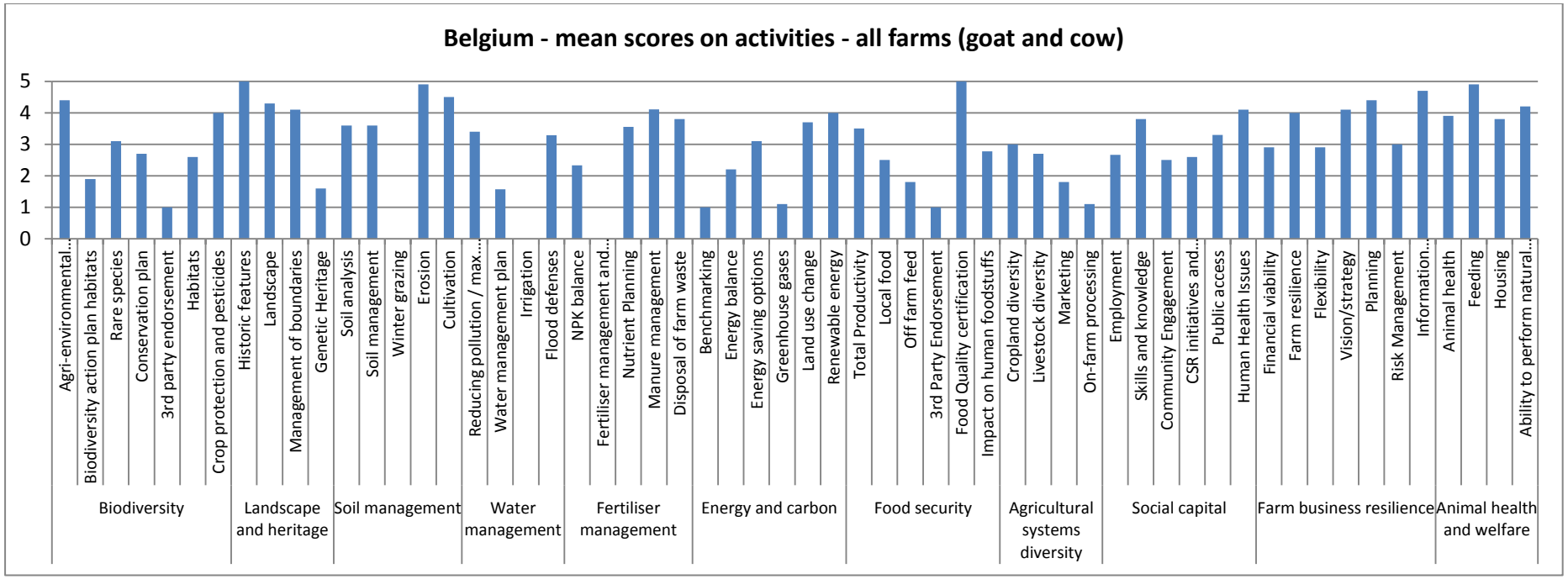

Figure 5 Mean scores for activities for Belgium.

3.3 **Denmark** (Mette Vaarst, Anne Braad Kudahl)

The majority of the milk in Denmark is produced in Jutland, the western part of the country. The holdings are basically family farms with one or two employees. More than 90% of the milk is produced by specialised dairy farms. The roughage is mainly grass and maize silage produced at the farm in a rotation with cereal crops. Thus the grass area is typically a two year ley and the share of cereal is around 20% of total land use. Almost all farms practise all year round calving. Less than 1/3 of the conventional dairy herds practise grazing (for cows). The most common breeds are Danish-Holstein (73%) followed by Jersey (12%).

Approximately 10 % of the dairy farms practise organic farming. The organic dairy farms are typically slightly larger than the conventional farms in terms of cows per herd and have a lower stocking rate, thus managing more land. The milk production per cow is approximately 10% lower in organic than in conventional systems (8400 versus 9200 kg milk for heavy breeds). The typical land use on organic farms consists of a higher share of grass (primarily clover/ grass at a rate of 50-60% in the rotation) at the expense of maize and cereal crops. In both organic and conventional production, automatic milking systems (milking robots) are extensively used. 30% of the domestic liquid consumption is organic milk (a large proportion of the conventional milk is manufactured into cheese and butter for export).

3.3.1 Characteristics of the case study farms

The ten Danish farms which took part in the rapid sustainability assessment were selected by the Thise Dairy Company project manager in collaboration with the research partner, from the 87 organic milk suppliers to the company. The Thise Dairy is a cooperative dairy owned by the suppliers, who are mainly situated in the middle, western, and northern part of Jutland. Averages describing the Thise Dairy supplier group are not available; based on the available information we consider Thise Dairy suppliers to be generally representative of organic dairy herds in Denmark. Column one in Table 5 describes averages of all organic dairy farms in Denmark split into larger breeds and Jerseys.

Table 5 Characteristics of Danish organic dairy farms and farms selected for assessment

		Mean of all organic dairy farms in Denmark (Danish Cattle Federation, 2009)	**Mean of farms selected**	**Range of farms selected**
Farm size	ha	188[a]/124[b]	229	56-357
Herd size	No. of adult cows	138 [a] /133 [b]	161	36-480
Stocking rate	Livestock units/ha	Unknown	0.98	0.60-1.85
	Grazing livestock units/forage ha	Unknown	1.51	0.95 – 2.26
Milk sales	l/cow/year	8099 [a] /7515 [b]	6453	4554-8750
Level of concentrate fed to milking animals	kg/cow/year	Unknown	Unknown	Unknown
Total purchased concentrate per cow [1]	kg/ cow/year	Unknown	1110	4 - 2920
Milking cows per Annual Labour Unit	Milking cows per Annual Labour Unit	Unknown	72	36 - 105
Labour input per unit area	Annual labour units/100 ha	Unknown	1.19	0.57 – 2.31

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above
[a] Large breeds
[b] Jersey

Farms were selected so that they represented the widest possible range of dairy producers within the Thise dairy company. The main criterion was large variation between farms, in terms of size of herd and farm, breed, geographical location. In addition, farmers should of course be willing to participate in the project. Some farms were partly chosen because of special characteristics, such as a farm shop and ice cream production, or special interest in and activities around nature conservation. Most farms specialized in milk production, but a few of them had some innovative characteristics, mentioned below, and special crop rotation systems.

For most of the participating farms, the activities and enterprises on the farm were centred on milk production. There are few multi-functional farms. Unusual or interesting practices were seasonal calving, keeping calves with suckler “aunts”, and trying to feed with large amounts of hay instead of silage (there have been projects on this in Thise, because they sell special ‘hay cheese’; the challenge is the huge amounts of electricity / diesel used to dry the hay under Danish weather conditions).

With regards to novel forages, a few farms in Thise (one among the interviewed farmers in this project) used herb mixtures in the grass to promote health and biodiversity.

The farms had been organic for between 12 and 28 years (mean 16). The selected 10 organic farms had a little more land area and larger herd than the average Danish organic dairy farm but covered a wide range. The average milk yield was somewhat lower on the ten farms than on organic farms in general. Some of the 10 farmers explained that they had an intentional low-input-low-output-low-stress-level-of-cows-strategy to keep the disease level low in the herd. This type of farming strategy might be over-represented among the 10 farms, because we deliberately chose for differences between farms. The share of Jersey herds is also over-represented compared to Danish organic dairy herds in general, where about 10% of the herds are Jersey herds and the remainder use larger breeds, mainly Danish Holstein. That also contributes to a lower average milk yield among the 10 project herds compared to organic farms in general.

The project herds were specialized milk-producers selling all their milk to the Thise-Dairy, they were more or less self-sufficient in feed, and a few had other niche products.

The average number of cows per ALU was the highest within the project countries at 72, with a low labour use of only 1.19 ALU/100 ha. The proportion of permanent pasture was low at 12% on average.

3.3.2 Results of the sustainability assessment

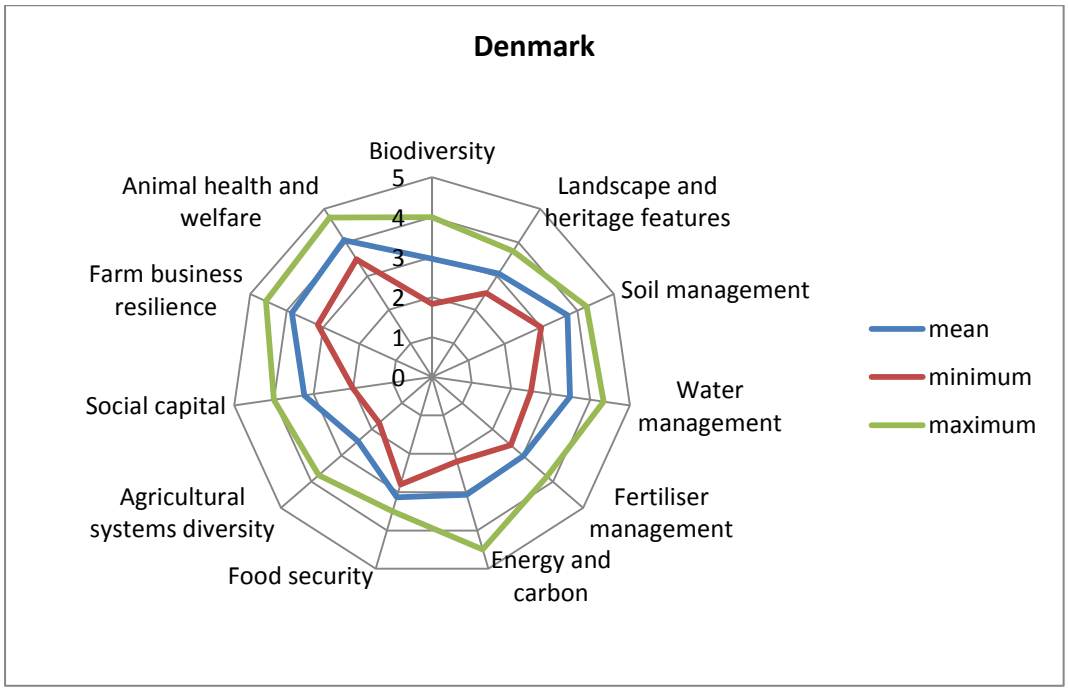

Figure 6 Spur diagram for Denmark

A wide range of responses was observed within the spurs across the Danish farms (Figure 6). The largest variation between farms occurred in “Biodiversity”, “Energy and Carbon”, and “Agricultural Systems Diversity”. Relatively high scores (>3.5) were assigned to “Animal Health and Welfare”, “Farm Business Resilience”, “Soil Management and Water Management”. Relatively low scores were

assigned, in particular, to “Agricultural Systems Diversity” and “Biodiversity”. Danish dairy farms are in general highly specialized and characterised by intensive land use and herd management. The plans mentioned in the rapid sustainability assessment tool (Biodiversity Action Plan and ‘Sites of Importance for Nature Conservation’) are not well known in Denmark. Instead most of these sites are protected by national laws, which prevent alteration of all meadows, saline meadows, dry hilly grasslands, heaths, moors, bogs and lakes larger than 100 m^2. The share of these protected farming areas varies across Denmark which is reflected in the variation in biodiversity score. Also the score for “Water Management” is elevated by the fact that since 1987 Denmark has implemented more and more strict laws (“Water protection plans”) protecting both drinking water and surface water (water courses, lakes, fiords and the sea) from contamination with N, P and pesticides. During these years the use of artificial fertilizers has been reduced by 50%. N balance had a mean value of 99kg/ha (range of 13 to 182), P balance -2.2 kg/ha (- 18 to 3.8) and K balance 9.6 (-75 to 48) kg/ha. The median N balance figure is comparable with those from the study of Oudshoorn et al (2012) of 110 and 66 kg N/ha for nine Danish organic farms with and without automatic milking systems respectively.

All ten farms scored maximum points for the following individual “activities” within spurs (Figure 7): agri-environmental participation, crop protection and pesticides (organic farms, no pesticide use), erosion (Denmark is flat, shelterbelts stop wind erosion), fertilizer management (no artificial fertilizer used), third party endorsement (all are members of the cooperative dairy which has received several prizes for its dairy products), food quality certification (all certified organic producers), and information seeking/networking (without being dynamic and forward thinking farmers cannot stay in business).

Low scores (around 1) were found for genetic heritage (rare breeds are very rare in Denmark, and heritage crops were not grown by any of the ten farmers, although they are grown elsewhere in DK), benchmarking energy and carbon (energy and especially fuel use is very high in DK), Local food (milk from Thise Dairy is sold all across Denmark, most animals are slaughtered at big slaughterhouses distributing meat nationally, only few animals are slaughtered and sold locally, and one farm produced and sold its own ice cream), on-farm-processing (uncommon in DK, requires certification of factory-like processing facilities with high hygiene standards), employment (often only very few people work on the farm – technology has taken over many tasks that previously required manpower).

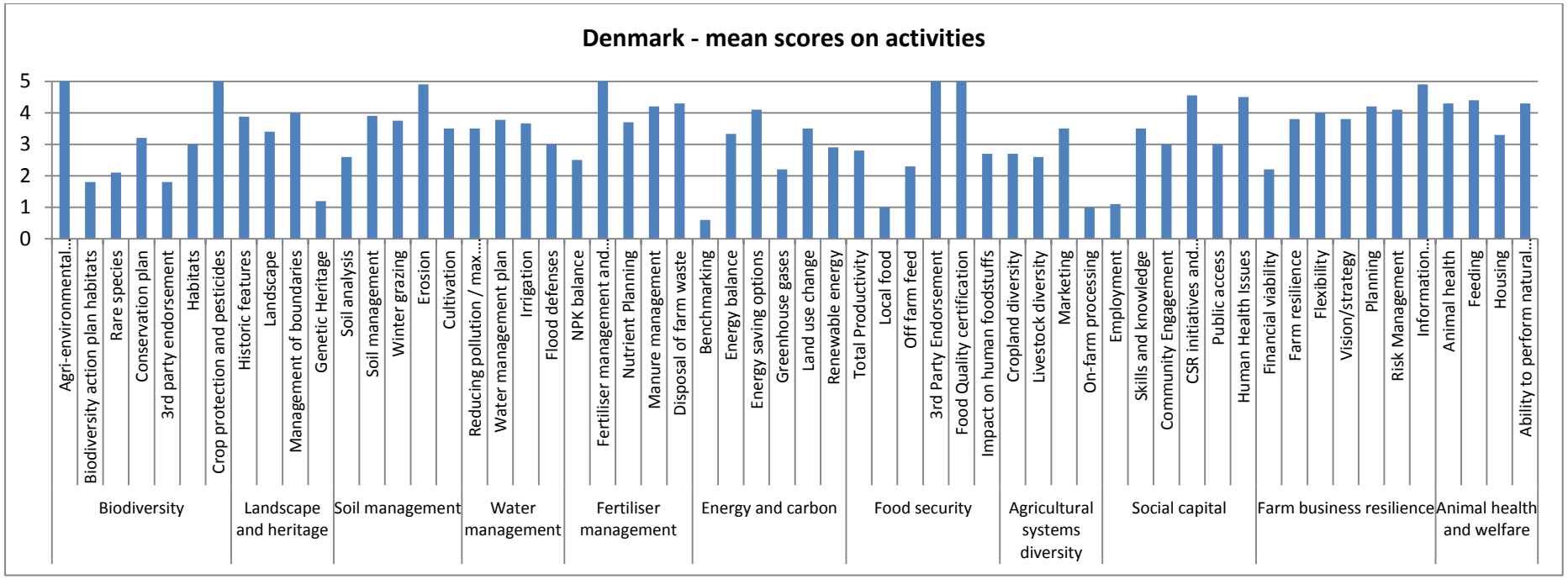

Figure 7 Mean scores on activities for Denmark

3.4 **Finland** (Arja Nykänen)

The farms assessed in Finland were all members of the SME Juvan Luomu Ltd, which is a small organic dairy company in eastern Finland. Seven out of nine partners of the company were interviewed and they all produce organic milk. The aim was to interview all partners of Juvan Luomu, which is also a SME partner in SOLID project, but two of the partners were not able to take part.

Only very few data about Finnish organic dairy farming could be identified. Most of the organic milk production is situated in eastern and western Finland. All organic milk is sold from farms to dairy companies which process and sell it further. Finnish organic dairy product markets are dominated by two dairy companies: Valio Ltd and Arla Ltd. Juvan Luomu Ltd and Juustoportti Ltd have a smaller share of the Finnish organic dairy market. In addition some small companies are producing small amounts of dairy products e.g. ice cream and cheese.

The most common breeds of milking cows in Finland are Ayrshire and Holstein and on organic farms their share is 61% for Ayrshire and 34% for Holstein. The remainder (5%) includes Western, Eastern and Northern types of Finn cattle. The study farms mostly have only Ayrshire cattle. Two farms also have Holsteins and one farm has some Finn cattle.

3.4.1 Characteristics of the case study farms

The general characteristics of the farms are described in Table 6. The Finnish farms had been organic for 10 – 22 years (mean 17). Stocking rate and yield were very close to the national organic average

although the farm size was considerably larger than average. Labour inputs were relatively high, among the countries involved in the project.

Table 6 Characteristics of Finnish organic dairy farms and the SME farms selected

		Organic dairy population in Finland, average. (Finish Food Safety Authority EVIRA)	**Mean of farms selected**	**Range of farms selected**
Farm size	ha	70	139	18-414
Herd size	No. of adult cows	39	47	9 - 124
Stocking rate	Livestock units/ha	0.54	0.51	0.39-0.61
	Grazing livestock units/forage ha	Unknown	0.85	0.54 – 1.20
Milk sales	l/cow/year	7834	7765	6400-10071
Level of concentrate fed to milking animals	kg/cow/year	Unknown	Unknown	Unknown
Total purchased concentrate per cow [1]	kg/ cow/year	Unknown	1010	410 – 2300
Milking cows per Annual Labour Unit	Cows/ Annual Labour Unit	Unknown	25	9 - 53
Labour input per unit area	Annual labour units/100 ha	Unknown	2.35	0.60 – 5.48

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above

3.4.2 Results of the sustainability assessment

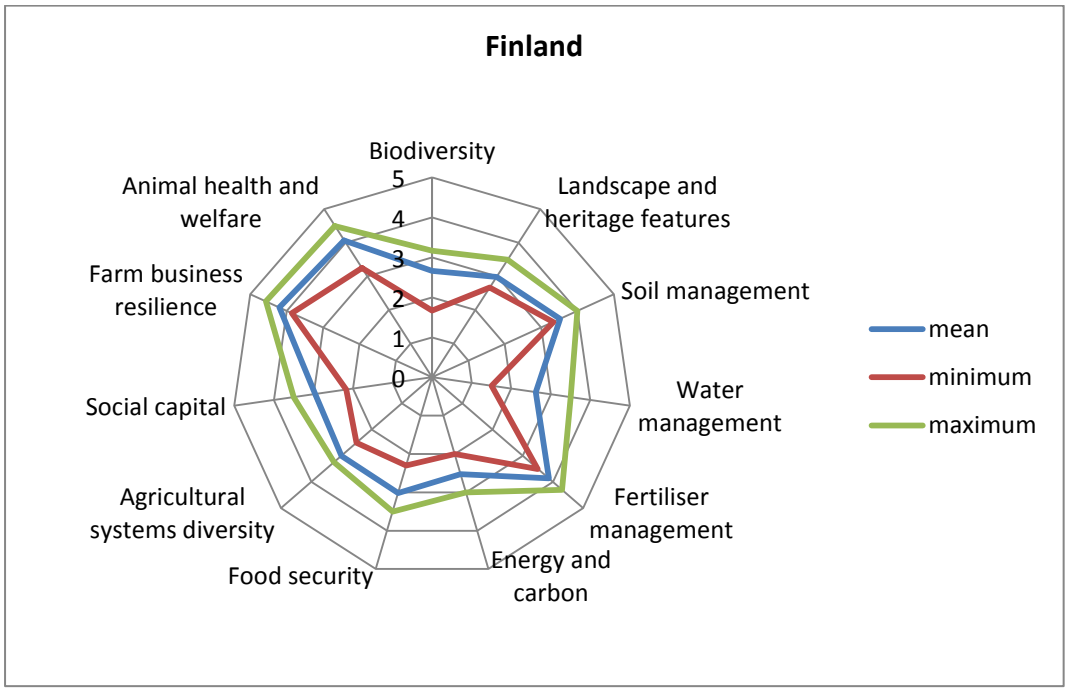

Figure 8 Spur diagram for Finland

The highest mean scores for Finland (Figure 8) were achieved in the spurs "Farm Business Resilience", "Animal Health and Welfare" and "Nutrient Management". "Soil Management" also scored quite highly. Farmers considered their farm profitability to be quite good and expected it to be the same or better in the future. In Finland farmers take in a lot of information from advisors, farmer magazines, seminars, the Internet and even from abroad. They make many economic and other plans for their farms and have good forward vision. The lowest variation in scores was found in "Farm Business Resilience". All the farms had health care plans which were formulated together with the vet and updated regularly. Costs of medicines and treatment are quite high, but they also include preventive actions which result in good animal health. The average number of lactations was below 3 on all farms, which all farmers considered to be too low. All farms except one have loose housing and even when not on pasture, the cattle have access to the outdoors. The grazing period in eastern Finland is normally 5 months.

Under "Nutrient management" it is notable that soils and manures are analysed on all farms and computer based programs are widely used for nutrient management planning and are completed with the help of an advisor. N, P and K balances averaged 118, -1.6 and -2.9 kg/ha respectively. N-balance seemed to be quite high on farms, but there is a degree of uncertainty in these figures, because it is quite difficult to estimate the correct amount in clover-based short-term grasslands, which cover the majority of the farmland. The mean of estimates of N fixation based on the area of legumes, and the farmer's description of the clover content of swards was 100 kg/ha (range 78 – 121). A major weakness on the farms is that the slurry tanks for storage are not covered. The good scores in "Soil Management" were recorded mainly because of low risk of erosion

The lowest scores were recorded in the spurs “Energy and Carbon”, “Water Management” and “Biodiversity”. The highest variation in results was found in the spur “Water Management” (standard deviation 0.61). Energy use per head in Finland seems to be very high. The reason for this is possibly the long distances between the main farm and the fields which are quite far away, because of big farms, combined with large areas of forests and lakes. It is also notable that there is no attention paid to greenhouse gas emissions in Finland. Renewable energy use is on quite a high level in Finland because wood is used for energy production and much of the energy is produced with ‘green tariff’ (water) power. “Water Management” scored low mainly because water is not a limiting factor in Finland and therefore little or no attention is paid to saving water and water management. On the other hand, much attention is paid to prevention of water pollution and, in particular, nutrient leaching. Third party endorsements are very rare, so this question scored low in all farms. At the moment, biodiversity actions on farms are quite rare, because little attention is paid to biodiversity on a national level.

Some general observations can also be made. The lowest score for each spur was quite often found on the same farm and similarly for the highest score reflecting that either the whole management of the farm is good or a farm requires further improvement across a range of areas. The genetic heritage is quite narrow in Finnish dairy production but on the other hand, good care is taken of the landscape. The diversity of plant species is high, but the diversity of animal breeds is low. The fodder and feed self-sufficiency is high.

On one farm, the farmer aimed at 100% self-sufficiency in energy consumption in field work. That was mainly achieved by producing turnip rape both for feed and oil for fuel in tractors. No novel feeds are used on the farms. It was also interesting to see that the farm does not have to be large to achieve a good economic result.

Figure 9 Mean scores for activities for Finland

3.5 **Greece** (Georgios Arsenos, Thanasis Gelasakis)

Since very little is recorded about the Greek dairy goat industry, a larger survey was initially carried out before the selection of the smaller sample of goat farms to participate in the rapid sustainability assessment. Overall, fitting the Greek dairy goat industry into the categories used by CEAS (2000), the Transhumant system is still practised with both sheep and goats mainly in Thessaly, Central Macedonia and Thrace while goats are found on low-input and organic mixed farms in Western Macedonia.

Initially, 60 dairy goat herds (comprising 23,426 goats), were randomly selected from 16 prefectures to undertake an initial survey to collect data about the Greek dairy goat industry. Data were collected during pre-scheduled, on-farm visits, using a case-specific questionnaire which comprised questions about livestock, facilities and equipment, environmental aspects, nutrition and management practices. The questionnaire was completed during visits to the farms (minimum duration 4 hours). Based on the results obtained by the questionnaire, ten of the farms were chosen to undertake the sustainability assessment using the rapid assessment tool. The selection of the farms was carried out on the basis that they were representative of the existing situation of low input and organic dairy goat farms in Greece and they were located according to the geographical spread of goat farms across the country.

In the initial survey of the 60 flocks it was found that the most common purebred animals belonged to the following breeds: the Indigenous Greek goat, the Damascus breed and the Skopelos breed. Moreover, there were significant numbers of crossbred animals of the aforementioned breeds as well as crossbreds of Alpine, Saanen and Murcia (*Murciana Granadina* that has been imported into Greece from Spain in significant numbers over the last four years). The overall majority of farms were selling milk to dairy companies with the exception of two farms that had their own facilities for

processing the milk into different types of cheese. In all cases, the milk was used for either production of different types of goat cheese or for the production of FETA cheese in combination with milk from sheep. The produced cheese was sold through local or national marketing channels.

3.5.1 Characteristics of the case study farms

The farms used for the rapid sustainability assessment were selected to cover the range of organic/low input systems; two farms were specifically selected as novel farms adopting "innovative" systems of particular interest. The general characteristics of the population of the farms selected for rapid sustainability assessment are shown in Table 7. Some of the farms chosen were also members of the SME partner PROODOS Cooperative. The number of these was limited as a result of a drastic reduction of the population of the goats that were milked in the cooperative due to low milk prices and low demand for goat milk.

One farm was fully vertically integrated producing pasteurized milk and different types of cheeses. The second novel farm was the largest flock raising purebred Damascus dairy goats in Greece under a semi-extensive system of production.

Table 7 Characteristics of farms in the Greek SME population and the farms selected

		SME population average (PROODOS)	Mean of farms selected[3]	Range of farms selected*
Farm size	ha	Unknown[2]	41.2	1.8 – 178.1
Herd size	No. of adult goats	100	558	200 – 1600
Stocking rate	Livestock units/ha	Unknown[2]	1.23	0.62 – 1.91
	Grazing livestock units/forage ha		1.0	0.02- 8.53
Milk sales	l/goat/year	48	220	47 – 615
Level of concentrate fed to milking animals	kg/goat/year	100	Unknown	Unknown
Total purchased concentrate per goat [1]	kg/ goat/year	Unknown	140	0 - 420
Milking goats per Annual Labour Unit	Goats/Annual Labour Unit	Unknown	173	80 - 400
Labour input per unit area	Annual labour units/100 ha	Unknown	1.5	0.08 – 5.79

[1]Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above
[2]The majority of flocks are mixed flocks grazing in communal areas and hence the stocking rate is difficult to estimate
[3]Farms were selected from a population wider than the SME

Other examples of best and innovative practice on the farms undergoing the rapid sustainability assessment included:

- Breeding of Skopelos goats under an extensive management scheme with high milk production
- Traditional farming of indigenous goats and production of high quality milk
- Cultivation of *Vicia ervilia* and *Vicia faba,* both chosen for their drought resistance and used as an alternative source of protein to replace the use of soya.
- Large family farm with a remarkably efficient crop management plan and satisfactory utilization of grassland
- A farm with its own butcher selling both goat meat and homemade dairy products direct to the public

The 14 Greek goat herds included six which had been organic for 2 – 10 years, the remainder being extensive but not organic. Nine grazed some common land; this meant that standard stocking rates were very difficult to calculate. The herds were much larger than the SME population mean, including a wider variety of farm structures and their yields were also higher.

3.5.2 Results of the sustainability assessment

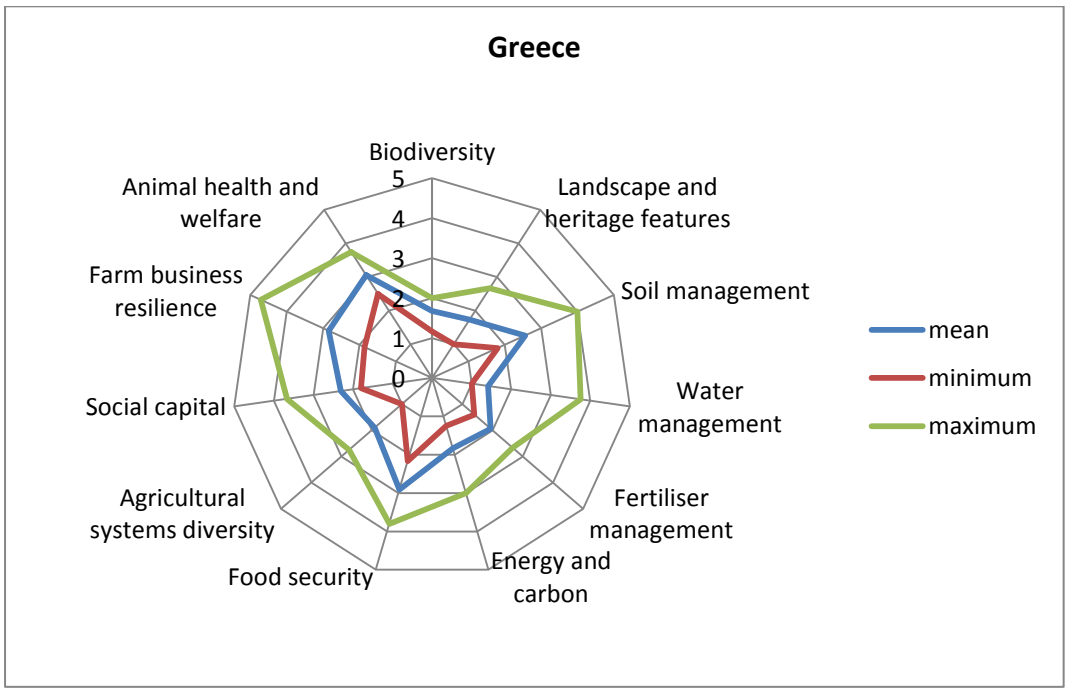

Figure 10 Spur diagram for Greece

A wide range of responses was observed within the spurs across the Greek farms (Figure 10). Relatively high scores were assigned to “Animal Health and Welfare” and “Food Security” spurs. “Biodiversity” and “Water Management” were assigned the lowest average scores.

The lack of financial incentive was a common explanation for the lack of practices which might promote “Biodiversity” and facilitate “Water Management” and secure “Landscape and Heritage Features”. The maximum value for “Biodiversity” was relatively low.

In general, farmers did not seem very interested in taking measures towards the preservation of biodiversity on their farms. Nevertheless, there was diversity in the ecosystems which goats encountered during grazing which the tool did not identify. All the farmers were unaware of the red species list, with the exception of some endangered species of mammals. However, it was very interesting to notice that the majority of them knew in detail the flora and fauna of the pastureland used for grazing by their flocks. Furthermore, field boundaries such as hedges, which increase landscape and biodiversity scores in the assessment, were not commonplace among the farms.

"Water Management" showed low scores across farms with one exception. This was possibly associated with the rather extensive management scheme linked to low investments in facilities supporting the efficient management of water resources. Interestingly, although the lack of sufficient water resources during grazing was commonly observed, the importance of *ad libitum* fresh water was in some cases underestimated.

Most of the farms shared common land in order to graze their goats, with the major type of grazing land being scrublands. During the survey it was revealed that almost none of the farms kept accurate records of production traits, financial indices and health status (including prevalence and incidence of diseases, preventive medicine and treatments) and thus most of the data provided should be considered as estimates. In general, the farmers were not convinced of the value of record keeping. Moreover, a detailed farm-plan was rather rare and when it existed it was often inappropriate.

Figure 11 shows the mean values for individual activities contributing to the overall scores for the rapid assessment tool's spurs. "Crop protection and pesticides", "local food" and "ability to perform natural behaviours" were assigned high values (around 4), whereas, "3rd party endorsement", "management of boundaries", "fertilizer management and application", "greenhouse gases" and "CSR initiatives and accreditations" were assigned the lowest values (around 1). Nutrient balance levels were relatively low (mean 72 kg N, -0.5 kg P and 5.3 kg K/ha).

Only on one farm was a well-designed management plan implemented, which explains the reason why that farm was assigned the highest scores on most of the spurs. Of course, the specific farm was selected on the grounds of representing an innovative management scheme and in no case can be considered as representative of the majority of existing management schemes. This single farm was fully vertically integrated, producing pasteurized milk and different types of cheeses and was a good example of a farm working towards sustainability. However, even on this farm the marketing channels were only partially efficient.

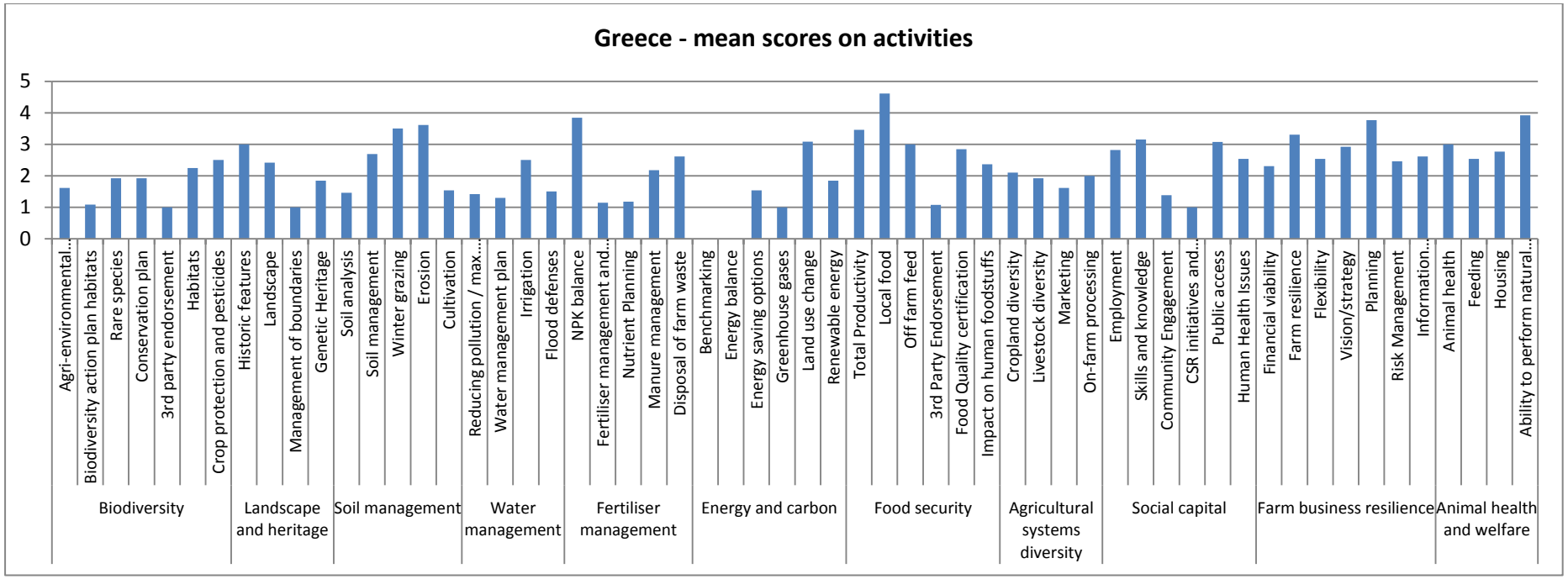

Figure 11 **Mean scores for activities for Greece.**

3.6 **Italy (**Anna Maria Baraldi, Antonio Compagnoni)

The majority of dairy cows are farmed in northern Italy (70 %), then in southern Italy (20 %) and the remainder in the Centre. The majority of livestock farming takes place on the Padana plain. The Friesian breed is prevalent, but there is also a high presence of different local breeds, in particular in mountainous (north) and marginal areas (south) where there have been policies to protect endangered local breeds and provide economic support.

The SME project partner (ICEA) is the largest control body for organic agriculture and voluntary certification in Italy in terms of total number of operators. Overall it has 13,000 members and about 1,300 of those are certified for livestock production.

3.6.1 Characteristics of the Italian case study farms

The various farm structure variables for the SME (Table 8) show that dairy farms in marginal areas and managed as family businesses are more common in the organic sector than large farms managed by companies. The herd size is typical of a “small farm” and the stocking rate is often quite low resulting from large field size and use of common land in marginal areas. This way of farming suits the organic livestock rules and so the standards are easier to apply. In the last ten years, in particular for small and marginal farms, the price of raw materials, the low rate of entry of young people into the agricultural sector and political choices addressing only increased milk production, have made these farms less competitive. The organic market has represented, for them, a valuable opportunity to remain in the market. In the farms chosen for study, a wide range of farm and herd sizes were included (from small farms located in the mountains to larger farms on the plain) to illustrate the variety in the population (Table 8). With regards to the SME population, further detail is shown in Appendix 2.

The Italian sample consists of nine farms whose production and geographical location correspond to the general distribution of the SME‘s farmer members, although two are not in fact members of the SME. Of the selected farms, one is in South Italy and eight are in North Italy. In selecting farms the

preference was for farms with several years in the sector (organic or low input) as it was felt that farms present for longer periods of time within the sector provide more accurate data, and their products have an established market presence. Two conventional low input farms were included, one as an interesting example of producing cows' milk with a particular composition as a specific marketing approach, alternative to organic, and one processing its own goats' milk and marketing it directly. Seven of the farms selected for the rapid sustainability assessments were dairy cow farms (6 organic, 1 conventional low input) and two were dairy goat farms (1 organic, 1 low input). Four of the farms have their own on-site dairy; the other five are members of cooperatives.

The dairy cow farms studied in Italy are very different to each other and some interesting aspects of the farms selected are briefly described below:

- A farm in an area where there is an intensive approach to farming and, therefore, reduced biodiversity. The distinguishing feature of this farm is in providing grazing and pasture areas for cows throughout the year.
- A farm in a natural national park which is managed in a traditional way. In common with a number of local farms, it maintains the territory and the landscape.
- A farm which constantly adapts its management with a view to keeping local citizens in close contact with agriculture. In fact it is creating a project for a public "park farm" in its fields and is working with the local council.
- Three farms with different breed management and different areas, but all producing *Parmigiano Reggiano* , a typical product of this region.
- A low input dairy cow farm in the south of Italy, where the economic system is "basic". This is a farm with a new marketing channel (www. lattenobile.it), based on the milk composition that results from grazing mixed pastures.

Other results which are of interest include:

- One farmer used a novel irrigation method for pasture, with a lower consumption of water than conventional irrigation. This method provided nutritious summer grazing.
- Some organic farmers practise biodynamic approaches.
- One farmer has crossbred-back from Friesian to a local breed.

Two goat farms were also included, since these are also a feature of the Italian organic dairy industry. The selected goat farms, one organic and one low input, are very different in size (14 and 113 ha, 55 and 180 goats, yielding 611 and 750 l/goat/year respectively – higher than the ICEA mean of 470l), but they have a similar economic development model: on-site dairy and high quality products. They both have a large local market because they are close to towns, and also participate in high quality specialized fairs and markets. One of them is in a highly industrialised area with very intensive farming systems and so is very unusual in its area. The other is a low input farm in a marginal area and is the first farm in its area to start processing its own milk directly for local and regional markets.

Table 8 Characteristics of Italian organic cow farms registered with ICEA and farms selected

		ICEA Population mean	Mean of farms selected	Range of farms selected
Farm size	ha	142	75	14 - 276
Herd size	No. of adult cows	55.45	77	12 - 301
Stocking rate	Livestock units/ha	0.39	0.79	0.41 - 1.2
	Grazing livestock units/forage ha	Unavailable	2.02	0.07 – 3.41
Milk sales	l/cow/year	6300	5194	3525 - 8219
Level of concentrate fed to milking animals	kg/cow/year	1100		
Total purchased concentrate per cow [1]	kg/ cow/year		1290	(0 – 2004)
Milking cows per Annual Labour Unit	Cows/Annual Labour Unit	Unavailable	33	22 - 58
Labour input per unit area	Annual labour units/100 ha	Unavailable	2.60	0.17 – 4.88

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above

3.6.2 Results of the sustainability assessment

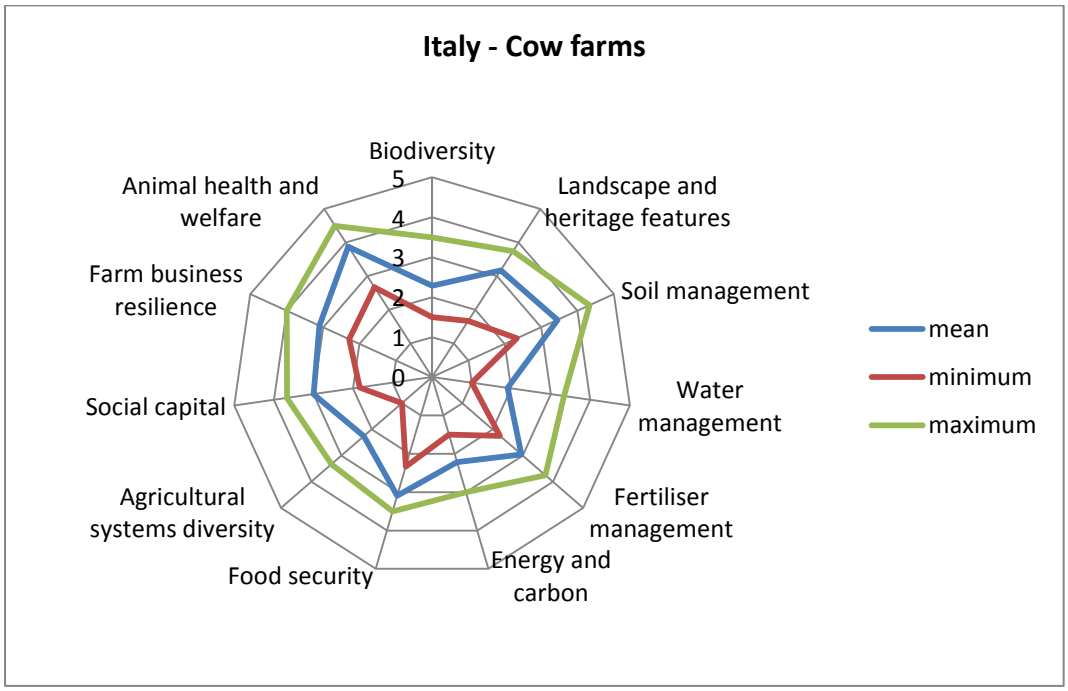

Figure 12 Spur diagram for Italy

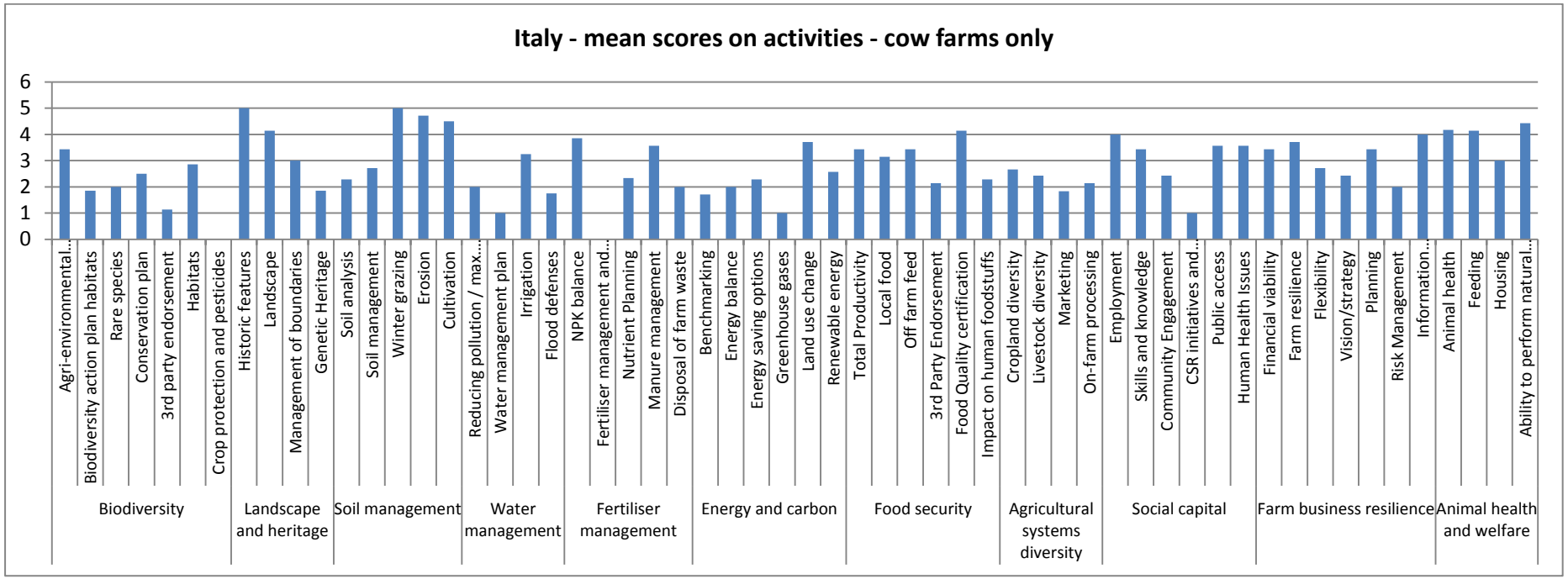

Figure 13 **Mean scores for activities for Italy**

Figure 12 shows the scores for the spurs and Figure 13 shows the scores for the activities.

In general, the range of results between farms was quite large, probably due to the wide variety of farm types that were included, with the highest mean scores for “Food Security “and “Animal Health and Welfare” Figure 12). “Fertiliser Management” scored relatively well; N, P and K balances were relatively low, with means of 112, 0.5 and 6 kg/ha respectively. These values are lower than the surpluses reported for Italian farms by Penati et al (2011), who reported N surpluses of 137 and 186 kg/ha, and P surpluses of 24 and 30 kg/ha for farms with and without grazing respectively. For “Energy and Carbon”, the overall score is rather low; it is known that on Italian farms, the farm machinery fleet is often oversized and also the greenhouse gas control activity scored poorly (Figure 13). The lowest results were obtained in the “Biodiversity” spur despite different management, geographical areas and answers. Biodiversity tended to be higher in small, mountainous farms, than in big farms on the plain. In general there is a good final result for “Social Capital”, where the employment activity scored high, and “Farm Business Resilience”, which could be due to family managed farms, and capacity for change. In “Water Management”, only one farm has a relatively high value, this is the only one that has invested in water recycling; all the others have a poorer result although there is a variation in types of irrigation, geological conditions and type of crops. Despite farmers’ concerns about water management, the activity scores showed that few farms have a water management plan. Avoidance of winter grazing, erosion and cultivation boosted the Soil Management score (Figure 13).

3.7 **Romania** (Catalin Dragomir)

The Romanian dairy sector has a large proportion of small businesses, many of which can be characterised as semi-subsistence, low-input farms. The distribution of dairy livestock is as follows (data valid for 2010):

- 60% in very small farms (1-2 cows),
- 20% in farms of 3-5 cows,
- 6% in farms with 6-10 cows,
- 10% in farms with 10-100 cows
- 4% in farms with more than 100 cows

There are no specific data available on the low-input farms, but because of their large proportion in total livestock, they are the main determinant of the national averages. Data on the overall dairy cows sector in Romania are presented in Table 9. There is limited data on this topic and so the figures given here are unofficial and are based on data from the website of the ministry of agriculture and internal reports from INCDBNA.

There are several aspects that qualify many Romanian dairy farms as low-input: very low proportion of concentrates in diets, scarce or no use of fertilisers, lower stocking rate, etc. Often, just one or

two supplementary feeds are used that usually originate from the farm itself (typically cereals or a cheap by-product such as bran).

Milk production in Romania is also characterized by a large heterogeneity: from big modern farms to families with 1-2 cows kept in a traditional system; diverse geographical & climatic conditions (from fields to high mountains, from rather dry to more rainy areas), diverse quality of pastures and produced milk, etc. There are various patterns of cow feeding including silage plus concentrates in the lowland areas, grazing or hay and smaller quantities of concentrates in higher areas. In the lowland areas, the nutritional value of the pasture tends to decline fast from the end of July because of the climatic conditions (in these areas pasture area is small anyway). Generally, the cows are housed from October to April but the housing period is variable because of the variety of geographic conditions.

Concerning the breeds used in the dairy sector, the most widespread in Romania are Romanian Black-Spotted (derived from Holstein-Friesian), Romanian Red-Spotted (derived from Simmental), Brown Swiss and a few newly imported breeds. There is a high degree of hybridisation between these breeds because of the decentralisation of the national breeding system (including official milk recording).

The inputs of concentrates and fertilisers are rather proportional to the size of the farm. Many of the small enterprises have potential for organic production (in Romania known as “ecologic”) but their small size (and weak financial power) prevents them from gaining certification.

There are two main marketing channels of dairy products in Romania. The most important is selling the milk to dairy processing factories, which have large collection networks across the country. Another marketing channel is on-farm processing of milk and selling dairy products directly to consumers (in vegetable markets or small shops). In general, this marketing channel is characteristic of the traditional / local products. The first channel is used by larger farms, whereas the second is used by the smaller-size businesses. The price of milk at the farm gate is rather low (0.25 Euro/l on average) and proportional with the farm size and technology level (ranging from 0.17 to 0.35 Euro/l). As previously mentioned, many animals are in semi-subsistence systems and this means that their production is intended for home consumption and only the surplus is sold; many owners have another source of income as well. There is a tendency for livestock concentration in bigger farms and for milk production to be the main source of income of the farms’ owners/tenants.

3.7.1 Characteristics of the case study farms

The 14 farms undergoing the rapid assessments were selected using the institute’s network of connections, and aimed to cover various geographical areas and rearing conditions: use of pasture, tethered; various breeds. The geographical position of the 14 farms is represented in Figure 14. It should be noted that in Romania, the geographical position also relates to the breeds, use of pastures, feeding strategies, etc. As selection filters, although no thresholds were used, the farms with low levels of concentrate and fertiliser use were eligible. On the other hand, small herds (e.g. less than 5-10 cows) were not considered because they tend to disappear following the

concentration of livestock in bigger farms (natural tendency and agricultural policies) and the data provided by these farmers are too scarce and inaccurate, hindering the production of valid assessments. Moreover, such small farms have a very low capacity to absorb research results. Also, most of the large farms can be characterised as conventional, therefore such farms were not selected for rapid assessments. Thus the farms selected are small and medium farms, not small semi-subsistence farms. Consequently, as observed in Table 9, their average size is higher than the national average. No organic farm was selected, as this kind of dairy system is poorly represented in Romania, therefore all 14 farms are close to the definition of a low-input dairy farm.

One farm was selected for its innovative approach: the owner studied abroad and is adapting its equipment for more efficient use and is selling milk and dairy products directly at the farm gate to a well-defined pool of customers. This is one of the few farmers performing soil analysis and he is pro-active in acquiring and valorising new knowledge in the field.

The breeds encountered in the 14 farms were in line with the breeds used at national level. One farm uses mainly Montbeliarde and is an example of the farmers who opted for imported breeds in their attempts to increase milk yield. With few exceptions, the farms chosen did not take part in the national official milk recording scheme.

Figure 14 Geographical distribution of the 14 Romanian farms used for rapid sustainability assessment

Most of the 14 assessed farms sell their milk to processors, with two exceptions – one farm selling the milk through a street dispensing machine, and one farm selling milk and dairy products at the

farm gate. Therefore it can be concluded that, in general, the assessed farms integrate into the first type of marketing channel and are dependent on sales to processors.

The low input dairy farms are spread virtually all over the country with no particular concentration or absence (see Figure 14). There are some regions known for their traditional dairy products and in these areas most of the farms are low-input. The geographic distribution of the 14 assessed farms did not follow a particular pattern; as a minimal condition it covered all the main regions of the country.

The visits revealed a series of good examples that could be extended to other farms: diversification of marketing channels, arrangements with local community to have access to the common land (e.g. access versus maintenance or improvement), biogas installation in order to save energy, and a plan to ensile brewers grains using bacterial ensiling additives not commonly used any more in Romania.

There are some cases of new feeds being used, for example alternative sources of vitamins and minerals, use of feed-grade turnips (as a farmer-conducted feeding trial), use of various varieties of corn, wheat and alfalfa (in order to compare them) and resuming the use of some forgotten crops such as millet and sorghum. Except for brewery grains and bran (both of which are very popular), awareness of the potential use of industrial by-products as feed is quite low. Herds selected for the project were relatively small and yields were relatively low. Farms ranged from 10 – 160ha of owned or tenanted land (mean 58ha), and in addition 11 of the 14 farms grazed some common pasture. Permanent pasture constituted a relatively small proportion of the farms' owned or tenanted land (0 – 38%) and labour input was high.

Table 9 Characteristics of the population of Romanian dairy farms and of the 14 selected farms

		Population mean[2]	**Mean of selected farms**	**Range of selected farms**
Farm size	ha	3.8	81.65	25 - 232
Herd size	No. of adult cows	1.3	39	20 - 70
Stocking rate	Livestock units/ha	Unknown	0.99	0.1-2.4
	Grazing livestock units/forage ha		1.00	0.09 – 2.62
Milk sales	l/cow/year	3210	3865	2000 - 6000
Level of concentrate fed to milking animals	kg/cow/year	Unknown	635	0 - 1460
Total purchased concentrate per cow [1]	kg/ cow/year	Unknown	510	0 - 2100
Mineral N fertiliser input	kgN/ha/year	Unknown	7.09	0-33.4
Milking cows per Annual Labour Unit	Milking cows per Annual Labour Unit	Unknown	10	5 - 20

Labour input per unit area	Annual labour units/100 ha	Unknown	6.37	1.10 – 16.0

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above

[2] No specific values for low-input dairy systems are available. As the low-input farms reflect the traits of the Romanian dairy systems overall, comparison is made with the country average figures. There is limited data on this topic therefore the figures are based on data from the ministry of agriculture website and internal reports of INCDBNA.

3.7.2 Results of the sustainability assessment

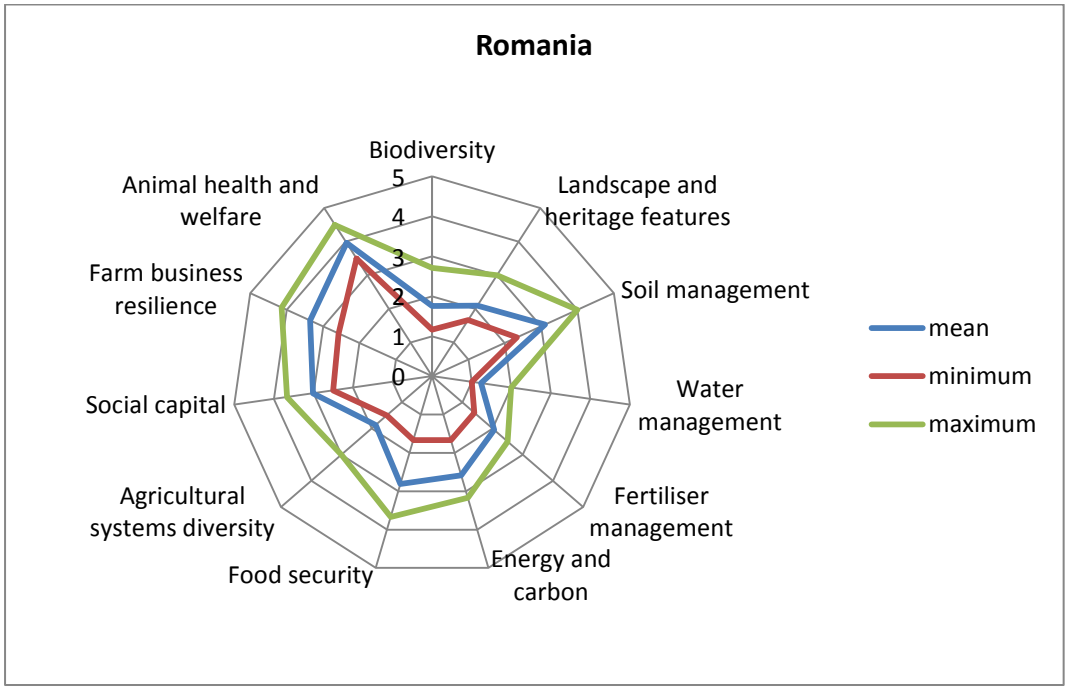

Figure 15 Spur diagram for Romania

In Romania, the highest mean scores were registered for “Animal Health and Welfare”, “Farm Business Resilience” and “Soil Management” spurs whereas the lowest scores were recorded for “Water Management”, “Biodiversity” and “Agricultural Systems Diversity” (Figure 15).

“Animal Health and Welfare” had not only the highest average score, but also a low variability of the answers. This could be explained by the fact that the ratio of animals to workers is very low, therefore animals receive more care. The second highest score, although moderate, was recorded for “Farm Business Resilience”. This can be explained by the small to medium size of the herds, cheap price of labour (the family of the owner often contributes), low costs for farm maintenance, low pressure on cash flow (e.g. purchase of feeds is limited, no investments are made and therefore there are no bank loans to return). The range of scores is moderate, as the business resilience depends on factors such as proximity to big cities and access to pasture.

The third highest score was recorded for “Soil Management”, also with a moderate variability of individual scores. Although the assessed farms do not focus heavily on soil management (e.g. only

one farm performs soil analyses at the farmer's initiative), animals do not graze in winter and, in general, there are no serious problems with soil erosion.

The lowest average score registered for "Water Management" is largely determined by the fact that, in many areas, there is no functional irrigation system available, farmers cannot apply corrective measures because they lack financial power and there are no strict rules related to water management with which to comply.

The second lowest score registered for "Biodiversity" can be explained by the fact that farmers are not aware of the importance of this criterion. Also, there are no specific rules imposed.

Scores for "Fertiliser Management" were quite low, influenced largely by a lack of nutrient planning. N balance values were not high (mean 84, range 23 – 127 kg/ha) and P and K balances were also low (mean 3 and 6 kg/ha respectively).

"Agricultural Systems Diversity" also registered one of the lowest average scores, with quite a large range. Whereas the farmers are aware of and practise crop rotation (due to tradition and strong agricultural education before 1990), they restrict their choice to only a few species. This is common in Romanian agriculture, mainly because they lack technical knowledge on alternative crops. Also, they have limited options to market their products, because of lack of investments, and dependence on milk collectors.

The mean values for the activities of the rapid assessment tool are presented in Figure 16. The following activities recorded high scores, which are in line with the general traits of the Romanian low-input dairy sector: ability to perform natural behaviour, information searching and networking, local food, energy & carbon benchmarking, erosion, crop protection and pesticides. Somewhat unexpected high scores were recorded for feeding (as the farmers admitted they lack knowledge on feeding/feeds) and planning (actually the farmers are not used to keeping farm records or written plans). Low scores were recorded for irrigation, water management plan, flood defence (all in line with the general traits of Romanian agriculture), greenhouse gases (a result of the low-input approach), on-farm processing and marketing (a drawback of the local dairy system), historical features and biodiversity action plans (both as a result of low awareness and the lack of a centralized, national-level approach of the subject). Unexpectedly low scores were recorded for genetic heritage (despite the fact that many Romanian farmers still keep animals from old-fashioned breeds for the sake of genetic heritage or by tradition) and rare species (although they try to protect them when they are aware of their existence).

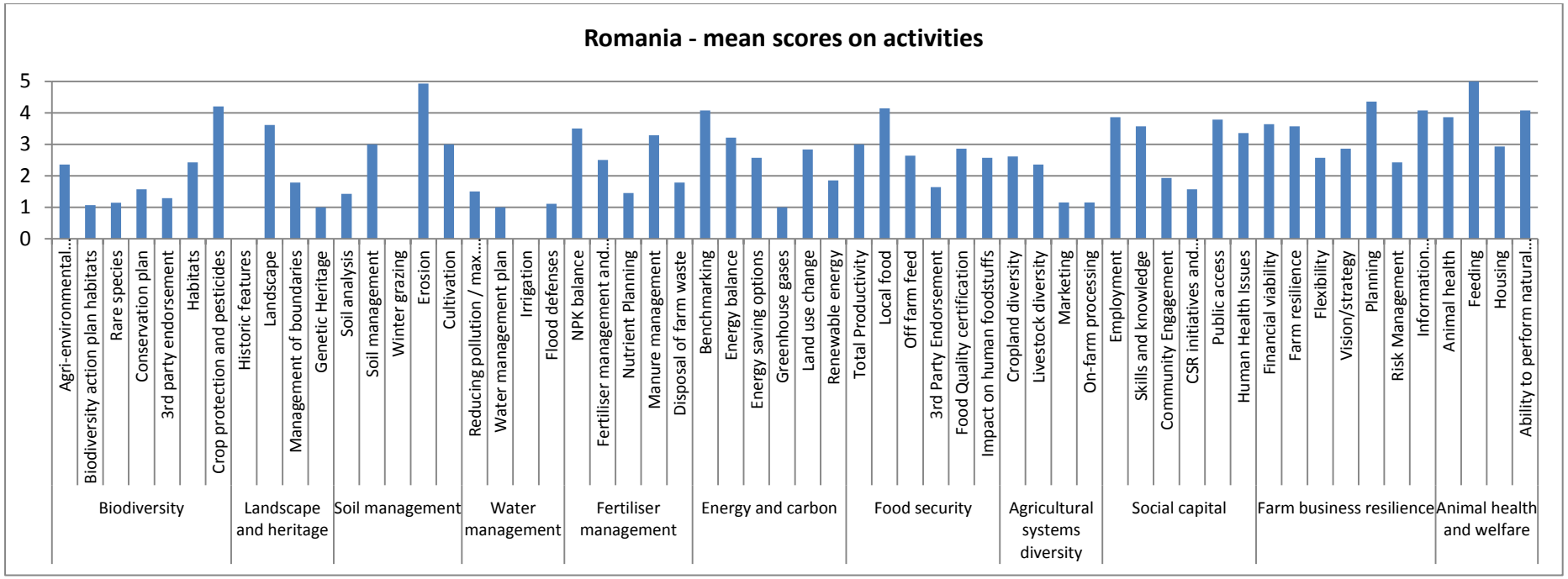

Figure 16 **Mean scores for the activities for Romania**

3.8 **Spain** (David Yanez Ruiz, Pablo Rufino)

The situation in Spain with regards to low-input and organic dairy production can be outlined as follows:

- There are 1,777 organic farms in Spain (including all types of production)
- Cattle represent 45%, with only 4% of those dedicated to dairy
- Goats represent 8%, with 37% of those dedicated to dairy
- Sheep account for 28% with 3% of those in dairy.

Around 70% of the farms make use of grazing land using extensive or semi-extensive systems. The tendency shows a slight annual increase in the numbers of farms (1-2% per year).

The rapid sustainability assessment exercise was focussed on goat farms as the SME partner is involved in the dairy goat industry. Most of the goat industry in Spain is oriented towards milk production, particularly in three regions: Andalusia (where the sustainability assessment was conducted), The Canary Islands, and Castilla La Mancha, where 71.1% of the milk goats in the country are concentrated.

There is a wide diversity of ecosystems in Spain (Atlantic in western-north, Mediterranean in south-east and also continental in the centre) as well as different breeds of goats. According to the Spanish Ministry of the Environment and Rural and Marine Affairs there were 22 indigenous breeds in 2009. Due to this genotype diversity, goats cohabit in traditional systems of meat and meat–milk production with intensive milk production systems. Traditionally goat production systems were focused on producing goat kids for meat with a live weight of 20–40kg after spring grazing, and cheese manufacturing at these farms during this season. However, in recent decades these systems have been revolutionized as a consequence of a series of social and legislative changes. In the 1980s the demand for kid meat shifted in favour of 1- month-old suckling goat kids (8kg live weight). Another reason for this change was the implementation of stricter health standards which

hampered small-scale cheese manufacturing and marketing, therefore the majority of farmers opted for selling whole raw milk to the commercial cheese industry, instead of producing cheese themselves. A third aspect to consider is that, after the mid-1990s, prices of feedstuffs fell while the price of milk rose, which gave way to the beginning of intensive, specialized milk production systems, which had not previously been profitable.

As a consequence of this evolution, the traditional meat production systems are decreasing, and are being replaced by hunting activities or other uses established by the CAP (rural tourism or natural environmental conservation). Likewise, dairy goat farms that depend mostly on grazing are also declining.

There is wide diversity among dairy goat farms, which are divided into two types of systems; those in which goats are permanently confined (C systems) and those where goats are kept on pasture with different grazing times (G systems). The G systems use indigenous goat breeds such as Murciano-Granadina, Malageña, Florida, Payoya, Palmera, Majorera and Tinerfeña. These goat production systems are predominant in Andalusia and the Canary Islands. Further information on this can be found in Appendix 3.

The C systems are steadily increasing in Spain. In Andalusia, the principal goat-farming region in Spain, 42% of goats and 47% of farms operate under this production system (Castell *et al*., 2010). The most productive Spanish dairy goats such as the Murciano-Granadina, Malageña, Florida and Majorera are used on these farms and can achieve their maximum productivity in these systems. Milk production fluctuates between 400l and 800l per goat per year, depending on the genetic merit of goats, management and facilities.

In some Spanish regions with little tradition of goat production, a few selected foreign breeds (Saanen and Alpine) have been introduced, but due to the lower fat and protein content in the milk of these breeds the market price is lower. There are some other problems that explain the failure of these initiatives, including the adaptation of these breeds to the environment of the Spanish farms, besides the farmers' low level of experience. Because of this, and in contrast to sheep milk production, goat operations with indigenous Spanish dairy goat breeds are competing favourably with the introduced breeds and even expanding outside their own regions.

3.8.1 Characteristics of the case study farms

The 10 farms were chosen to cover the whole range of systems existing in southern Spain: production in mountains and valleys; more and less selected breeds; purely extensive and semi-extensive; cheese making and milk selling; organic and non-organic. Having said that, the region covered (Andalusia), although it is the largest region for goat dairy production in Spain, does not represent the whole country. Some production occurs in northern Spain, although it does not contribute significantly. We have included four different dairy breeds, so different genotypes in terms of breeding intensity are covered in this study. Selected breeds are: Murciano-Granadina, Malagueña, Florida and Payoya. These cover the main breeds used in Spain, with the exception of the dairy systems in the Canary Islands. Our list includes three farms that make cheese and two

organic ones. We have found out that some organic farms are seriously considering returning to conventional methods as organic management does not seem to be an advantage for extensive dairy goat farmers. 2 farms from the original list withdrew due to unwillingness to provide financial details.

Examples of best and innovative practice identified on the farms undergoing the rapid assessment include:

- Excellent grazing management, including grass, shrubs and fruits. Special attention given to carefully designed supplementation to reduce costs and maintain milk yield
- Excellent records of animal health and welfare and high levels of concern about these issues.
- Strong marketing strategy for selling. This farm in particular is highly innovative compared to others as it is selling directly to some restaurants using a 'tailor made' product
- Good management of on farm grains and forage cultivation
- One farm is also very involved in educational programs, with constant collaboration with local schools to organize children's visits over the year.

The main strength overall in the SME is the use of high genetic value animals as the farms are part of the breeding program in each Association which is strongly supported by the regional government. The average individual milk yield is clearly improving over the last 5-10 years as a result of such activity.

Another identified strength was the overall improvement in awareness of the importance of health and milk quality in the dairy goat sector in recent years. Although ten farms were visited, it proved very difficult to obtain milk production figures from them all, so only seven farms were included in the final analysis, due to missing data. Land area and stocking rate ranged extremely widely reflecting the range of systems from "landless" to extensive and there was minimal permanent pasture. The number of milking goats and yields also varied widely, the mean being lower than in previous studies. Purchased concentrate use also varied greatly. The mean of 0.38 tonnes per goat per year was similar to that in previous studies, although it is not certain whether the calculations were directly comparable. Mean labour inputs were higher in the selected farms than were reported in previous studies (Castel *et al.*, 2010).

Table 10 Characteristics of Spanish goat farms compared with the 7 selected farms

		Population mean [2]		**Mean of selected farms**	**Range of selected farms**
		Confined (C)	Grazing (G)		
Farm size	ha	Not available		70	0 - 314
Herd size	No. of adult goats	179 or 382 depending on geographical area	353	313	140 - 640
Stocking rate	Livestock units/ha				
	Grazing livestock units/forage ha	Not applicable	0.22	1.05	0.14 – 2.57
Milk sales	l/goat/year	487	473	384	117 - 687
Level of concentrate fed to milking animals	kg/goat/year	343	389		
Total purchased concentrate per goat[1]	kg/ goat/year			380	7- 560
Milking goats per Annual Labour Unit	Milking goats per Annual Labour Unit	Not available	Not available	258	117 - 674
Labour input per unit area	Annual labour units/100 ha	135	41	0.78	0.05 – 2.97

[1] Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above

[2] From studies reported by Castel et al., 2010

3.8.2 Results of the sustainability assessment

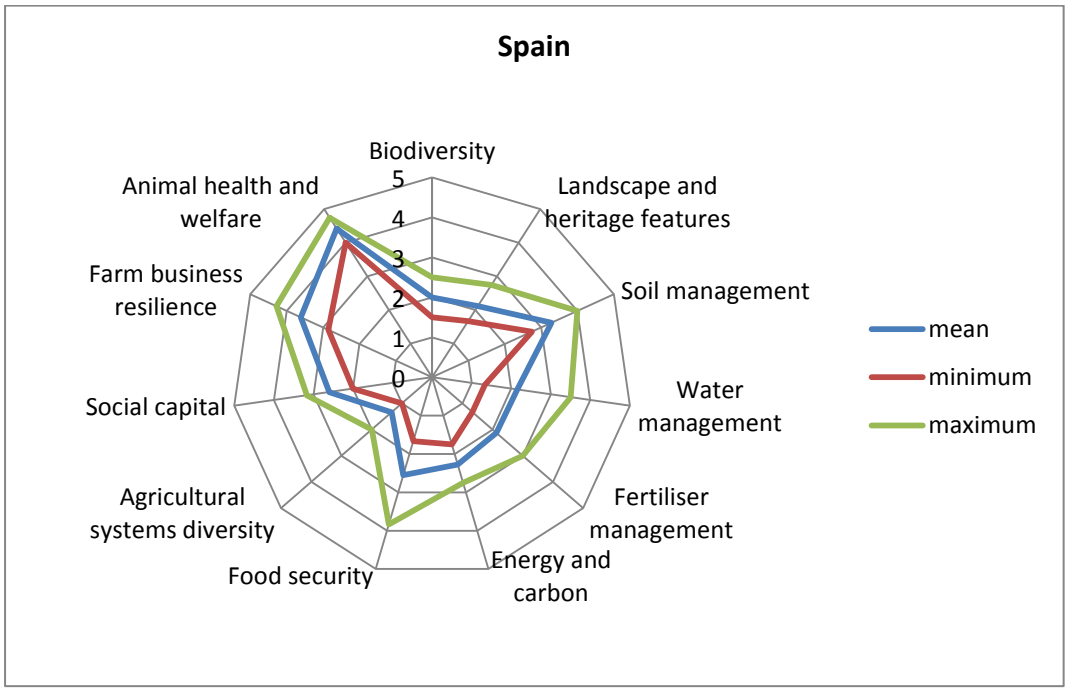

Figure 17 Spur diagram for Spain

The scores obtained from the rapid sustainability assessment in Spain show a high variation, especially for "Food Security", "Fertilizer management" and "Water Management" (Figure 17). The highest scores were obtained for "Animal Health and Welfare", "Farm business resilience" and "Soil Management". The lowest were observed for "Agricultural Systems Diversity" and "Biodiversity".

It is important to point out that the farms selected are based in different areas of south Spain, which include mountains and valleys, arid, semi-arid and temperate weather as well as different marketing strategies. Therefore, it was expected that there would be a range of scores for those spurs strongly linked to the ecosystem where the farm is located.

The high scores reported on "Animal Health and Welfare" could be a result of the combination of different factors: the relatively low number of animals of the farms, the family type business and therefore strong attachment to the animals as well as the low stocking rate.

The low scores obtained for "Biodiversity" might be a combination of a lack of legal/financial incentive to work on this area and low awareness of its social and environmental importance. On the other hand, when the individual scores are analysed we could see that there were high scores for those practices that are actually highly beneficial for keeping biodiversity and conservation which are part of the local tradition but not the result of public programs or 'formal education'.

"Water Management" showed a high degree of variation in scores across farms. This was possibly associated with the rather different ecosystems where the 10 farms are placed, basically more

technical in valleys than in mountain areas, where farmers rely exclusively on waterfalls and streams.

“Fertiliser Management” also showed a wide range. There were some very high N balance figures (mean 221 kg N/ha) influenced by the relatively small land base of some farms. Some farms exported manure because of their small land area. N fixation rate was low (mean 23.2 kg N/ha) since legumes and clover were not commonly grown. Interestingly, there were also some farms which imported manure.

Overall, the level of management and planning in feeding and nutrition was very poor and this was discussed at both farmers’ workshops. Farmers have become more aware of this weakness as feeds have risen in price over the last few years. As a general observation, the grazing management with regard to maximizing the potential of shrub land, especially in mountain areas was rather good. However, one particular area which shows great potential for improvement is the supplementation of animals after or during grazing.

In cheese-making farms, marketing plans are not efficient at all and there is room for much action to be taken. The marketing strategy of one cheese-making farm toward targeting high-end restaurants to sell goat cheese under different ways of maturation (olive oil, herbs, etc..), showed that this ‘a la carte’ strategy could be very successful.

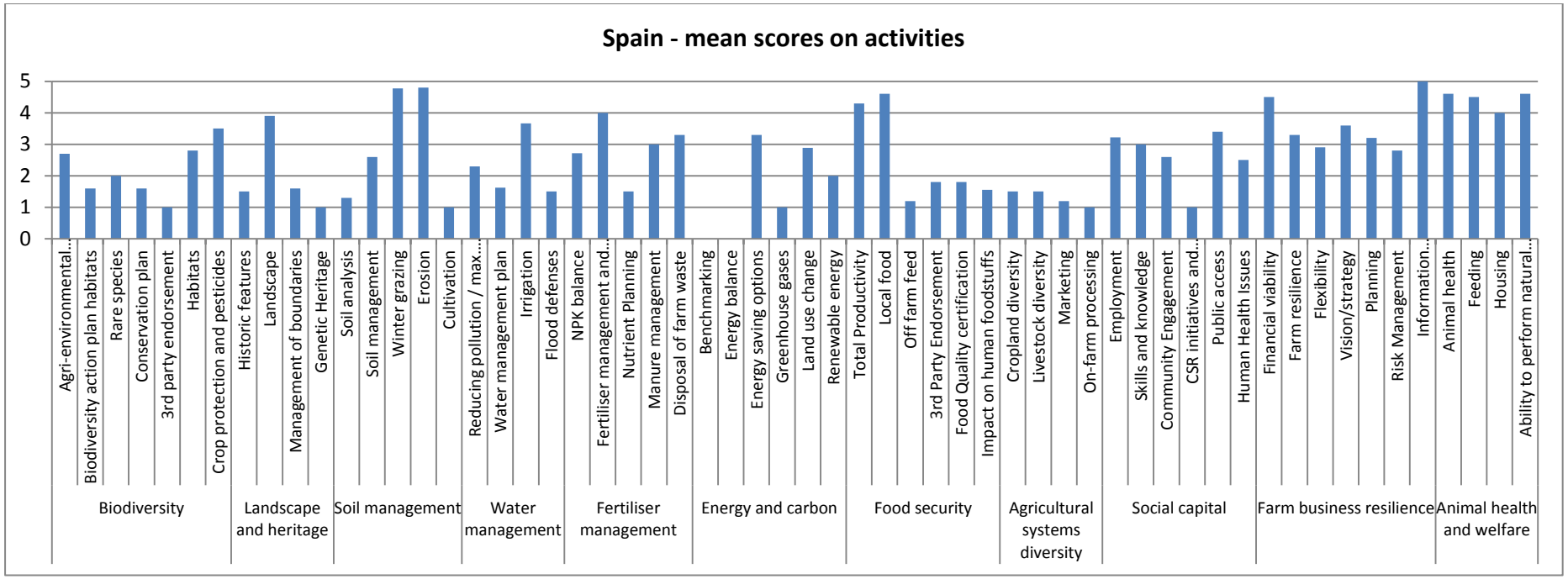

Figure 18 **Mean scores for activities for Spain.**

3.9 **UK** (Katharine Leach, Catherine Gerrard, Susanne Padel)

Dairy farming in the UK is concentrated largely in the Western part of the country, where rainfall is higher and grass growing conditions more favourable. Organic dairy farming follows the same distribution. Both organic and conventional production include a range of systems, for example, autumn calving herds that are highly dependent on conserved forage and purchased concentrate but benefit from higher milk prices in winter, spring calving herds where the aim is to minimise concentrate input and produce milk as cheaply as possible from grass, and year-round calving giving the benefits of a steady income and less pressure to maintain a tight calving pattern. The most recent figures available for organic milk sales are 169 million litres sold in 2009/10, sold by the co-operative OMSCo, which provides 80% of the total UK organic milk supply. This volume constituted 3.3% of all national milk sales. Yogurt is the product with the largest organic share of the market (7% of the total yoghurt market). In 2009/10, organic milk output fell by 2%, the first drop since 2004. (OMSCo, 2010). Although the majority of conventional herds in the country are Holstein-Friesian, cross bred herds are relatively common in the organic sector.

3.9.1 Characteristics of the case study farms

For the sustainability assessments, a total of 17 farms in both England and Wales were assessed, reflecting the locations of the farmer members of the two SME partners. Both SME partners are milk buying co-operatives that collect and buy milk from their members and sell it to other processors. The ten farms assessed in England were all members of the SME partner OMSCo, the Organic Milk Suppliers' Co-operative, with approximately 300 members, forming 80% of the UK organic milk supply. Information on the structure and performance of the complete population of organic dairy farms in the UK does not exist. Some data are available from the sample of 48 farms included in the Farm Business Survey and reported in the report on Organic Farm Incomes in England and Wales for 2010/11 (Moakes et al., 2012a). Data from this sample are combined in Table 12 with some from the population of OMSCo farms which record financial data. It should be noted that not all OMSCo members (and not all those undertaking the assessment) take part in this recording scheme. Seven farms representing the second, smaller SME partner in the project, the Welsh co-operative Calon

Wen, were also assessed. Calon Wen has a total of 27 farmer members and has a limited range of own-branded products.

OMSCo farms reflect the geographical spread of dairy enterprises across England, being more concentrated in the south and west of the country. All farms sold all liquid milk direct to OMSCo. Two herds were of British Friesian cows, one was Holstein and one Ayrshire. All the remaining herds included cross-bred cows with breeds including New Zealand and British Friesian, Holstein, Swedish Red, Norwegian Red, Montbeliarde and Brown Swiss. The remaining herds had Holstein or Friesian cows.

The Calon Wen farmers that took part in the sustainability assessment cover the geographical region from West Wales to the Shropshire border. Although all 27 members of the co-operative were given the chance to participate, six of the seven who volunteered were smaller producers with fewer than 100 cows. This balanced the tendency for larger than average herds in the OMSCo group (See Table 11). One of these farms had its own cheese-making business, but sold any surplus milk to Calon Wen. There were two single breed herds – one Ayrshire and one Holstein, and the rest were of cross-bred cows including most of the same breeds as those in OMSCo herds, with Meuse Rheine Issel also being represented.

Overall, the UK farms had been organic for an average of 13 years (range 3 – 30). The farms selected had slightly smaller herds and lower yields than the mean for OMSCo farms that recorded financial performance. This might be expected as larger and higher performance herds would be more likely to use the recording scheme mentioned earlier. The selected farms were similar in mean herd size to the farms included in the Farm Business Survey, but had slightly lower average yields. There was a wide range of concentrate inputs and stocking rates in the selected farms.

Several interesting aspects were observed on the farms selected. There were two examples of spring calving, cross-bred herds using very little purchased concentrate. Expert grassland management resulted in good milk production from forage. There was also a herd with very low antibiotic use, which achieved very good health and welfare. A third interesting farm type was a marginal upland unit. Across all 17 farms there was a range from small “one-man” units to much larger herds. One Welsh farm was well established in diversification into tourism, and another had a cheese-making business on the farm. There were few examples of novel forages, but one farmer included chicory and plantain in medium term pastures, chosen for their drought resistance. This resulted in a more productive and nutritious pasture, which could withstand more frequent grazing in drought conditions than a simpler grass/clover sward. Another farmer grew a mixture of lupins and triticale for wholecrop silage.

Table 11 Characteristics of UK lowland dairy farms, SME farms (OMSCo) and all farms selected

		Mean for 48 lowland organic dairy farms[2]	Mean for SME population[3]	Mean of farms selected from OMSCo and Calon Wen	Range of farms selected from OMSCo and Calon Wen
Farm size	ha	144	Unknown	204	46 - 422
Herd size	No. of adult cows	144	173	152	65 - 378
Stocking rate	Livestock units/ha	1.4	Unknown		
	Grazing livestock units/forage ha	1.4	Unknown	1.58	0.33 – 2.49
Milk sales	l/cow/year	6202	6539	5433	2710 - 7368
Level of concentrate fed to milking animals	kg/cow/year	Unknown	1400	Unknown	Unknown
Total purchased concentrate per cow [1]	kg/ cow/year	Unknown	Unknown	1020	100 – 1740
Milking cows per Annual Labour Unit	Milking cows per Annual Labour Unit	Unknown	Unknown	61	24 - 145
Labour input per unit area	Annual labour units/100 ha	2.19	Unknown	1.93	0.34 – 6.50

1 Data from the tool - may include some concentrate fed to other livestock on the farm, therefore not necessarily directly comparable with the line above

2 Moakes et al., 2012a

3 31 OMSCo farms recording financial performance

3.9.2 Results of the sustainability assessment in the UK

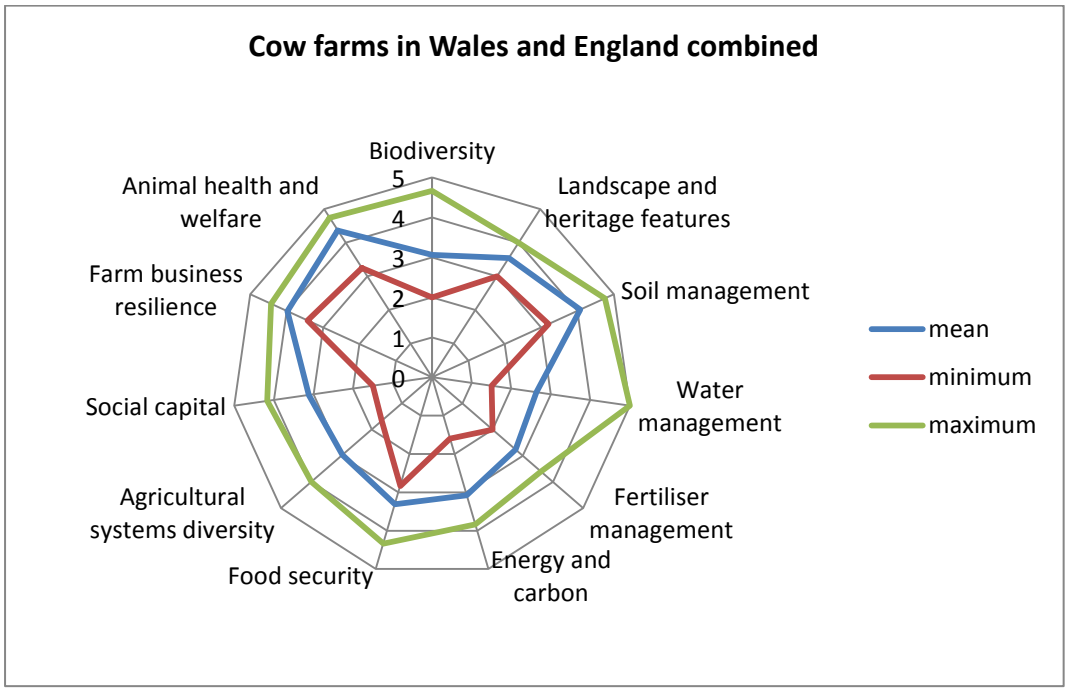

Figure 19 Spur diagram for UK

The distributions of scores for the various spurs are illustrated in Figure 19. For most spurs there was a wide range of responses across farms reflecting the interests of the owners.

Farms scored highly and relatively consistently on “Farm Business Resilience”, while “Farm System Diversity” was highly varied. The strongest activity within farm business resilience was information searching/networking. The other activities showed more variation.

Scores for “Animal Health and Welfare” were consistently high. Many of the questions referred to the Animal Health Plan, which UK farmers are required to have in order to be Farm Assured. However, despite selecting farms where good recording was expected, there was little accurate recording of disease incidence, especially where homeopathy is being used. Calculations of culling / replacement rates are often not made.

Overall, the maximum values for “Fertiliser Management”, and “Landscape and Heritage Features” were relatively low. Within “Fertiliser Management”, there was no particularly weak activity. N balance was low when compared with conventional UK herds (Romer et al, 2009), in the range 43 to 180kg/ha (mean 123); P balance averaged 22 and K balance 5kg/ha. The mean P balance was elevated by two farms which were importing rock phosphate fertiliser, because of concerns about low P indexes in soil. The mean estimated N fixation was 106 kg/ha. Within “Landscape and Heritage Features” genetic heritage only scored 1 or 2.

“Biodiversity” often scored quite low, although there was one exceptionally high maximum in England (on the marginal upland farm). Some farmers explained that lack of financial incentive prevented them from doing more to encourage biodiversity. It appears there is limited proactive conservation or habitat creation on dairy farms, although farmers generally felt that field boundaries, especially hedges, made an important contribution to biodiversity and landscape and some had been actively involved in creating new hedges and other habitat features. The question might be raised whether permanent pasture is sufficiently recognised as a valuable habitat by farmers and schemes (or indeed by the tool). For example, farmers often seem unaware of “red species lists” unless they have a designated site that is monitored by a third party. However, on questioning, there was generally at least one person on the farm who had an interest in and knowledge of natural species diversity, and some wildlife enthusiasts have a detailed knowledge of flora and fauna on their farms.

“Water Management” showed a particularly wide range of scores in the OMSCo group. This was likely to be caused by the variation in the necessity for irrigation or water conservation depending on local climatic and geological conditions. The highest score was achieved by the one farmer who had carried out a water audit and implemented some water-saving measures. The Welsh farms had a narrower range of lower scores, likely to be a result of their more similar conditions of high precipitation. The tendency for lower scores for “Fertiliser Management” in Wales may well be a result of the lack of Nitrate Vulnerable Zone legislation requirements, in contrast to England. “Soil Management” in Wales showed a slightly higher maximum, and “Social Capital” a wider range than in England. A contributing factor to the more consistent Social Capital activity score in England was the fact that all OMSCo farms are covered by an ethical trading agreement.

Consistently high scoring activities were agri-environment participation, cultivation and land use change (Wales), information seeking, animal health plans and animals’ ability to perform natural behaviour. Particularly low scoring activities were Biodiversity action plans, Genetic heritage, and on-farm processing (in England/OMSCo only), and water management plans (particularly in Wales).

Several farmers referred to the difficulties imposed by high prices of purchased organic concentrates. Those growing their own cereals were protected from this threat. Lack of funding for supporting biodiversity and landscape and heritage was often mentioned as a disincentive to work in these areas.

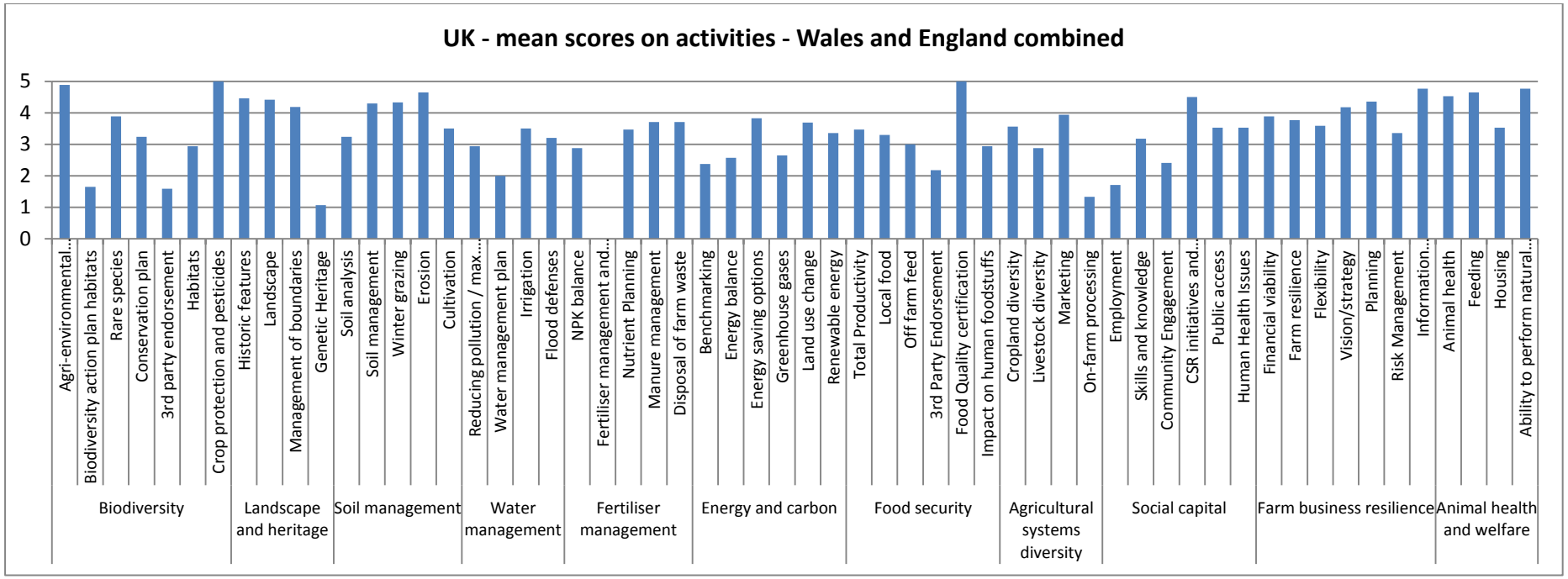

Figure 20 **Mean scores for activities for UK**

3.10 Discussion of the outcome of the rapid sustainability assessment

3.10.1 Overall results across countries

The mean, minimum and maximum descriptive statistics for each spur by country are illustrated in Appendix 4 and the mean scores are shown in Figure 21 and Figure 22 below. In this section the scores are broadly described to give some interpretation and explanation of the results, and some reference is made to published information on aspects of the scores where available and relevant, concentrating on the major strengths and weaknesses. The results will be further discussed in conjunction with farmers' opinions, and the outcomes of the workshops in Section 5.1.

The tool was able to illustrate differences between countries, and between cow and goat enterprises. Strengths revealed by the tool were more consistent than weaknesses, which varied more between countries.

The most variable spur between countries for cow farms was "Water Management", with particularly low country level scores in Austria and Romania, and the highest score in Denmark. In general, concern for water management on cow dairy farms was related to precipitation levels within the country, with much lower concern in wetter areas (Austria, Wales). Denmark was an example of a wetter country with better scores for "Water Management", achieved through legislation and mainly focussed on prevention of contamination of water supplies. However, on goat farms in Greece and Spain there was little attention paid to water conservation, which is a greater concern, since these are often in arid areas.

The highest scoring spur was consistently "Animal Health and Welfare". This finding should be treated with some reservation because the nature of the assessment relied to a large extent upon the existence of herd health plans and farmers' subjective opinions of their animals' facilities and freedoms. Some data on incidence of health measures were included, but records were not checked for reliability. Animal health and welfare is not reliably assessed without animal based measures (Blokhuis et al., 2010), so the capability of assessment by these methods is limited. However, it is interesting to discover that farmers were largely allocated a good score to various aspects of health and welfare of their dairy cows. The scores for goat farms were lower, although relatively high compared with some other spurs for the goat farms. This suggests that more work on goat health and welfare would be beneficial, and indeed, this issue arose in the workshop discussions (see Section 4.3). Considering individual activities, feeding and ability to perform natural behaviour were in general the highest scoring activities within this spur for cows, but all activities were generally high. This was the case even for countries where tethering is still practised, demonstrating that the farmers' perceptions may be influenced by the norms within the agricultural practice in their country and illustrating the limitations of subjective questions such as "do your animals have the ability to perform natural behaviour?". For goats, the lowest scoring spur was found in Greece where scores for health, feeding and housing were rather low. Health and welfare components scored similarly within farms. If health activities are considered alone, in each country the summary scores do not differ greatly from the combined health and welfare score (the largest differences were in Italy which scored 0.6 better for health, and Belgium, scoring 0.5 better for welfare).

For comparison, some previous studies have reported better health status on organic farms compared with conventional, for example lower incidence of lameness (Rutherford et al, 2009). Lower inputs of concentrate have been also been associated with less lameness (Dippel et al, 2009). However, Vaarst et al (2004) and Weller and Bowling (2007) suggested that metabolic disorders such as ketosis might be likely to increase in systems with low concentrate inputs. This has been suggested that this is more likely to be the case if the animals are not genetically suited to the low input system (Boyle & Rutter, 2013), although an earlier study showed no difference in indicators of metabolic stress in low input and high output systems with cows of the same high genetic merit (Thomas et al, 1999). Olmos et al (2009) reported some metabolic indicators of nutritional stress in pasture fed cows in early lactation, but these did not result in poorer overall health and welfare compared with a continuously housed herd. The of genetic variation in ability to withstand negative energy balance is being studied in SOLID Work Package 2. Muller-Lindenlauf et al (2010) reported a range of animal welfare ratings across German organic dairy farms, with lower scores on the more intensive farms, but wide variation on the less intensive farms. Less work has been carried out on sheep and goat health and welfare in general, (Anzuino, 2010, Phythian, 2011), therefore the lower scores might be a result of less available information and support for farmers.

The next highest scoring spurs overall (for both cows and goats) were “Farm Business Resilience” and “Soil Management”. Both were quite varied between countries. “Farm Business Resilience” was on average lowest in Italy and highest in Finland, but the country averages conceal considerable differences between farms, particularly in Romania (with a wide range of flexibility and risk management) and Finland (where financial viability, vision and strategy were quite variable). Austrian farms scored well on this spur due to the number of different enterprises. Scores for most activities included in the “Farm Business Resilience” spur showed considerable variation both within and between countries. The exception was farm resilience on cow farms, which consistently scored 3 or 4 apart from in Austria where the variation was wider. Spain and Belgium had high scores for information seeking and networking by goat farmers, while Greece scored much lower in this activity. All other activities were again highly variable between farms, contributing to the overall variation in the spur.

Penati et al (2011) referred to the possibility of producing high value cheese from Alpine pastures as a contributory factor to a higher labour income per tonne of milk from Italian farms using mountain pastures compared with those abandoning Alpine grazing. Upland grazing subsidies also contributed. Published sustainability assessments of goat dairying have not been found, but Ripoll-Bosch et al (2012) reported that the economic efficiency of sheep dairying in Spain was positively influenced by added value in the products. These authors scored sheep dairy farms highly on self-sufficiency and productivity, in a method that was similar to that used here, but with fewer “spurs” so that more activities contributed to a “spur” score. They also reported that diversification was limited in sheep dairying enterprises and we have witnessed the same for goat dairies, restricting the “Farm Business Resilience” to some degree.

“Soil Management” activity scores (based on frequency of soil analysis and management of compaction and erosion) were relatively consistent on cow farms within countries, but varied considerably between them, being particularly low in Austria. In contrast, goat farms showed more variation in this activity within countries than the cow farms. Soil analysis was uncommon in Austria

and Romania, and on goat farms. Scores for prevention of erosion were consistently high or the activity was considered not applicable. Our results show greater variation in the aspect of soil management than results from assessments of German organic dairy farms using a similar whole farm assessment interview approach, from which Muuler-Lindenlauf et al (2012) reported that there was little risk of soil degradation.

The lowest scoring spur for cow farms overall was “Biodiversity”. The spur labelling might have been slightly misleading; a more appropriate title might be “Agri-environmental Management”, to cover more of the aspects included within the spur. Farmers often did not initially consider biodiversity as an existing feature of the mainly grassland farms, or as an important attribute. However, on questioning, there was generally at least one person on the farm who had an interest in and knowledge of natural species diversity. The tool may have had limitations here, not allowing sufficient representation of the biodiversity that may be associated with grasslands. The rich diversity of Alpine meadows is well documented (Dainese et al, 2012) and the sustainability assessment tool needs a better capability to reflect this. In all countries, the lowest scoring activities in this spur were Third Party Endorsement and Biodiversity Action Plans. These ideas were unfamiliar in many countries, which again may have limited the scores that could be achieved. Although scores may have been somewhat influenced by the questions asked in the tool, there is an indication that more could be done to improve this aspect of sustainability. For example, Muuler-Lindenlauf et al (2012) reported that on German organic dairy farms there was only limited biodiversity within the production areas, but scope for more conservation measures on the farm outside the productive areas, and these could contribute to biodiversity.

For goat farms the lowest scoring spur was “Agricultural Systems Diversity”, indicating that these were generally very specialised farms, as reported by Castel et al (2010). In the cases of the extensive goat farms in Greece and Spain, this is likely to be because of the limiting characteristics of the farms due to climatic conditions. Dairy cow farms were also relatively specialised, but showed slightly greater diversity, in general, than goat farms. Diversity was particularly low in Romania and highest in Finland and UK.

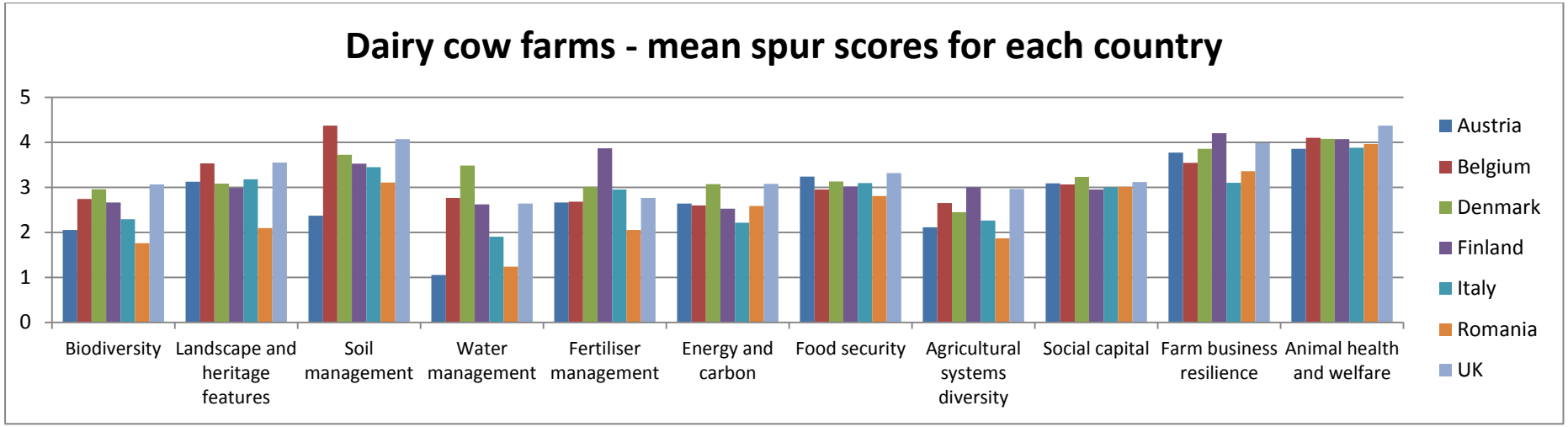

Figure 21 **Country comparison of spur scores for dairy cow farms**

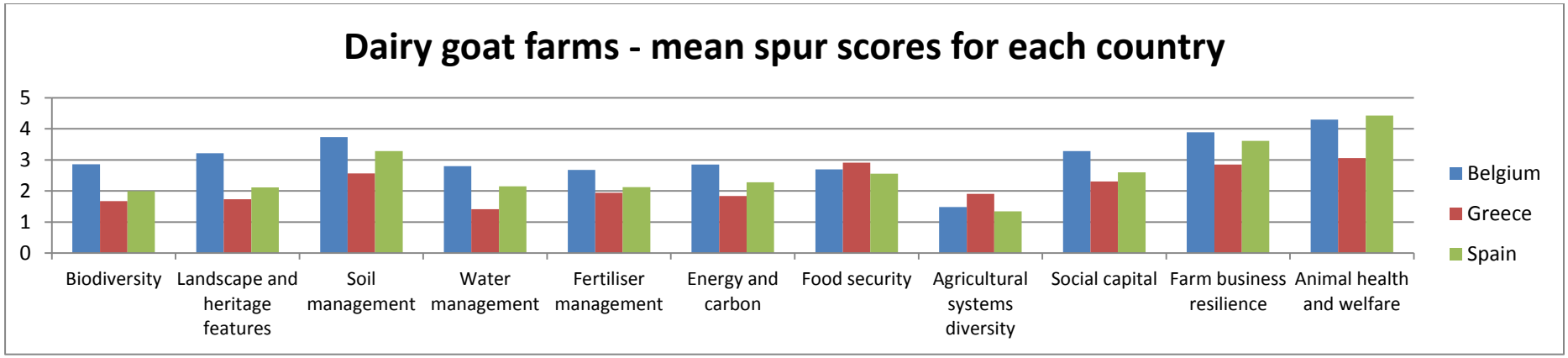

Figure 22 **Country comparison of spur scores for dairy goat farms**

"Food Security" and "Social Capital" scored very consistently across countries, neither particularly high nor low, at around 3 on the scale. Among the activities, third party endorsement of products was low for goat farms, but all other attributes were variable, as were all activities for cow farms. "Landscape and Heritage Features" showed similar country level scores, again around 3, with the exception of Romania, which scored lower. "Fertiliser Management" showed quite a wide range between countries, with a particularly high score for Finland, where there was consistently good nutrient planning and manure management, likely to be influenced by legislation, and a low score for Romania, where nutrient planning was weak – possibly due to lack of knowledge, and opportunities. Manure management and waste disposal generally scored better than nutrient planning on cow and goat farms, while nutrient balance scores were very varied. The mean N balance values were generally a little above the 90 kg N/ha achieved in a low input dairy system aiming to maximise N use efficiency by Leach & Roberts (2002), but the ranges were wide. Haas et al (2006) reported a lower nitrogen surplus of 43 kg/ha from farm-gate balances of 26 German organic dairy farms. This German sample averaged a P surplus of -3 kg/ha and K surplus of 0.5kg/ha, compared with the country means in this study ranging from -15 kg P/ha (Belgium) to 22kg/ha (UK) and -2.9 kg K/ha (Finland) to 38 kg K/ha (Belgium). Steinhaam (2004) in Norway also reported low balances from 10 organic dairy farms, with mean N surplus of 41 kg/ha and P surplus of 0.6 kg/ha. Muuler-Lindenlauf et al (2010) found variable nitrate leaching potential within and between different types of organic dairy farms. We did not evaluate farms to this level of detail. It should be remembered that in all systems involving legumes, the N input from fixation is difficult to estimate reliably; our estimates were based on farmers' descriptive information on the clover content of swards. Although the effect of the nitrate directive and water quality directive have been applied to the whole of the EU, it appears that concern and control measures are still variable between countries.

Finally, the "Energy and Carbon" spur showed moderate variation between countries and scored relatively low. The energy and carbon score in our assessment combines direct energy consumption with information on alternative energy sources and factors affecting "carbon footprint" which can be very variable, thus there are many factors that may be contributing to the wide variation between farms in this study. The lowest scoring activity was greenhouse gas emissions, based on general information on management practices likely to affect this. We do not have "greenhouse gas inventory" type data from the rapid assessment carried out here, for comparison with published data available, Direct energy consumption also contributed to this spur, variably both within and between countries. Muuler-Lindenlauf et al (2010) found little variation in the direct energy consumption of German organic farms at differing levels of production intensity, although the indirect use (not directly included in the energy and carbon spur in our assessment) was higher with greater purchased feed inputs. Muuler-Lindenlauf et al (2010) attributed a greater "climate impact" to low-input grassland based farms than to intensive "tilth-based" types, on the basis that high fibre diets are more likely to result in greater methane emissions per kg of milk produced. They found that the lower input organic systems were more variable in calculated carbon inventory values than the more intensive systems. Our information on greenhouse gas emissions was not detailed enough to include this type of differentiation. Danish, Finnish and UK cow farms were the only groups where

scores above 1 were recorded for greenhouse gas abatement. It is possible that in these countries there is more political will to act on these issues and farmers are therefore better informed about them, and more likely to be taken steps towards mitigation.

Thus, the "classical" indicators of environmental sustainability - management of soil, water and nutrients, and energy and carbon resources - all show considerable variation in the majority of countries, indicating that there is the capability for poorer performing farms to improve. In particular, farmers' attitudes to water management may need to be altered: even in dry areas there was a need for a greater understanding of the importance of water management. In some countries, notably Denmark, legislation has succeeded in improving specific factors influencing the environmental aspects of sustainability, such as water pollution, *e.g.* by mandatory buffer strips along water courses, and compulsory plans for nutrient applications and waste management. However, the discussions indicated farmers' lack of confidence in their understanding of soils and nutrient cycling in several countries. The systems studied have moderate dependence on fossil fuels and the farmers have only moderate concern for carbon footprint and greenhouse gas emissions. Finally there is the long-term vulnerability of forage production to climate change. In some countries it appeared that national legislation directed, but perhaps also restricted, farmers' concepts of sustainable practices, particularly with regard to nutrient use. Efficient energy use or reduction of fossil fuels received varying degrees of interest – *e.g.* very little in Greece where goat farms without electricity exist, and more in the UK where farmers have been made aware of their "carbon footprint" or greenhouse gas emissions by government and industry activity, and are also concerned by the price of fuels.

Our findings should be considered in the light of some of the limitations and possible biases introduced by the method of assessment, particularly the difficulties of assessing animal health and welfare without animal based observations, and business performance without detailed financial data. The tool may be limited in its ability to credit the mainly grassland based dairy systems with biodiversity. The findings are from a very small, potentially biased sample of farms and so this also needs to be taken into consideration when interpreting the results.

3.10.2 Farmers' opinions on the exercise and thoughts on sustainability

The sustainability assessment was positively received in most cases. Austrian farmers were very interested in the assessment and willing to spend time with the interviewer despite being surprised about the type of survey as they were more used to talking about a farm's economy than biodiversity or landscape and heritage. In Finland, all of the farmers were interested in the results and also pleased to be involved in this kind of assessment. They were interested to see how their farms compared with the SOLID definition of "low input". Five farmers were also willing to continue with more detailed interpretation of the results as well as taking part in on-farm experiments. There was interest in being involved in the process to develop the rapid assessment tool for further use in Finland, to compare different farms and production methods (organic, low-input, and conventional). In Italy, again all the farmers were interested in the assessment and only one was critical, or rather

questioned some spurs. Some relevant queries were made about energy benchmarks, and in general there was interest in biodiversity.

The sustainability assessment seemed to interest Belgian farmers as a benchmarking exercise. The potential of the tool to illustrate the outcome with a graph at the end of the discussion was positively perceived by all farmers (giving an immediate 'return on investment'), but the additional report on their individual farm result, discussed in comparison to the average of the group, was considered as an essential next step in the process. A good reference frame was perceived to be crucial, and although the group of 5 farms may be rather limited in this respect, it was felt to be satisfactory. The Belgian farmers expressed an interest in results from other regions, particularly from the same production type (goats, cows), as an additional benchmark. Similarly Finnish farmers were also very interested to see and compare the results from their farms to the results of other partner countries.

In some countries individual spurs inspired particular interest and discussion. In Greece, farmers were mostly interested in the "Health and Welfare", "Farm Business Resilience" and "Social Capital" spurs. The spurs which most interested the Romanian farmers were again the "Farm Business Resilience" (with a expressed interest in economic efficiency and feeding efficiency), and also "Energy and Carbon" (with particular emphasis on sources of cheap energy and ways of saving energy) and "Food Security" (with interest in local marketing channels and orientation toward quality of products) suggesting a general interest in cost savings and efficiency and in alternative markets for their products. In Spain it was noted that there was a variation in reactions to the different spurs. Most of the farmers showed a lack of interest when the spur was named, but then became more interested when specific questions were asked. "Farm Business Resilience" was probably the one that was most attractive to them. In the UK in general, farmers' immediate feedback on the exercise was positive. They were often particularly interested in the information provided in the "Energy Efficiency" spur, awareness having been raised by political emphasis on "Carbon footprints" and other measures of greenhouse gas emissions, but also by the cost of fuel. Two farmers were very aware of the cost of and dependence on fossil fuels, and interested in the implications of trying to reduce the number of tractor operations, but unsure of the feasibility of such an approach. Interest in the biodiversity section was very variable, depending on personal interests. The thought of considering water use efficiency was more often a novel idea to farmers, but this was very dependent on their local climate.

For some countries a lack of records on some specific areas assessed made the assessment more difficult. In Austria, some questions, e.g. on energy consumption, were difficult for the farmers to answer because of the lack of precise records, but all of them tried to give correct estimates. In Romania many farmers do not keep the usual farm records, therefore supplementary efforts were needed on their side to answer detailed questions (making calculations before answering them). On the other hand, it was noted that they seemed to have a good level of knowledge of the general status of their farm, knowing most indicators by heart.

Farmers did express some concerns about the assessment. In Austria, farmers did not criticize the questionnaire, but it was noticeable that they showed limited understanding of some spurs e.g. "Water Management" and "Biodiversity". Danish farmers did not all respond to the exercise in the

same way; in general, energy consumption led to many discussions, as well as “Social Capital” and “Farm Business Resilience”, the latter two because farmers queried the choice of parameters and how ‘British’ the method is. Some questions were felt to be difficult to answer because of the way they were formulated or the assumptions they seemed to make. Also in Finland, farmers criticised some questions and spurs. For example water use is not a critical point in Finland since the country has enough good quality water. On the other hand, they thought that there could have been a question about the water consumption of the milking system, because there can be big differences in approaches to this. In addition, questions about field boundaries were not felt to be very relevant, especially in eastern Finland, where forests act as boundaries and there is no need for others. Some farmers questioned whether the biodiversity and landscape definitions were suitable for Finnish conditions. Similarly, in Italy some questions were found to not be suitable, for example, manure and waste management are controlled by national laws for all farms, so there is little opportunity for individual variation. In Romania, farmers had particular queries on the exercise: they asked about its background, many of them asked for confidentiality, and some suspected that the investigator had hidden goals (a suspicion caused by the lack of experience with such approaches). Some Romanian farmers also criticised the complexity of the questionnaire and its time-consuming nature, underlined that some sections and questions are too far from the main goal of the farm (this being seen as production/survival/efficiency), and felt that some questions were too detailed (some farmers did not understand their usefulness).

General comments from the researchers and advisers who carried out the survey included concerns about the subjective nature of some questions, e.g. whether a business plan is in place – what constitutes a business plan? Some questions have been found to be unsuitable in particular countries’ contexts, e.g. in Italy farms do not apply a biodiversity plan, or have third party certification, while in the areas of energy, manure and refuse management, they are controlled by national laws mandatory for all farms. However, Belgian advisors remarked that the results were in line with their expectations, giving support for the validity of the tool.

4 Farmer Workshops

Once the Case Study Assessments had been carried out, workshops were held in each country to discuss the research needs to improve sustainability of organic and low input dairy systems. The central purpose of the workshops was to discover farmers’ opinions on research needs for planning the participatory research that will be carried out as part of the SOLID project. In order to ensure a consistent approach across countries a protocol for the workshops was drawn up with advice from an expert in participatory research. To keep the ideas for research topics related to the objective of enhancing sustainability in accordance with the project goals, the workshop began with asking the farmers to consider their perception of the sustainability of their own farms, followed by a presentation of the results of the Rapid Assessment of Sustainability in the relevant country (and sometimes others). The workshops (Task 1.3) therefore represent a clear link between the assessments (Task 1.2) and the Participatory Research (Task 1.4).

4.1 Methods for the workshops

Each country arranged the venue and timing of the meeting or meetings to be most convenient for the producer group or groups involved. In some cases, only the farmers who had participated in the rapid sustainability assessment attended (Austria, Belgium and Finland). In other cases, including the UK and Greece, a wider group was invited, still focussing on organic and/or low input farmers. Members of the research and/or SME partner organisations attended the meetings as facilitators. Table 14 indicates the participants attending the meetings in each country. The protocol used is briefly outlined here with full details available in Appendix 5.

After an introduction to the SOLID project, farmers introduced themselves with a positive aspect of their farm. If the group was larger than eight, the farmers were then split into smaller groups. In these groups, they were asked to score their own farms subjectively on the spurs of the radar diagram, and attach a problem, a success and an innovation from their own experience, or unusual aspect of their farm, to the diagram, close to the most appropriate spur. The aim of this was to make a link between everyday issues on the farm and the concept of sustainability, which might otherwise appear rather abstract, and to introduce any farmers who had not completed the assessment using the tool to c the concepts involved.

After presentation of the results of the sustainability assessments undertaken in Task 1.2, the diagrams prepared by the attendees were used as a starting point for discussion of areas in which research could help to address the perceived problems, or develop strengths further. Facilitators were present to try to draw out themes, and find the areas of greatest interest, relating to farmers' practical situations while remaining relevant to the overall issue of sustainability. Priority topics were arrived at with the help of a facilitator. In some cases, specific research projects were suggested, in others this stage was not reached, but the topics of interest and relevance were identified. In a concluding session, groups reconvened to share ideas.

Table 12 Attendees at the farmer workshops

	Total number of attendees	No. of farmers attending (no. who had undertaken assessment in brackets)	No. of attendees other than farmers	Comments
Austria	16	13 (10)	3	
Belgium (goats)	10	5 (5)	5	Research opportunities in SOLID will be linked to the participatory development of a decision support model, so final discussions covered this, rather than considering specific on-farm research trials. See Appendix 6 for outcomes
Belgium (cows)	14	9 (3)	5	As above
Denmark	41	35 (5)	6	Other members of SME invited – combined with co-operative meeting
Finland	8	6 (6)	2	
Greece	35	20 (6)	15	Results of a larger survey of goat husbandry also presented
Italy	15	15 (not recorded)	5	
Romania	26	20 (4)	6	2 separate meetings held
Spain	30	27 (10)	13	2 separate meetings held
UK	26	19 (4)	7	Other members of the SME and low input farmers invited

In three cases, circumstances dictated a slight divergence from the full protocol. In Austria, the meeting was shortened to an evening to fit in with the usual practice of the co-operative. In Denmark the meeting was combined with another meeting of the dairy company, so the time available was limited. In Spain and Romania, two separate meetings were held in two geographical areas, to reduce the travelling by farmers. In Belgium, two separate meetings were held for goat and cow farms and the format was adjusted because in future the farmers will be involved in on-farm modelling as part of WP6 rather than in on-farm participatory research. Therefore a presentation of the idea of participatory modeling was followed by a discussion about farm specific dilemmas that could be the subject of a decision support model.

The following section of the report summarises the outcomes of the discussions from all workshops, leading towards research topics in each country.

4.2 Overall challenges faced by farmers

Discussions in the workshops largely began with the problems which farmers were facing. The format of the workshop was designed to set these in the context of sustainability in the broadest sense, by bringing in the results of the sustainability assessment. These problems are summarised here to provide background to the more specific discussions which follow. Inevitably, discussions included some larger "external" problems that cannot be solved by research. The Danish workshop report included a comprehensive summary of these, many of which would be relevant to other countries.

Discussion in Denmark came to the following conclusions:

- "Some of the challenges we face are actually results of much bigger questions, such as consumer choices, population growth, global trade and investments, and that it is too cheap to get energy and water, which makes it all unsustainable."
- "Specialisation has increased dramatically, and the 'whole farm' has turned into one production system."
- "Diversification is not prioritized and too expensive."
- "Prices for food are too low."
- "There is lack of knowledge sharing about how things are practised."

In Spain the farmers mentioned:

- Legal constraints to starting processing cheese on farm (i.e. too many regulations)
- Low milk prices due to the fact that the market is controlled by a few companies

Belgian goat farmers asked:

- "How can organic farmers communicate the need for the higher price of organic milk to the public?"

On the other hand, the immediate problems of the day were also often apparent, for example, the difficulties UK farmers were facing in managing grazing animals because of an exceptionally wet spring. These problems might be viewed as also being a result of an "external" problem in the shape of climate change, and an indication that adaptations to changing weather patterns will need to be made in the future.

Farmers in Belgium and Finland made specific reference to labour issues. For Belgian goat farmers the issue was caused by labour peaks in the kidding season. They raised questions such as: How can farmers optimize their tasks to achieve a shift in the work balance? What is the optimal number of goats per labour unit? How to deal with the labour quality and job satisfaction (several farm tasks are very intensive, but contribute in a high extent to job satisfaction)? In Finland, labour issues were more related to field work due to the short season. Farmers desired more effective working methods for cultivation practices, to make them less time demanding, and to use labour more effectively. During the short growing season, workers also want to have their holidays. Some kind of

'labour stock market' owned by several farmers was suggested as a solution. This could help to overcome difficulties related to tax issues and finding the right staff.

In Austria, it was apparent that there are problems closely connected with the small structures of the farms and also with the specific on-site conditions (mountainous region with high rainfall). The topics which were discussed reflected the farmers' concerns that current agricultural research does not address low-input systems. Italian farmers complained of the total lack of technical assistance in the organic sector.

Romanian farmers interviewed and attending the meeting raised some very basic problems, including the lack of irrigation systems, disorganisation of the official milk recording system, insufficient knowledge of the nutritional value of feeds, and the strong need for overall modernisation of the farm in order to apply modern technologies (e.g. total mixed rations, bale-ensiling).

The overall purpose of the workshops was to move on from the general problems to specific topics and questions where research could provide solutions to support greater sustainability. With a few exceptions, these topics overlapped closely between countries, so the reporting will be by topic, including examples of suggestions and special issues from specific countries.

In all countries there were instances where the farmers' perceived needs for information could in fact be met by using existing knowledge, indicating a need for more effective dissemination of existing research results. These instances are identified for the individual countries in the tables in Appendix 7. These tables give a summary of how research topics suggested by farmers are aligned with existing information and current research, thus highlighting the remaining outstanding research needs. The existing knowledge transfer was particularly restricted in Greece and Romania, where progress is hampered by the lack of information in the native language.

4.3 Research topics suggested

The outcomes of the discussions on research topics across all countries are summarised in this section, by subject, with indications of variation between countries if this exists. They can be summarised under the following headings: Feeding (including Protein sources, Forage production, Feeding forage and concentrate), Soil and nutrient management, Breeds and breeding, Animal health and welfare, Product differentiation and marketing, Energy use and Water management. The individual research topics suggested by farmers in each country are listed in Appendix 7. A comparison of the farmers' suggestions and existing knowledge and ongoing research is made in section 5.3, including Table 13, thus leading to a summary of outstanding research needs in section 5.3.3.

4.3.1 Feeding and forage

Many of the topics discussed are related to the overall issue of feeding. Within this extremely broad topic area, the greatest attention was given to the forage component of the diet, and in particular forage production. The issue of maximising home-grown feed and forage was universally raised, and

in most cases there was emphasis on the protein component of the diet. However, in some cases, for example among goat farmers in Spain, the concentrate component of the diet also received considerable attention.

On-farm protein production

The issue of protein sources arose in all groups except the Belgian goat farmers, irrespective of whether the participating farms were organic or low-input. How to achieve higher protein self-sufficiency is one of the main questions on Finnish farms. Lucerne as a partial substitute for red clover in perennial leys, blue lupin as a feed, and white lupin or faba bean in mixtures with cereals for wholecrop silage were considered the most interesting crops with the greatest potential for further research at present. Belgian cow farmers saw a great need for information on protein rich crops suitable to Flemish conditions. At present they are reluctant to grow their own protein crops, although they aspire to do so, because of uncertainty about yield, damage from wildlife, and unexpected experiences. Two Greek goat farmers were already cultivating *Vicia faba, Vicia ervilia* and *Cynara cardunculus.* Danish farmers listed self-sufficiency in protein as a suitable topic for participatory work. It is difficult to find alternative sources of protein that can be home-grown, thus reducing the need for feed to be imported to the farm. Calculating the potential and security of various protein feeds under Danish conditions, and sowing protein rich plants in pastures were suggestions for research from two Danish subgroups. In the UK the topic of providing more home-grown protein was also raised, but was not a priority issue for all farmers. Those purchasing soya prioritised this, but others were already using protein rich forages, and home-grown peas and beans. Romanian farmers, although not bound by organic restrictions, were concerned about the high price of protein feeds. Forage production and utilisation, with an emphasis on finding alternative sources of protein, was a priority for Greek goat farmers. Italian farmers approached the subject from the angle of incorporating higher protein components in pastures.

More general forage production issues

Despite, or perhaps because of, the longstanding reliance of organic and low input dairy systems on clover, this still featured in discussions. UK farmers desired more information on the management of clover, particularly to improve its persistence. Finnish farmers also commented that clover is the main element on grasslands in organic farming, but it does not persist well enough in the leys after several years of organic farming and they wondered how this could be overcome. Danish farmers also referred to pastures losing productivity. There is information on clover management available for dissemination, but there are still research needs, such as the development of clover with earlier growth potential. Ways of improving the quality and quantity of grass-clover fodder produced, were raised as important topics in both Finland and the UK.

Danish farmers discussed plant breeding, seeing a need for identifying seeds and plants that are specifically suited to organic production conditions. UK farmers saw this need particularly for grass and clover; information on performance of specific grass and clover varieties under organic conditions, and specifically under grazing, is not available, and would be valuable.

Various aspects of the grazing sward were raised, with needs relevant to local conditions. Drought resistant forages (for both grazing and winter forage production) were desired by farmers in Italy and Romania. Swards for drought conditions were also important for some UK farmers, but this need was localised. Information on the best way of supplementing grazing when necessary was of importance to both organic and low input farmers in the UK.

Alternatives to grass based forages were often discussed. There was interest in the UK in winter forage crops such as kale and stubble turnips , although this was only relevant to farmers whose soils and climatic conditions were suited to keeping cattle out through the winter. Establishment of maize and peas in the absence of seed dressings was a problem for which some UK organic farmers sought a solution.

Belgian cow farmers mentioned links with animal health related to soil mineral status, and asked whether certain types of vegetation could improve mineral availability for livestock. Some information on herbs and trees is already available, but more is needed.

In Finland, the discussions were dominated by aspects of feed and forage production. The recommended diet of dairy cows is based on high quality silage (in terms of digestibility and protein). Yet too often the quality of silage is not at a sufficiently high level and farmers wanted to know how a higher quality of silage could be achieved on different farms. Crop rotations quite often include too much forage and too little grain compared to the forage and feed demands of the cattle and they also wanted to know how to achieve a better balance of these.

Discussion relating to pasture management in Denmark included the subject of alternative weed control in pastures to be compatible with organic regulations. In Greece, grazing management of goats on grasslands and shrub lands in mountainous areas and the nutritional value of the accumulated plants was raised as an important topic.

In Italy, there was a focus on intercropping with one or more types of crop to cover the requirements of the production animals' diet. Some examples already in use are garden peas/triticale, vetch/barley or vetch/oats. Farmers felt that there was a need for more information on including such crops in the rotation. Italian dairy farms in the plains had a particular issue with finding the best species and varieties to include in pastures. Specific interests were over-sowing on pastures with suitable species for dry periods, and intercropping for grassland rich in protein.

Feeding strategies

In addition to forage production, aspects or implications of certain feeding strategies were also raised. Austrian farmers were interested in ways of improving hay quality, to enhance the production of milk without concentrates.

At the Finnish meeting, this discussion went a stage further to consider diet planning: the targets of good animal husbandry are higher milk yield, longer life of cows and better health of animals and the question was how can better diet planning help to achieve all of this.

In Romania, topics related to feeding strategies were popular, specifically, strategies related to drought periods, high prices of protein feeds, volatile prices of cereals / energy, unknown value of some feeds available on the market, and quick prediction of nutritive values. Based on these, suggested research opportunities were:

- studies of dietary complements during drought periods
- alternative protein feeds
- alternative cheap feeds for low-input dairy production
- studies to assess the nutritive value and enhance knowledge of the effects of by-products
- methods / equations for quick assessment of nutritive value of feeds

In Spain the cost of organic concentrates is almost prohibitive and ways of reducing the use of cereals without reducing milk yield were desired. Farmers felt that they lacked knowledge about nutrition to overcome the sharp increase in feed prices and to maximize grazing potential. The scope for improving forage quality (generally hay rather than silage) was identified as offering large potential here. There is information on this topic available for dissemination. One particular area of work is the supplementation of animals after or during grazing, which shows great potential for improvement. A genuine new research area is that of alternative feeds based on by-products, which is being studied in SOLID WP3, and this does fit with farmers' needs and interests. Developing new forages and feeds to grow on farm was also identified as a valuable research area.

A specific need mentioned in the UK and Romania was more reliable nutritional analysis for grass-clover silages and alternative forages, to assist with rationing.

A previous UK consultation with members of the SME revealed an interest in the relationships between nutrition and cow health.

4.3.2 Soil and nutrient management

UK farmers identified soil and nutrient management as a central issue of production where they felt they lacked understanding particularly of the biological component of the soil and the reasons why organic farms often seemed to lose productivity after about ten years. The problems associated with reduction of P and K, particularly in clay soils, were raised. There was a fundamental desire to better understand what affects soil organic matter and nutrient availability, and discover more reliable ways of optimising these in organic systems. Danish farmers also referred to soil management as a factor in maintaining clover in swards, which was a difficulty for them.

Soil management was chosen by Belgian cow farmers as an important topic, and one where they could make a difference. They had some concerns similar to those expressed in the UK, regarding reduction of soil fertility in organic systems, due to mineral exports exceeding imports. They felt that this was linked back to health and production limitations for cows. General discussions covered reducing soil erosion and organic carbon depletion. Belgian goat farmers had questions relating to the timing and method of manure spreading to achieve efficiency of work processes and nutrient use. They experienced difficulties in spreading fresh goat manure on grassland and had questions about the consequences of spreading manure earlier in the season. Improving the quality and use of

manure was also of interest to the Austrian farmers, who had limited knowledge about the fertiliser value of manure and soil nutrient contents. Researchers viewed this largely as a knowledge transfer issue. Research into slurry additives, to improve the fertiliser value, was suggested.

4.3.3 Breeds and breeding

Farmers from Sennerei Hatzenstädt in Austria were dissatisfied with cows originating from the conventional breeding programmes, feeling that these were not suited to low-input systems. They saw a need for breeding animals specifically for systems with low concentrate input use.

Greek goat farmers were interested in creating a description and typology of goat flocks, and in the identification and genetic improvement of indigenous breeds. Genetic improvement in terms of milk quantity and quality were favoured goals.

In Romania, separate INCDBNA seminars have revealed interest in breeds and breeding across a wide spectrum, with reference to both modern technology (impact of multiple ovulation and embryo transfer on the maximisation of genetic progress in cattle) and the conservation of vulnerable traditional breeds of livestock.

In the UK several farmers had cross-bred cattle and were interested in the longevity and lifetime performance of these in comparison with pure Holstein-Friesians.

4.3.4 Animal health and welfare

Goat farmers in the Netherlands were concerned about improving the opportunities for the expression of natural behaviour in goats in intensive systems. They discussed the consequences of natural behaviour for milk production and the fact that despite high health and welfare scores, organic farms had lower productivity than conventional farms. One farm had problems with *pasteurella* after vaccinating for Q-fever. It was thought that more information about the optimum intervals between vaccinations was needed. Further information on the most suitable housing systems for goats was also felt to be useful and it was suggested that information from other countries could be combined with the findings of on-going research in Belgium.

Animal health and welfare was the aspect where Greek goat farmers believed there to be the greatest lack of information, and the most help required. Farmers were interested in more information on the aetiology, epidemiology and risk factors of subclinical mastitis and neonatal losses leading to better management of these conditions. Investigation of the parasitological status of Greek goat flocks was also suggested. Spanish goat farms also sought solutions for loss of neonates, particularly where twins are born. Some of the information requested is already available to some extent. Spanish researchers indicated that information is available on the management of new-born kids in (semi) extensive goat farms, and Greek researchers considered that the greatest need was for dissemination of knowledge on reduction of mortality in kids, control of ectoparasites and prevention of mastitis and contagious agalactia.

Rearing calves at grass, or on suckler cows was considered a possible “healthy” and “natural” approach, which interested farmers in both Denmark and the UK.

There was some interest in Denmark in developing alternatives to straw as bedding in deep litter barns, *e.g.* wood, sawdust or compost. The Finnish discussion also made a link between the housing environment and meeting targets of high milk yield and better health and longer life for cows, considering this to be another useful area for discussions between farmers, advisors and scientists.

In the UK there was interest in developing the ability to reduce the use of antibiotics, learning from farms with low usage. The most common use for antibiotics was considered to be for clinical or subclinical mastitis and farmers raised mastitis control as a potential research topic. However, this is a subject where there has been considerable recent research in the UK and dissemination of the information is clearly necessary.

Cow farmers in Belgium suggested the topic of parasitic diseases, feeling that these were limiting production.

4.3.5 Product differentiation and marketing

Austrian farmers supplying Sennerei Hatzenstädt were interested in the ability to differentiate their traditional production system from other, more intensively managed systems, even within the Alpine regions. A particular area of interest was the influence of sward biodiversity on product quality, and whether this could be used as a marketing opportunity. Greater ability to describe and value the biodiversity, than was available in the assessment carried out initially, was requested.

The effects of grazing a variety of herbs upon milk quality and quantity was also raised for Greek goats, as one of the suggestions within the general topic of development of innovative milk and meat products and creation of marketing channels for their promotion.

Danish farmers suggested developing and marketing meat from “nature areas”.

Spanish goat farmers saw developing markets for milk, cheese and kid-meat as the greatest opportunities for improving business sustainability. Marketing tools, training and developing international marketing would be very valuable.

In Finland there is a particular problem with a lack of markets for surplus and male calves from organic dairy herds.

4.3.6 Environmental sustainability issues - energy use and water management.

Austrian farmers were interested in barn drying of hay using renewable energy sources. There is already some information available on this, so knowledge transfer is needed. Cow farmers in Belgium were interested in grass drying, but realised that lower energy methods were required. Energy use was also discussed by goat farmers in Belgium and investment in solar panels was a suggestion for future progress. Danish farmers suggested that demonstrations of energy

minimisation, showing the practical and technical implications of various steps or innovations would be a useful activity suited to participatory work and biogas and windmills were specifically mentioned during these discussions.

Belgian goat farmers were interested in ways of re-using water on farms, using water purification systems. In Denmark re-using water from roofs was also suggested. Romanian farmers had considerable concerns about irrigation, but this was more a question of affordability than raising issues for research.

4.4 Summary of unusual practices and innovation

There was an aim to include within the sustainability assessments a number of examples of farms using innovative practices. As stated in the introduction, this was not restricted to new inventions, but also included farms where an activity or approach was unusual for the particular region at this time, perhaps even being a return to more traditional practices. Incorporating these within modern systems is classed here as "innovation". Contact with the SME's was generally the way of identifying these more unusual approaches. A few other examples were identified through contact with further farmers attending the workshops. Very few practices were found which were completely new. In some cases, farmers were returning to traditional practices which have become unfashionable, so their use in today's systems is considered along with the innovations in this case. The examples are summarised in this section under subject headings.

4.4.1 Feeding

Some goat farms in the Netherlands were using unusual industry by-products as feed, *e.g*. from a muesli factory. Feeding with large amounts of hay instead of silage, for the purpose of producing milk for specific processing requirements, was considered unusual in Denmark, although quite a common, traditional practice in Austria and Italy. In Denmark this requires large inputs of electricity or diesel to dry the hay. Some Austrian mountain farms used "grass cobs" made from their own grass to reduce purchased concentrate use. The cultivation of *Vicia ervilia* and *Vicia faba* for use as feedstuffs for goats was considered innovative in Greece, although these crops are commonly grown in other countries. Some Romanian farmers attending the workshop were trying some "forgotten" feeds such as feed-grade turnips, millet and sorghum; other farmers were carrying out their own variety trials for maize, wheat and alfalfa and this was considered innovative in the group. The use of herbs in the diet for goats, to enhance animal health and product quality, was reported in Belgium.

4.4.2 Improving soil

One UK farm has established very diverse and herb-rich swards and grazes them using an extended rotation interval, along the lines of "mob grazing" principles (Chapman, 2012), with the intention of increasing soil organic matter (Richmond, 2011). This farmer was keen for further research input to help with monitoring of the approach in UK conditions.

4.4.3 Animal management

Unusual or interesting practices in Denmark included seasonal calving and keeping calves with suckler “aunts”. One UK farmer aims to maximise animal welfare (having built new housing for the cows) while minimising environmental footprint and taking a “lean farming” approach, aiming to reduce inputs and maximise efficiency.

Some goat farms in the Netherlands (studied from Belgium) took an innovative approach of extended lactations which resulted in more milk, better goat health and lower mortality, reduced labour requirements and reduced the production of unprofitable male kids. Extended lactations are also practised for dairy cows in Belgium. Due to its large size farm in Flanders with over 1000 goats was also considered innovative.

Once a day milking is a relatively new approach in the UK used by a minority group of farmers wishing to reduce costs and inputs.

4.4.4 Marketing

There were several novel approaches to marketing. Austrian mountain farms achieved direct marketing of farm produce and good connections to the public through agro-tourism. There were good examples of specialised marketing of kid meat from the Netherlands.

In Greece, there was a fully vertically integrated Greek goat farm, producing pasteurized milk and different types of goat cheese. Another goat farm had its own butcher shop selling both goat meat and homemade dairy products directly to the public.

Two Romanian farms sell part of the milk they produce in local markets through authorized dispensing machines.

In Spain, the marketing strategy of one cheese-making farm toward targeting high-end restaurants to sell goat cheese under different types of maturation (olive oil, herbs, etc..) showed that this ‘a la carte’ strategy could be very successful.

In Italy one low input farm was selected for the rapid sustainability assessment for its approach using a new marketing channel (www. lattenobile.it). The feeding was 70% forage, including at least 4 botanical types of broadleaved species, aiming to produce milk with a particular Omega 3 fatty acid composition, and levels of Vitamin E, beta-carotene and conjugated-linoleic acids, as mentioned above. This topic has been studied in projects (eg Larson et al, 2011, Petersen et al, 2012, Povollo et al, 2013, Revello-Chion et al, 2011) ,but few farmers have taken it into practice as yet.

4.4.5 Farm self-sufficiency in energy

Austrian mountain farms demonstrated self-sufficient practices using biomass from their own forest to fuel a hay drying installation.

In Finland, some farmers cultivate oil seed rape and it is pressed on their farms or transferred to small factories to be pressed for oil and protein feed. In some tractors, part of the fuel can be replaced by vegetable oil. One Finnish farmer aimed to produce an equivalent amount of rapeseed oil on his farm to the amount of fuel used in tractors for field work. This farmer calculated that he produces the same amount of rape seed oil as he uses fuel in his tractors. Although he does not actually use his own oil in his tractors, thinking this way demonstrated a novel approach to considering energy use.

5 Summary of outcomes of assessments and workshops

This final section draws together the findings from the rapid sustainability assessment, discussions with individual farmers, and workshop outcomes. In section 5.1 the strengths and weaknesses apparent from the sustainability assessments are summarised, with reference to some relevant information from the literature. An overview of what has been learned about farmers' views of sustainability follows in section 5.2. In section 5.3 the information gathered on perceived research needs is summarised and assessed in comparison with existing information and ongoing research to enable a categorisation between topics for knowledge transfer and true research needs (Table 13). Reference is made to other recent sources of information on farmers' views of research needs (Section 5.3.1), although this is limited. Overall conclusions are drawn in Section 5.4.

5.1 Strengths and weaknesses of organic and low input dairy systems revealed by the sustainability assessments and case studies

Despite high scores for "Farm Business Resilience" using the tool, many organic and low input farmers are definitely concerned about the survival of their businesses at the present time. According to the rapid sustainability assessment, economically there is relatively good business resilience so that these businesses should be able to survive in the current challenging economic climate as long as there are good market opportunities. Farmers often felt that marketing was a weakness and recognised that on-farm processing and specialist marketing channels could contribute to strengthening this aspect of the system. This is in agreement with Penati et al (2011) and Ripoll-Bosch et al (2012). In the case studies, all countries picked out as a good example at least one farm which was fully integrated or directly marketing a specific product, which contributed to strengthening aspects of their farm business resilience score.

In the farmers' view, good use of forage was seen as a strength of a dairy farm, undoubtedly both contributing to, and affected by, aspects of sustainability. Data from Canada and the UK have shown that increasing the amount of milk produced from forage contributes to profitability of dairy enterprises (Charbonneau et al, 2011; Waterfield, 2009), although a recent UK analysis did not show such a relationship with common margin (sum of all sales minus sum of all costs) (Dale et al, 2013). Austria and the UK included farms with particularly low concentrate input to dairy cows as good examples in the case studies. From modelled life cycle analyses, Thomassen et al (2008)

recommended reducing use of concentrate feed per kg of milk produced as a method to reduce environmental impact of milk production. In both the UK and Spain, good grazing management was picked out as a beneficial feature on several farms – in the contrasting systems of grass-clover swards for UK dairy cows and shrub land for Spanish goats. Alternative feeds were mentioned as strengths or good examples in Greek goat farms (beans), Romania (ensiled brewers' grains) and Belgium (industry by-products – muesli). Purchased feed costs represent a major proportion of the costs of all dairy systems and organic feeds are particularly expensive to buy (Kingshay, 2012; Promar, 2012). A major weakness that was clear from the workshops in most countries is that there is often a lack of confidence in the reliability of forage production– both in terms of quality and quantity. This affects the whole system and business because of the central role that forage plays in milk production.

Although all countries scored relatively well on "Animal health and welfare", especially for cows, there was always interest in improving this further for both cows and goats. Farmers mentioned the benefits of improved health and welfare, to the animals, productivity and product image. According to the tool, goat farms, particularly in Greece, but in other countries as well, had greater need for improvements in this aspect than cattle. Later discussions with farmers in the meetings confirmed that they recognised this need. Previous studies have indicated good health and welfare in some aspects on organic dairy farms (e.g. Rutherford et al, 2009). However, there are still aspects of concern, in particular parasite control in small ruminants, despite recommendations on clean grazing and newer work on phytoactive plants (Marley et al, 2006). Low input systems were not shown to impose any more or less metabolic stress than high output systems by Thomas et al (1999) but more recently, with more extreme systems, it has been suggested that there may be compromises to animal welfare caused by metabolic stress in low input systems and caution has been urged, to guard against this by using the most suitable breeds (Boyle & Rutter, 2013). The farmers were aware of this and it was often high in their list of priorities. Work is ongoing in SOLID Workpackage 2 investigating this subject further.

Other strengths illustrated in the case studies were alternative or on-farm sources of power (eg solar power, biogas, wind power) which were represented in Austria, UK and Finland. Agro-tourism was a common strength of Austrian farms, and several other countries also gave an example of a farm that had direct contact with the public, thus creating potential market links and education for consumers. Belgium gave an example of a goat farm with extended lactations which achieved improved animal health and reduced the production of unprofitable male goats.

Turning to the weaknesses of the systems studied, economic sustainability is threatened by high costs of feed inputs, particularly when forage production is poor. Many dairy farms are quite specialised and so do not benefit from wide agricultural system diversity, being economically vulnerable when the dairy enterprise performance is challenged by high costs or low returns, whether caused by low prices or low productivity. Businesses also face problems when there are no well-defined premium marketing opportunities. This is a particular problem for organic goat milk in Spain where the premium is insufficient to cover production costs, and many organic producers are considering decertification. Low input farms often suffer from the lack of a clearly defined specialist product or output, although there were several examples of farmers taking action to overcome this such as producing their own artisan cheeses, or selling meat from goat kids.

5.2 Farmers' views of sustainability in general

Carrying out a structured assessment of aspects of sustainability on the participating farms has stimulated discussions about the topic. Discussions with the farmers, both individually over the rapid sustainability assessment exercises and in groups in the meetings, show that farmers' considerations of sustainability inevitably include, and generally begin with, economic sustainability – if they cannot run the business financially there is no future. Ripoll-Bosch et al (2012) reported the same top priority for Spanish sheep farmers, who also included social components and a few local environmental factors in their concepts for sustainability. However, all farmers were also aware of other components of sustainability. Aspects of product quality, whether nutritional composition or consumer perception of a "unique" or "valued" product, are also seen as important. Animal health and welfare is seen as underpinning the sustainability of a dairy system, and cow longevity is something that many farmers take as an indicator of achievement. Organic farmers in particular also recognise the importance of the soil in sustaining the complete system, and are aware of gaps in their understanding of soil processes which limit their chances of totally sustainable management. Provision of forage, in sufficient quantity and quality to maintain or improve productivity, was a topic which featured strongly in discussions in Finland, UK and Italy. In Romania and Spain there were more concerns about the provision of supplements to forage.

The current economic climate, the perception of reduced markets, particularly in the UK and Spain, and increased costs of the organic sector, make organic farmers feel vulnerable. They generally see opportunities for improvement to be based on product differentiation. Low input farmers, on the other hand, in general regard cutting costs as the way to economic sustainability, although they are also seeking specific marketing opportunities linked to their system of production.

Use of the tool encouraged farmers to think about the wider aspects of sustainability. It introduced some topics that initially surprised farmers, but which, when given further consideration, sparked interest and discussion. This was true, for example, of the biodiversity spur in Austria. Farmers were not always concerned about biodiversity (or agri-environmental management) for its own sake, particularly when economic and physical conditions were difficult, but in several cases (eg Austria, Italy) were interested in the potential for using sward biodiversity to enhance product quality and differentiation, animal health and soil organic matter.

In the Danish workshop, there was considerable discussion of the overall topic of developing sustainability. Danish farmers felt that developing sustainability should include:

- Considering greenhouse gases
- Improvements in sustainable fuels
- Adaptation to climate change
- Diversified farms
- Care of nature in marginal areas

Suggestions for active steps which might be taken included: reusing water from roofs, collaboration between crop and dairy farms for more diversification and lower energy consumption, reducing stocking rate, and "stable schools" (Vaarst et al., 2007) addressing climate change topics.

These perceptions underlie the suggestions for research needs which have emerged from carrying out the sustainability assessments with individual farmers, and discussions based upon the results pooled at country level with larger groups of farmers. These research needs are discussed in more detail in the following section.

5.3 Information on research needs

The SOLID workshops and interaction with individual farmers through the sustainability assessment were used to gather the opinions of organic and low input dairy farmers on research needs relevant to the sustainability of their systems, and to begin to build communication and relationships leading to the formation of participatory research projects. The workshops were designed to elicit responses that could be developed into on-farm trials, but also gathered information on needs that would be better met in other ways, including formal research in Institutes, or transfer of existing knowledge. In the following section, the research needs identified in this study are set in the context of other research needs exercises previously conducted.

5.3.1 Information from other research need consultations

In each country, the numbers of farmers consulted through the SOLID project was relatively small, ranging from 5 to 35 (Table 12). To assess the representativeness of the opinions gathered it is beneficial to compare their research needs with those derived from other, similar exercises. However, the availability of research needs from other directly comparable consultations with farmers is fairly limited, and varies between countries. Various Committees and Governments have published research agendas for organic agriculture (e.g. Niggli et al., 2008) or with reference to low input systems within a larger agenda, which will have included some farmers in the stakeholder groups consulted, but there are very few reports of direct consultation of groups of farmers as has been carried out in the SOLID project.

In 2007, the IFOAM EU group representing the organic sector, initiated a forum which produced a "vision paper" for innovative research activities for organic agriculture and food systems, with a strong focus on providing public goods (Niggli et al., 2008). The paper resulted from 14 months consultation with stakeholders (including farmers, retailers and scientists) from 2007 -2008. The "Technology Platform Organics " (TP organics), was launched in 2008, and aimed to produce a strategic research concept and research action plan to present to the EU. The publication "Vision for an Organic Food and Farming Research Agenda to 2025" (Niggli et al., 2008) was an outcome of this process. The publication shows groups of strategic priorities and highlights specific research activities for the future. The overall strategic priorities identified were:

- Empowerment of rural economies
- Securing food and ecosystems by means of eco-functional intensification
- High quality foods as a basis for healthy diets
- Novel, smart and appropriate technologies, integrating them in to organic food and farming where they strengthen organic principles and practices.

Although the consultation included stakeholders other than farmers, in the paucity of information from other farmer-only consultations on research priorities, it is interesting to compare the outcomes with those from the SOLID workshops. The report has few direct references to dairy systems, but draws attention to the issues of variability in yields from organic farms and the conflict between the objectives of energy efficiency, reducing greenhouse gas emissions, reducing nitrate losses and respecting animals' behavioural needs. Some of these conflicts have been mentioned by the farmers in the SOLID consultation. The TP organics research agenda puts a strong emphasis on preventive health management and reduction of antibiotic use in animal production. An EU funded project has already been funded to pilot approaches to support this goal (Ivemeyer et al, 2012). Another animal related topic which farmers mentioned in the Belgian and UK SOLID meetings was developing livestock management practices that foster welfare and allow natural behaviour; TP Organics suggested that this should be combined with minimising environmental impact of livestock systems.

More specific suggestions of research needs mentioned in the TP organics exercise that overlapped with the SOLID consultation findings included: improved management of soil organic matter, diversified mixed farming systems, enhancing genotype x environment x management interactions for livestock, and the value of holistic quality traits (e.g. longevity, frequently mentioned in SOLID consultations) in selection procedures. The value of traditional genetic resources was recognised by the TP organics group, and was alluded to in some of the SOLID groups, particularly for small ruminants. Improved food quality from low input and organic systems was a suggestion from TP organics that frequently appeared in SOLID groups. TP organics suggested more work on assessments of resource use efficiency and greenhouse gas emissions, which within SOLID meetings, received most attention in Denmark and Austria.

Following on from the broad vision, the resulting research agenda (Schmid et al, 2009) contained a small number of specific references to dairy production systems. Under the topic of greenhouse gas emissions, the agenda suggested research into purely grazed grassland management systems, adjusting livestock production to seasonal production of feed, reduction of cow replacement rates through improved health and longevity, and including legumes containing tannins in ruminant feeds to reduce enteric methane production. With the exception of the last, these were all alluded to in at least one of the SOLID workshops. The TP Organics Agenda (Schmid et al, 2009) placed a strong emphasis on disease management strategies to work towards phasing out the use of antibiotics in dairy herds, advocating more research into the use of phytoactive herbs and homeopathy, herbs for regulating digestion and stabilising metabolism, as well as for specific disease prevention strategies. Similar topics were raised in some of the SOLID workshops, but are more challenging topics to address robustly in farm-based trials. The TP Organics Agenda (Schmid et al, 2009) recognised that organic dairy goat and sheep production has not been as well researched and resourced as the dairy cow industry, and this opinion was reinforced in the SOLID workshops, particularly in Spain and Greece. In agreement with SOLID, exploring disease management challenges in organic goat and sheep systems was given high priority by the TP Organics Agenda. The Agenda also suggested work promoting animal health and welfare by including relevant technology, e.g. use of robotic milking in outdoor milking systems, and systems allowing early detection of disease. These specific issues were seldom mentioned by SOLID farmers. The Agenda also had a strong emphasis on the development of mixed livestock systems. This was mentioned in SOLID workshops in Finland and Denmark.

Research partners have reported on findings from other research needs consultations of organic and low input farmers as follows:

Austria

During the first meeting in which the SOLID project was introduced to farmers (July 2011), the chairman of the dairy co-operative Sennerei Hatzenstädt presented some topics which from his point of view seemed to be relevant for farmers: expansion of milk production without increasing the amount of bought-in feeds, improvement of forage quality, adapted grassland management and fertility of cows. Further suggestions for research topics were gathered by researchers of BOKU and LFZ Raumberg-Gumpenstein in the course of their regular contact with dairy farmers: these overlapped to some extent with the above topics and the workshop findings and included forage based milk production without the use of concentrates, breeding for robustness and implementation of rotational and continuous grazing for dairy cows. As might be expected from a wider consultation, there were some extra topics suggested but many of these were also raised at the SOLID workshop.

Belgium

The Research agenda for organic farming in Flanders running from 2008 - 2012 is categorised into six main headings. Within these, objectives relevant to dairy farming include:

- Soil
    - To improve the understanding of soil biology, structure and chemistry
    - To determine indicators and measuring methods for determining soil characteristics, that can form a basis for optimal advice
    - Soil organic content levels and management
- Crops
    - N-fixation by one-year and perennial legumes under different management strategies
- Feed
    - Optimization of organic feed rations for cattle and poultry: protein levels, vitamin and mineral levels, optimal utilization of roughage
- Animal health and welfare
    - Further improvement of health and welfare in the existing organic production systems
    - Risk analysis in relation to disease control measures
    - Breeding and genetics (e.g. breeds more suited to organic production systems)
- Agri-food chain and marketing
    - Relation with consumer: how can sales be promoted, what are consumer needs and wishes?
- Organic farming and the environment
    -
    - Efficient water use and –management
    - Contribution of organic farming to safeguard natural resources (fossil fuels, mineral fertiliser, …)

- Influence of organic farming on climate change (reduction of greenhouse gas emissions, carbon sinks, …)
- Contribution of organic farming to reducing mineral losses, thereby improving water quality
- Management, recycling and application of organic matter
- Contribution of organic farming to biodiversity

Denmark

ICROFS has recently presented a summary of the research related to organic agriculture that has taken place from 1996 – 2012 (ICROFS, 2012), which included some consultants' opinions on whether this has been relevant and influential. The consultants considered that the greatest challenges to organic farming in 1996 – 2010 were in the areas of calf mortality, udder health, forage production, protein supply, consumption and sales and quality of meat and milk. Recent research programmes in Denmark have addressed many of these issues and begun the task of disseminating the findings to farmers. Farm advisors in Denmark considered that the information on protein crops and reduction of antibiotics in dairy cows derived from this research has been well applied in Denmark (more than 50% of farmers were considered to use information from these projects) and it could therefore be very valuable to transfer this information to other countries, since it is aligned with perceived SOLID research needs. Despite this supposedly good research uptake, the topic of growing protein crops still arose in the Danish SOLID workshop discussions. The current ICROFS organic research agenda refers to the objective of development of more robust farms, and suggests that this "requires a better understanding of factors such as biodiversity at soil, field and landscape level and management diversity in the form of multifunctionality, inter-farm cooperation and/or integration throughout the value chain to ensure the sustainable use of resources and economic profitability" (ICROFS, 2012). The only specific mention of a dairy system project in the English publications of ICROFS (2012) is "Optimum grazing and management systems for larger dairy herds". Interestingly, this was not an issue that was reported from any of the SOLID workshops. Stakeholders from the Danish organic sector, including farmers, who were consulted on the future scenarios for organic dairying in 2008, agreed that production respecting animal welfare, and the environment, while achieving farm profitability and a reasonably priced product, were the main goals for the future (Ooudshoorn et al, 2011). However, this consultation did not include any questions on research needs to achieve these aspirations.

Finland

There has been no official consultation on research needs in organic farming in Finland since 2005. A small unpublished consultation for the Ministry of Agriculture and Forestry of 8 stakeholders and 15 researchers carried out in 2009 revealed that home-grown protein and quality of red clover-grass silage were considered the most pressing research needs, as was the case in SOLID farmer discussions. There had been no research for organic production since 2007 in Finland, until the start of the SOLID project.

Greece

The Greek partners were not aware of any existing consultation or documents relating to the research needs relevant to dairy goat farming, prior to the work taking part in SOLID, which has stimulated a lot of interest and attracted some supplementary projects.

Italy

No information on consultation on research needs was received from Italy

Spain

In Spain a relatively recently published paper concluded after a survey of 19 goat farms, collecting technical and economic data (but not consulting farmers directly about their research suggestions), that the main weaknesses of the systems were related to feeding management, particularly grazing, and productivity. Farms tended to have either high concentrate input and only a moderate output, or be very extensive, with low costs, but also very low production. Research on the nutritive value of rangeland and pasture and appropriate efficient and cost effective supplementary feeding was advised. Improving production through breeding while maintaining hardiness was also mentioned (Ruiz et al 2009). A later paper also mentioned the need for improving the central structure of the goat milk industry and promoting goat products (Castel et al 2010).

Romania

In Romania, INCDBNA is continually collecting research needs specific to animal husbandry through various events and through direct contacts with farmers and their associations. For example, at a national seminar organised by INCDBNA on cattle husbandry in April 2011 suggestions submitted in advance by farmers' organisations were discussed. It must be noted that research needs identified through this approach are filtered by the association's management. Also, the farmers who attend such seminars are more educated and more active in searching for new approaches (and probably more innovative) than average, and especially in comparison with many of the low input farmers included in the SOLID consultation. The perceived research needs would therefore be expected to differ somewhat between the two sources. The most frequent research needs that were identified from the main national population by INCDBNA were:

- nutritive value of less known by-products from processing factories (alcohol, starch, biofuels)
- harmonizing the national feeding system with the international ones
- increase the accuracy of estimating breeding value of farm animals
- update the feeding value of genetic-improved forages
- increase the efficiency farm animals' feeding
- methods/procedures for fast evaluation of the nutritive value of feeds
- feeding strategies for drought periods
- impact of multiple ovulation and embryo transfer on the maximisation of genetic progress in cattle
- conservation of vulnerable farm animal breeds

- alternatives to expensive or variable price feeds

There were some overlaps with the outcomes of the SOLID workshops, particularly in terms of coping with drought, the need for cheaper alternative feeds and more easily accessible information on the nutritive values of feeds. The two SOLID workshops confirmed the findings of these previous national exercises collecting research needs – most research is needed in the field of animal nutrition, while for other fields, (breeding, technological approaches), substantial improvements can be made by applying existing knowledge. Low-input farmers tend to be less aware of existing knowledge relating to nutrition, so it may be the case that the research needs perceived in the SOLID workshops could be dealt with via knowledge transfer rather than new research.

UK

The UK Government carried out a major consultation exercise in 2006 resulting in publication of the Defra R & D Subcommittee's views on research in support of UK organic food and farming (ACOS 2006). Although this is some time ago, some of the same topics are still arising, in particular increased understanding of management practices on soil biology and function, and the most suitable of breeds of livestock for organic systems. There appears to be a combination of failure to complete all the research suggested and failure to disseminate widely the results of that which has taken place. There were two research needs consultations of UK dairy farmers during 2011. One was a meeting of industry representatives to discuss input to the "dairy roadmap" to make recommendations to Government for research priorities towards 2020. This was heavily dominated by the veterinary profession, and included only two members with an interest in organic farming. From this meeting, topics that overlapped with the UK SOLID consultation were mastitis control and reduction of antibiotic use, home grown proteins to feed to dairy cows, on-farm analyses of milk, forage and soil, and grasses with growth patterns that fit dairy systems' needs better. Maintaining soil fertility, unlocking P in the soil, and increasing the availability of soil minerals were raised but not discussed in as much detail as in the SOLID group. However, conventional farmers were also concerned about dairy cow infertility, "precision farming for grass", and mentioned breeding N-fixing grasses, topics which did not arise in the SOLID consultations in any country. A second comparable exercise was an on-line survey conducted in winter 2012-13 by the Soil Association. There were many overlaps here with the SOLID priorities including: control of perennial weeds in grassland, better yields of clover, breeding cows suited to low input systems, controlling high cell counts without antibiotics, understanding and assessing soil microbiology, measuring and improving soil fertility, concerns about P depletion, out-wintering, legumes, diverse swards and better use of home grown forages. Topics that were not mentioned in the SOLID workshops included parasite control, building soil organic matter, "new strategies to feed dairy cows", reducing energy use per hectare and "increasing the life of the cow". It is possible that some of the respondents were also involved in the SOLID discussions.

Overall, the general subject areas from the SOLID workshops seem to overlap with the findings of other published lists of research needs resulting from consultations of groups wider than the farmer population. However, farmers' focus is sometimes much more specific, and related to everyday issues, and the specific information that farmers are searching for is not always provided by research output. The overlap with older consultations suggests that either the research advocated earlier in

the 21st century has not been carried out, or the results have not been applicable, or made available, to farmers. In some cases, another step, by which farmers gain confidence in the findings of research may be necessary and participatory projects may be a way of providing this. Therefore, even if a topic has been covered by "Institute based", it might still be suited to further participatory research.

5.3.2 Topics for research and knowledge exchange

There are common themes across the suggested research topics arising from the SOLID consultation, but the perspectives on these can differ from country to country. The main suggestions are consolidated in Table 13. Table 13 also indicates where research is already on-going, and topics in which research has already taken place and the need is for knowledge transfer, rather than further research. The availability of this knowledge may vary between countries, and Appendix 7 provides further information at the individual country level.

As with other consultation exercises on research priorities, e.g ACOS (2006), many of the topics raised as "research needs" have been the subject of considerable research already, indicating a need for knowledge transfer and dissemination. In the UK, some of the same topics are still arising despite the observation in 2006 that information was already available; these include "farming systems to improve home grown feed supply for livestock", "effective control of mastitis", "control of perennial weeds in grassland" and "improvement of animal health and welfare in existing organic systems". However, these are very broad topics, so it is conceivable that despite considerable research in the intervening period, there are specific questions that remain unanswered. In the time available in the SOLID workshops it was difficult to facilitate the formation of very specific research objectives. A third recommendation from the UK, from ACOS (2006), to draw on European research to identify suitable and improved breeds for organic production, is also still raised by farmers but is receiving considerable attention in SOLID WP 2 and other current projects (e.g. LOW INPUT BREEDS). There are some topics (eg some aspects of the agronomy of high protein forage crops) where the research has been carried out in Institutes but the farmers may need to be convinced by seeing its application on farm and the SOLID project would give opportunities for this to happen.

A recent report (ICROFS, 2012) suggests that Denmark has been particularly successful in transferring the results of research programmes to aid organic agriculture into practical use by farmers (both organic and conventional). Other countries could be alerted to this information and encouraged to make use of it. However, as already stated, it is the case that Danish farmers are still suggesting that they need more information on some of the topics covered by this research programme, particularly becoming more self-sufficient in protein feed.

Knowledge transfer is still widely needed, particularly in the areas of manure utilisation, clover management, analysing and understanding soils, mastitis control and neonate survival in small ruminants, although the particular requirements are country specific. Farmers need confidence to use the existing information on protein crops and are still seeking for more information, particularly in more northern regions.

Table 13 Overall summary of topics raised by farmers, indicating needs for research and Knowledge Exchange.

For further details, and references to individual existing projects and information sources see Appendix 7.

Topic	Need confirmed by other consultations or research agendas	Ongoing research	Information available, KT needed	More research needed	Different approach needed	Comments
SOIL						
Understanding soil biology	BE, UK	√		√		
Building soil organic matter	BE, TP Organics			√		
Links between soil/herbage mineral content and animal health			√	√		Information often linked to commercial products/services with limited evidence
Dealing with depletion of phosphorus (and other minerals) under organic management	UK			√		
Understanding soil processes and analyses	BE, UK		√			
GRASSLAND MANAGEMENT						
Soil/sward management to encourage clover		√	√			Do newer varieties have different management requirements/responses?
Persistence of clover						
Soil management practices to improve grassland productivity		√	√	√		
“Mob grazing” techniques to increase soil organic matter				√		

Topic	Need confirmed by other consultations or research agendas	Ongoing research	Information available, KT needed	More research needed	Different approach needed	Comments
FEEDING/FORAGE						
Maximising homegrown feed and forage	AU	√	√	√		
Understanding and increasing the potential and reliability of protein forage crops	UK	√	√	√		
Particular emphasis on increasing protein self-sufficiency	FI	√	√	√		Farmers in temperate regions are still not confident in reliability of protein crops
Optimum protein levels in diets	BE					
Intercropping			√			
High protein grazing swards			√			
Drought resistant crops, swards and forages	RO	√		√		
Understanding, enhancing and exploiting the nutritional value of mixed swards	UK, SP	√ MULTISWARD project		√		Some information from PHYTOMILK PROJECT
Equipment and energy for drying forage	AU		√			
Crop, grass and clover varieties tested under organic grazing conditions				√		
Improving silage and hay quality	AU, FI		√			
FEEDING/RATIONING						
Feeding/rationing to increase yield, longevity and health	SP, RO					

Topic	Need confirmed by other consultations or research agendas	Ongoing research	Information available, KT needed	More research needed	Different approach needed	Comments
Rapid and reliable forage analyses (especially for protein rich forages)	RO, UK	UK		√		
Reducing feeding costs – eg using byproducts or less concentrate	AU, RO, SP	SOLID WP3				
BREEDS AND BREEDING						
Breeding for animals best suited to specific systems, whether low input systems or organic farming	AU, BE, UK, TP Organics	√ including SOLID WP2 and LOW INPUT BREEDS	√			
Effects of cross-breeding on health and longevity	AU, BE, UK, TP Organics	√				Farmers wish to analyse results from their own farms
Making the genetic improvement of goat breeds more efficient	SP			√		
Investigating the link between milk quantity and quality and goat breed		SOLID WP 2		√		
ANIMAL HEALTH AND WELFARE						
Safe vaccinations for goats						Possibly a specific farm problem?
Relationship between opportunity for expression of natural behaviour, stress and productivity (esp. goats)	UK, TP organics					

Topic	Need confirmed by other consultations or research agendas	Ongoing research	Information available, KT needed	More research needed	Different approach needed	Comments
Risk factors and prevention for neonatal losses and sub-clinical mastitis in goats			√			
Parasitological status and control of parasites in extensive goat herds				√		
Links between soil/herbage mineral content and animal health	TP organics		√	√		PHYTOMILK project provides some information
Reducing mastitis without use of antibiotics	DK, UK, TP Organics	√	√	√		Information available on prevention but organic farmers would like more on alternative treatments Information from ANIPLAN project needs to be disseminated
PRODUCT DIFFERENTIATION AND MARKETING						
Creating a unique product – based on the inputs e.g. effects of herbs in diet on milk composition	TP Organics – food quality	√	√			Information available from PHYTOMILK project and QLIF project
How best to communicate with consumers regarding the premium for organic produce	BE					

Topic	Need confirmed by other consultations or research agendas	Ongoing research	Information available, KT needed	More research needed	Different approach needed	Comments
Addressing the lack of an organic beef market						
Innovative products and marketing channels	SP					
CLIMATE CHANGE/GREENHOUSE GAS						
Minimising energy use	TP organics					

TP Organics: Schmid, O., Padel, S., Halberg, N., Huber, M., Darnhofer, I., Micheloni, C., Kpplmans, C., Bugel, S., Stopes, C., Willer, H., Schluter, M., Cuoco, E. (2009) Strategic Research Agenda for Organic Food and Farming. TP Organics Technology Platform. http://www.tporganics.eu/upload/tporganics_strategicresearchagenda.pdf

5.3.3 Summary of topics needing research

Common research needs identified across many of the SOLID workshops (corroborated by many other research needs exercises, and taking note of what research has already been conducted (Table 13 and Appendix 7)) include:

- Agronomy and conservation of high protein crops in specific regional and climatic conditions
- Relationships between sward biodiversity and product quality
- Relationships between sward diversity and mineral availability, linking to animal health
- Some aspects of calf rearing, e.g. rearing calves at grass
- Efficient and economic feeding systems, including use of by-products
- Ways of improving the production and utilisation of forage, particularly security of supply and reliability of quality.
- Trials of grass and clover varieties in organic/low input systems
- Forages for extreme climatic conditions (drought and wet)
- Rapid analyses of soils
- Rapid and representative analyses of high protein forages
- Understanding soil biology
- Addressing the issue of phosphorus depletion in closed farm systems
- Parasitology in extensive goat systems
- Robust cows for low input systems

Greece and Romania stood out as identifying very basic research needs, including the quantity and quality of goat milk produced under semi-extensive management, and development of cost-effective nutritional programs, adjusted to low-input management.

5.4 Conclusions

The main purpose of the report is to inform the discussion about research that will help increase sustainability of low-input and organic dairy systems. As part of this a sustainability assessment tool was used on approximately 10 farms in all 9 participating countries, followed by a workshop to discuss research needs.

These case study farms illustrate the enormous variety in organic and low input dairy systems in the EU, with examples of systems as diverse as goat production without electricity in Greece and robotic milking in Denmark; and herds of under 20 cows in Austria but over 450 in Denmark.

The most valuable outcome of using the sustainability assessment tool was to encourage consideration of sustainability in its widest sense through discussion of relative values in the specific spurs. The discussions of the outcomes between researchers and farmers showed that the farmers' considerations of sustainability generally begin with economic sustainability. All participating farmers were aware that there are further components, but the use of the tool encouraged farmers to think about wider aspects of sustainability. However, not all questions used in the tool were fully applicable in some countries.

It should be remembered that the conclusions on aspects of sustainability derived from use of the tool are based on a limited number of case studies in the various countries and are not necessarily representative of all low input and organic dairy systems. Nevertheless, in general the findings do agree with other assessments of sustainability of organic dairy systems, with suitably comparable methods. Examples of information on specifically "low input" systems for comparison are more difficult to find. The SOLID sustainability assessment indicated that the organic and low input dairy systems studied have their greatest and most consistent strengths in terms of farm business resilience; contributing factors to this strength are diversification (which is not always possible for a dairy farm), and a specialist market for the product. On farm processing and marketing are beneficial to both organic and low input dairying, but need more support in most countries. Organic producers have a specifically defined product that requires better marketing and outlets. Low input producers can use a variety of aspects of their products to market them, but need to be proactive and creative in this. Profitability can also be improved by cutting costs and examples of farmers seeking to do this in innovative ways were reported. This included extending lactations (mainly on goat farms) and moving to once a day milking. Improving energy self-sufficiency was also mentioned. Despite the relatively positive assessment using the tool, many farmers have major concerns about the economic survival of their businesses. Animal health and welfare appeared from the assessments to be a strength yet farmers still aspire to greater improvements, being aware of the importance for productivity, consumer image, and the animals themselves.

The weaknesses relevant to sustainability as identified by the tool vary more between countries than the strengths. Water management appeared as a weakness of some systems, both in regions where water is plentiful, and also in some areas dependent on irrigation (e.g. parts of Italy and Romania). In view of the likely increase in extreme weather patterns with climate change, the issue is important. Breeding plant varieties and developing crop management systems for extremely high or low amounts of rainfall were suggested as research topics by farmers. Low scores for the biodiversity spur can partly be explained by the way the tool assesses grassland systems, and improvements in the assessment could be made. The "classical" indicators of environmental sustainability, i.e. management of soil, water and nutrients, and energy and carbon resources, all show considerable variation in the majority of countries, indicating that there is the capability for poorer performing farms to improve.

Moving on to research needs, the farmers suggested research topics under a range of headings: Feeding, Forage production, Soil and nutrient management, Breeds and breeding, Animal health and welfare, Product differentiation and marketing, Energy use and Water management (details in Section 5.3.2, Table 13 and Appendix 7). As with the sustainability results, although the conclusions were derived from consultation with a limited number of farmers, the similarity of topics identified on occasions when more than one meeting was held in a country, and general consensus with the limited number of other research needs exercises from dairy farmers in the countries concerned suggest that the groups involved in the project meetings are likely to have given a reliable view of the opinions of organic and/or low input farmers in these countries. In some cases, the availability of information to farmers does not seem to have increased greatly over recent years – cf ACOS (2006). In many countries farmers are unaware of the extent of knowledge available, particularly on manure management, husbandry of alternative forage crops, and management to reduce the risks of mastitis. However, it is acknowledged that often information is not actively directed towards organic

and low input farmers. The consultations suggest that there is still considerable potential to disseminate the findings of projects such as the QLIF project (www.qlif.org), and the SAFO workshops (Rymer et al, 2006), using methods such as Stable Schools (Vaarst et al, 2007) and Participatory Action Research (Kneirim et al, 2012).

Some innovative farmers have been identified, who may provide a focus, base, inspiration, or stimulus for participatory projects. The innovations may be an altered approach to the whole system, new marketing channels, or using feeds or forage management approaches that are unusual for the region (in some cases these may in fact be a return to more traditional practices). New technologies that make fundamental changes to systems are unusual in agriculture, most changes are incremental. Using the distinctions of Li et al, (2008), there have been more examples of exploitative innovation than of explorative innovation . However, the incremental changes of exploitative innovation are important for development and farmers who are willing to take the risk of implementing changes, whether small or large, can be valuable sources of knowledge and act as a focus for dissemination to others.

The overlap of interests between countries means that there is great opportunity for exchange of information and ideas between countries, although specific local conditions and situations must be borne in mind. This applies not only to new knowledge to be generated by SOLID but also to transfer of existing knowledge. In terms of more specific knowledge requirements, Greece and Romania in particular need more information in the native language.

Farmers' discussions and suggestions for further research show that forage remains the basis of organic and low-input milk production systems, along with a need for a greater understanding of soil processes, and how to maintain soil fertility, particularly in organic systems. Good use of forage is of vital importance for low-input and organic dairy farms and thus can be a clear strength; however, there is lack of confidence in the reliability of forage production systems, both in quantity and quality. Several innovative or unusual practices were present among the case study farms that can be interpreted as a response to this challenge, in particular experimenting with growing and feeding different crops and producing concentrate feeds on farms. Research that will lead to an increase in farmers' abilities and confidence in forage production and utilisation will be valuable to all countries.

The next step in the SOLID project is to carry out on-farm trials in which farmers can be involved in answering some of the questions they have raised. Meetings with farmers are on-going, to focus on the topics which are suitable for this approach. This communication with farmers has also indicated the great need for knowledge exchange which can also be facilitated through the dissemination Work Package of the SOLID project (WP7).

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7 Appendices

Appendix 1 BELGIAN DAIRY FARMS ADDITIONAL DATA

Table A1.1. Crops on the organic dairy farms (present on % of the farm; averages in ha)

Crops	% of the farms	average ha
Grassland	100	34.1
only silage (grass/clover)	100	12.2
grazing + silage	100	21.9
grass on conservation area	61	9.5
Forage Maize	61	4.6
Maize (grain)	22	3.2
Fodderbeet	44	1.0
Grain	89	7.5
Barley	50	3.1
Triticale	50	3.5
Spelt	33	5
Oats	33	2.3
Wheat	17	4.7
Rye	6	2.5

Table A1.2. Characteristics of the organic dairy herd

Measure	Mean value
Yield (l/cow/year)	**6160 l**
Fat content	41.5 g/l
Protein content	34.0 g/l
Urea content	286 mg/l
Number of lactations	4.2
Age at first calving	27 months
Intercalving period	390 days
Dry period	50 days
Concentrate/cow/year	870 kg

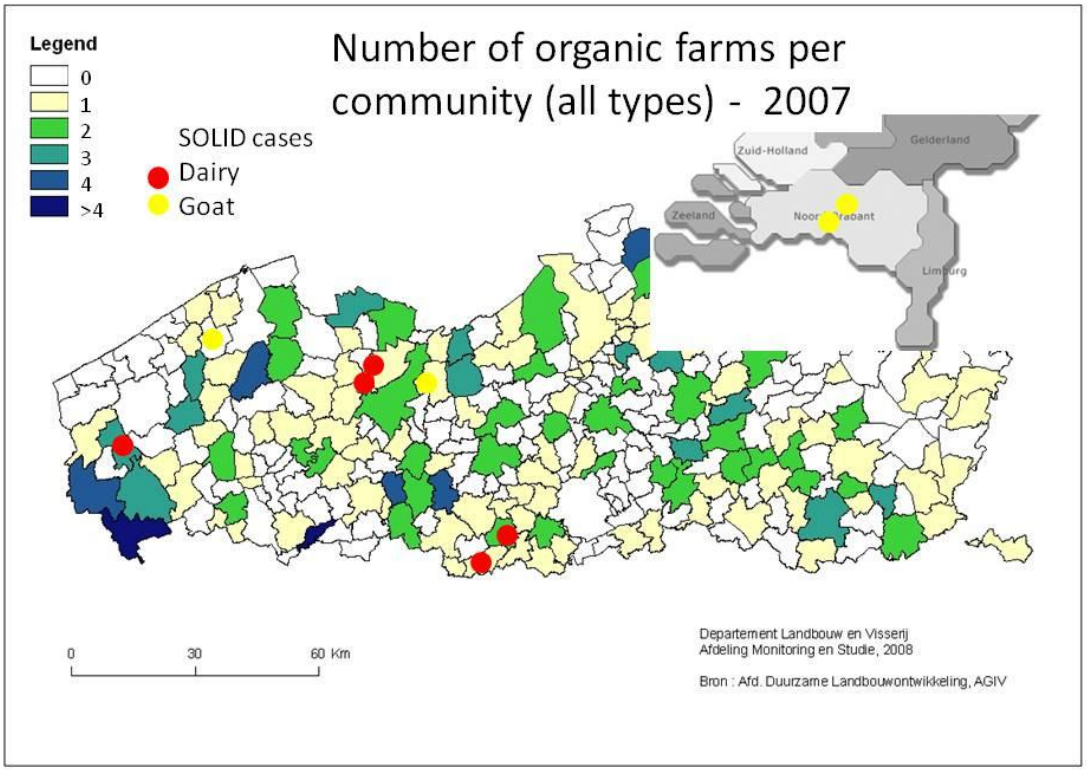


Figure A3: Geographical spread of the farms in Flanders

Appendix 2 ITALIAN DAIRY FARMS – ADDITIONAL DATA

Table A3.1: Cow and goat dairy farm structures

Median	**Goat**	**Cow**
Farm size (ha)	57.81	63.59
Herd size (n°of adult animals)	25	28
Stocking rate (LU/Ha)	0.07	0.42

Table A3.2*: Status of animals and land area on ICEA Dairy Goat Farms (N = 132)*

Animal status	**Number**	**Area**	**ha**
Organic	8972	Organic	1247.69
In conversion	416	In conversion	354.23
Conventional	121	Conventional	131.34
Total	9509	Total	1733.26

Table A3.3: *Status of animals and land area on ICEA Dairy Cow* (N= 93)

Animal status	**Number**	**Area**	**ha**
Organic	5038	Organic	12517.12
In conversion	119	In conversion	645.44
Conventional	168	Conventional	24.11
Total	5325	Total	13186.67

Appendix 3 SPANISH DAIRY FARMS – ADDITIONAL DATA

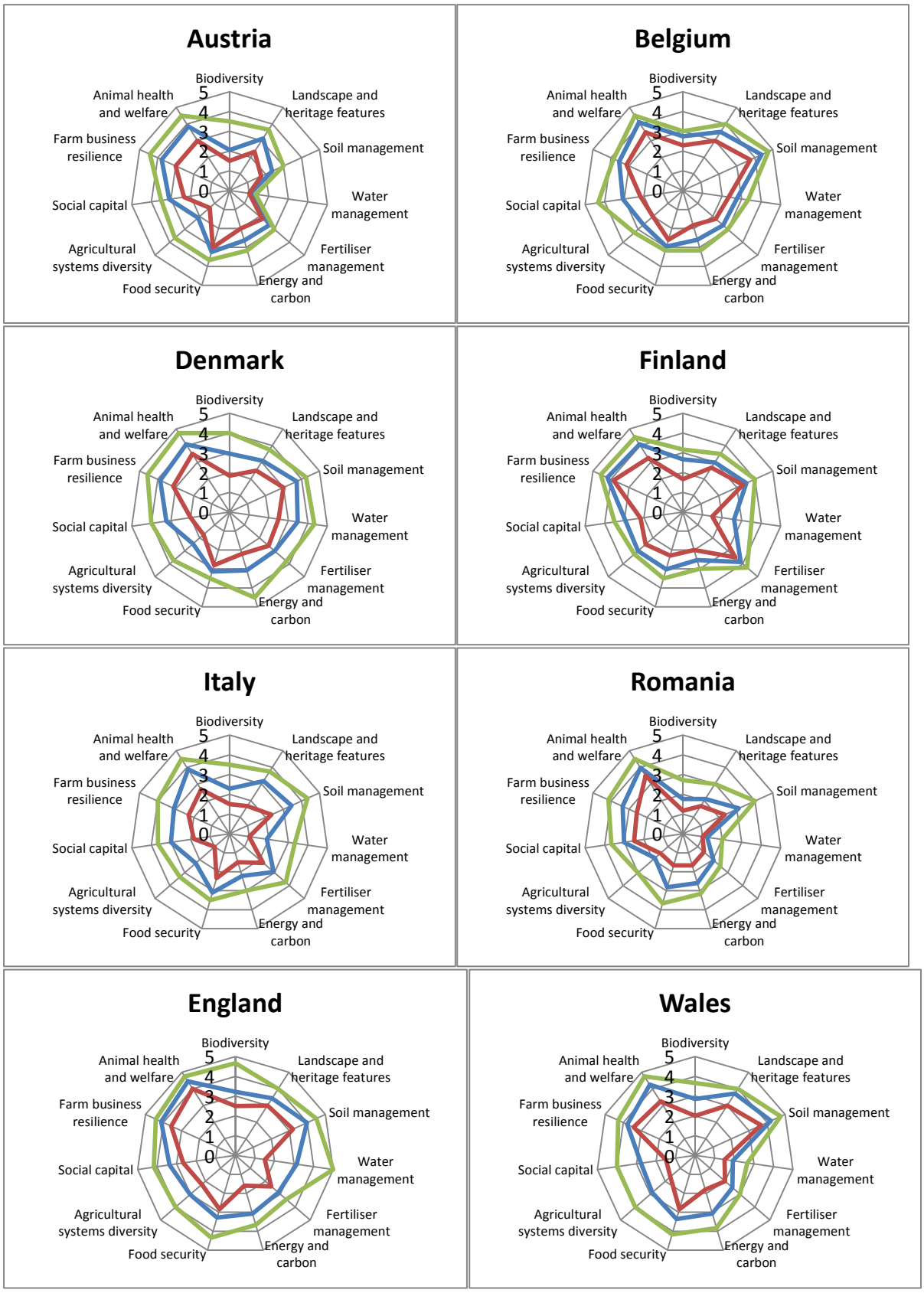
Table from Castel *et al.* (2010).

Table 1
Average yearly values of technical indicators of Spanish goat farms obtained from monthly monitoring.

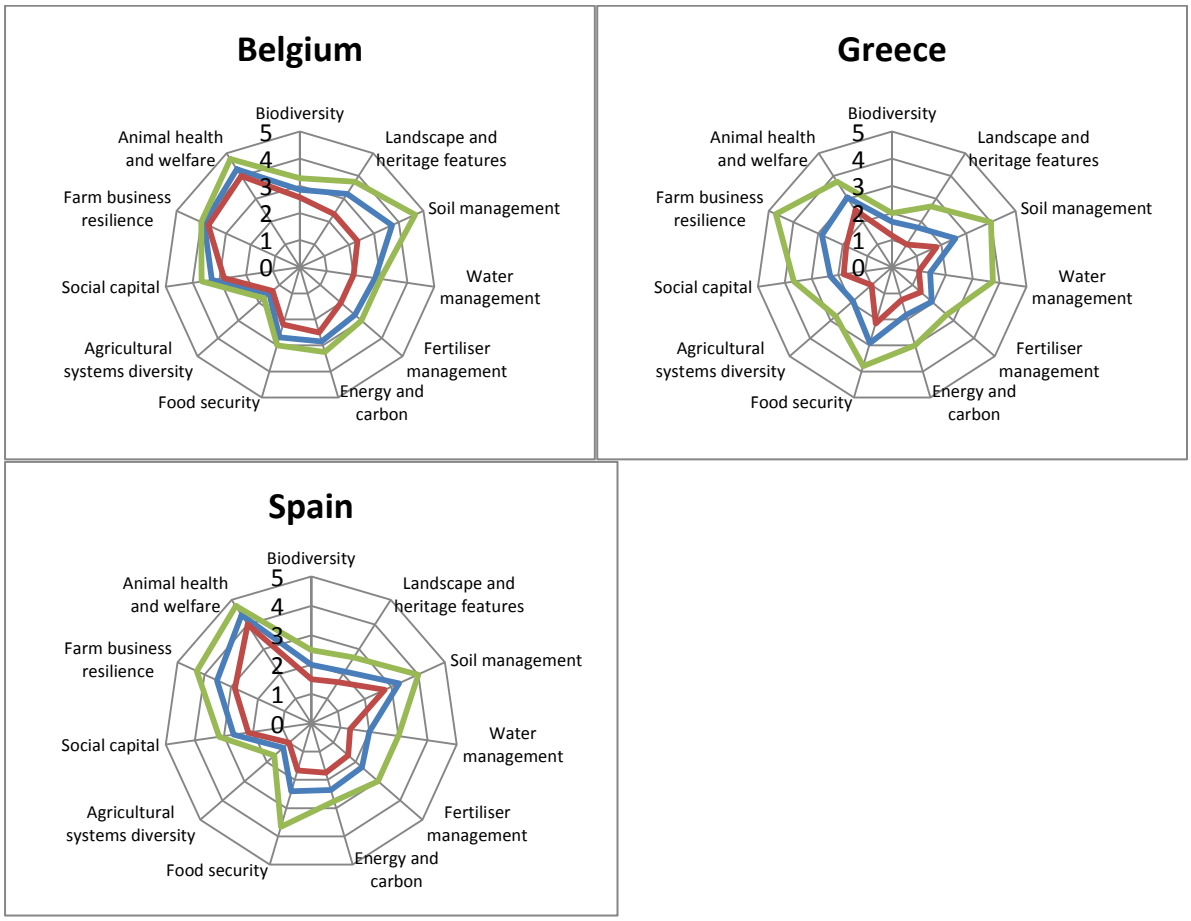
Indicators	Confined systems		Grazing systems	
	7[a] (Sánchez et al., 2006)	8[a] (Mena et al., 2005)	21[a] (Escuder et al., 2006)	18[a] (Ruiz et al., 2008)
Breed	Murciano-Granadina	Malagueña	Canaria	Payoya
Goats presents	179	382	122	353
Grazing surface per goat (ha)	NA	0.31	0.32	0.73
Labour per 100 goats (YWU[b])	0.74	0.69	NA	0.71
Concentrate per goat (kg)	343	392	319	278
Forage supply per goat (kg)	288	199	331	52
Milk produced per goat, per year	487	440	473	389

NA = not available.
[a] Farms studied.
[b] YWU, year worker unit.

Appendix 4 FIGURES SHOWING MEAN, MINIMUM AND MAXIMUM SPUR SCORES FOR COW AND GOAT FARMS **Dairy cows**



Dairy goats


Belgium
Biodiversity
Landscape and heritage features
Soil management
Water management
Fertiliser management
Energy and carbon
Food security
Agricultural systems diversity
Social capital
Farm business resilience
Animal health and welfare
0
1
2
3
4
5
Greece
Biodiversity
Landscape and heritage features
Soil management
Water management
Fertiliser management
Energy and carbon
Food security
Agricultural systems diversity
Social capital
Farm business resilience
Animal health and welfare
0
1
2
3
4
5
Spain
Biodiversity
Landscape and heritage features
Soil management
Water management
Fertiliser management
Energy and carbon
Food security
Agricultural systems diversity
Social capital
Farm business resilience
Animal health and welfare
0
1
2
3
4
5

Appendix 5 PROTOCOL FOR FARMER WORKSHOP

TIMETABLE

MIN	STEP	ACTIVITY	MATERIALS	GROUP	OBJECTIVE
10	1. Introduction	Introduce the day and the project	Project presentation as slides or handout	Plenum	Explain the purpose of the day in the setting of the project
10	2. Famers' own perspective	Write on post-it notes 1) something that is going well 2) a problem 3) something novel about the farm. Introduce with the good point	Post-it notes	Plenum	Individual introductions and thoughts of issues arising on farm
20	3. Splitting into groups (with post-its)	Farmers score their farms on the radar diagram (top of mind) Stick on post-its to relevant spur	RADAR diagram A3 or large stickers (5mm)	Go to groups	Think about aspects of sustainability in context of own farm & current issues
15	4. Presenting RAT results	Presenting RAT results	Project presentation as slides	Plenum	Introduce the findings of the RAT exercise
40	5. Draw out themes	Draw together the issues arising into themes & find the area of greatest interest	Flip chart to write topics/areas on	Back to groups	Focus the discussion area
	6. Explore the problems in the chosen themes	What are the practical issues that need to be solved? Could use tree root diagram to develop ideas. Write endpoints on cards	Flip chart to write topics/areas on	Stay in same groups	Identify the precise problems and ways in which on-farm work might help
	7. Identify the novelties/ good examples in the chosen areas	Identify 1) strengths that can be developed further/used as good examples.2) Novel approaches with potential to explore further.	Flip chart to write topics/areas on	Stay in same groups	Discover strong and novel areas in this spur
20	8. Subjects suitable for trials	Consolidate themes and think specifically about possible trials	Flip chart to write topics/areas on RAT diagram from group	Stay in same groups	Consolidating ideas for trials. Identify any concrete ideas
20	9. Final Plenary	Concluding session	Reporting by chairs about themes and possible trials	Plenum	Share ideas between groups and bring them all together

Appendix 6 BELGIUM – LINKS TO PARTICIPATORY MODELLING DETERMINED AT THE GOAT FARMERS' MEETING

Since no on-farm trials will be held in Belgium, the farmer meeting was used as an opportunity to explore the development of the participative modeling of dairy farm systems (in WP 6).

The overall conclusions of the introduction to participative modeling are as follows:

The farmers are enthusiastic about a decision support model.

Suggestions made by the farmers:

- At present, some of the goat farmers are involved in 'cost price groups', where they discuss their farms' economics using a model based on economic figures and farm accounts. They experience a lack of attention to technical aspects (e.g. the amount of kilos feed per euro).
- The model must be easy to use for several types of farms
- Results of the model must be given per quarter because there are a lot of differences related to seasonal influences.
- The model must try to use as input the data that farmers already have to collect for the currently-used software.
- The farmers place great importance on having a graphical representation of the model outcomes. This way, it is easy to compare their own farm with other farms and to visualize the improvement path they want to follow.
- It is useful to represent model outcomes in costs per stable place instead of per goat, so the impact of empty places in the barn becomes clear.

Current dilemmas on farms:

- What is the optimal ratio of young cattle in proportion to the whole group? What is the cost of breeding too many young cattle?
- When do you need to dispose of a goat? From which age do farmers get problems with a goat? What is the importance of the age distribution of the herd?
- What is the long term effect of extended milking?

Conclusion:

- The model builder will send a mail to the farmers with questions about the input he requires from them. The model builder will discuss the input with the farm advisor and start building a first concept model to be discussed in a next meeting. This first model will focus on the module for optimizing the use of different feeds and feed efficiency

Appendix 7 OVERVIEW OF TOPICS FOR WHICH RESEARCH NEEDS ARE PERCEIVED BY FARMERS:- SUGGESTED RESEARCH TOPICS, ON-GOING RESEARCH AND EXISTING INFORMATION

Discussions from the workshops are summarised here, by country, under five main subject areas. Current research already happening in these areas is noted in Column 3. Some references and links to existing information are given in Column 4. This is not intended to be an exhaustive source of reference material, but an indication of the availability of information. *Topics in italics are those which partners consider to reflect a return to more traditional practices*

AUSTRIA **1. Subject area**	**2. Issues/discussions**	**3. Ongoing research**	**4. Examples of existing information – much in native languages**
Forage quality	*Producing milk without concentrates → "hay milk concept"* Need to improve hay quality Utilization of feed analyses to strategically improve forage quality		Information on nutritive value of permanent pasture: http://www.raumberg-gumpenstein.at/c/index.php?option=com_content&view=article&id=1725%3Aeinfluss-der-fruehjahrsbeweidung-auf-den-pflanzenbestand-von-schnittwiesen-umsetzungsprojekt-bio-gruenlandforschung-und-beratung-&catid=23%3A4forschungsprojekte&Itemid=100028&lang=en http://www.raumberg-gumpenstein.at/c/index.php?option=com_content&view=article&id=1055%3Astrategien-z-reduktion-des-kraftfuttereinsatzes-in-bio-milchviehbetrieben-im-berggebiet-terreichs&catid=23%3A4forschungsprojekte&Itemid=199&lang=de http://www.raumberg-gumpenstein.at/c/index.php?option=com_fodok&Itemid=100033&task=detail&filter_publnr[]=5621 https://forschung.boku.ac.at/fis/suchen.projekt_uebersicht?sprache_in=de&menue_id_in=300&id_in=3349
Breeding for low-input systems	Robust cows suitable for low-input systems Fertility disorders Strong seasonal differences in fertility (decreased fertility rates in winter)	SOLID project WP2 https://forschung.boku.ac.at/fis/suchen.projekt_uebersicht?sprache_in=de&menue_id_in=300&id_in=9011	Health monitoring in cattle: development of genetic evaluations for health traits https://forschung.boku.ac.at/fis/suchen.projekt_uebersicht?sprache_in=de&menue_id_in=300&id_in=7007

AUSTRIA **1. Subject area**	**2. Issues/discussions**	**3. Ongoing research**	**4. Examples of existing information – much in native languages**
Use of renewable energy	Using biomass or solar energy in hay drying installations		Renewable energy http://www.raumberg-gumpenstein.at/c/index.php?option=com_fodok&Itemid=100033&task=detail&filter_publnr[]=3934
Manure/Soil management	Improvement of manure quality Negative influence of decreasing livestock diversity (only cows) on Manure quality Slurry additives Request for regular soil analyses and assistance in interpretation of the results Concerns about the supply of minerals and trace element supply from soil → assumption of negative influence on fertility	http://www.raumberg-gumpenstein.at/c/index.php?option=com_content&view=article&id=726%3Alangzeitwirkungen-von-behandelten-und-unbehandelten-wirtschaftsdrn&catid=23%3A4forschungsprojekte&Itemid=100028&lang=en	http://www.raumberg-gumpenstein.at/c/index.php?option=com_fodok&Itemid=100033&task=detail&filter_publnr[]=498 http://www.raumberg-gumpenstein.at/c/index.php?option=com_fodok&task=detail&filter_publnr[]=9058 http://www.raumberg-gumpenstein.at/c/index.php?option=com_fodok&task=detail&filter_publnr[]=4614 http://www.raumberg-gumpenstein.at/c/index.php?option=com_content&view=article&id=1769%3Aoptimierung-der-guelleduengung-auf-wiesen-durch-einbringung-zusaetzlicher-organischer-materialien&catid=23%3A4forschungsprojekte&Itemid=199&lang=de
Process-product quality	Biodiversity as a potential asset in dairy marketing; request for conducting a sound assessment of biodiversity Effect of biodiversity on milk quality	http://www.raumberg-gumpenstein.at/c/index.php?option=com_fodok&task=overview&job=grid&filter_leistungsnummer[]=3586&Itemid=100034 https://forschung.boku.ac.at/fis/suchen.projekt_uebersicht?sprache_in=de&menue_id_in=300&id_in=8911	

BELGIUM – GOAT FARMS **1. SUBJECT AREA**	**2. Issues/discussions/suggestions**	**3. Ongoing research**	**4. Examples of existing information – much in native languages**
Animal health and welfare	Housing allowing goats natural behaviour	New designs under investigation	Some information from other countries
Energy	Invest in solar panels		Yes
Water management	Increasing re-use of water, water purification systems		
BELGIUM – COW FARMS **1. SUBJECT AREA**	**2. Issues/discussions/suggestions**	**3. Ongoing research**	**4. Examples of existing information – much in native languages**
Animal health and welfare	Mineral deficiencies	Optimization of organic feed rations for cattle: protein levels, vitamin and mineral levels, optimal utilization of roughage	
	Extended lactations		
	Parasite control - problems with fluke and worms, resulting in a lower milk production	Alternative management strategies for worm infections in cattle (http://www.ccbt.be/sites/default/files/files/alternatief%20bestrijden%20wormbesmettingen%20vee.pdf)	

BELGIUM – COW FARMS **1. SUBJECT AREA**	**2. Issues/discussions/suggestions**	**3. Ongoing research**	**4.Examples of existing information – much in native languages**
FEEDING	Home grown proteins - suitable species to grow along or in combination with cereals, in Belgian conditions. Agronomy. Varieties of existing crops with higher protein content eg grass, clover , sunflower seeds	Some research on lupins in Flanders but not yet successful Optimization of organic feed rations for cattle: protein levels, vitamin and mineral levels, optimal utilization of roughage DAIRYMAN project: soil structure, nitrogen utilization, forage production in legume-grass meadows	
	Mineral supply to animals via deep rooting herbs in pasture	Towards a more efficient mineral utilisation in the ration of organic dairy (http://www.ccbt.be/sites/default/files/files/Mineralenproject.pdf)	Some information available
	Greater forage production from herb rich pastures		
SOIL MANAGEMENT	Overcoming the challenges of the closed farm system causing reduction in soil minerals – links to animal health	Using organic manure on grassland (http://www.ccbt.be/sites/default/files/files/Eigen%20stalmest%20of%20kippenmest%20als%20voorjaarsbemesting%20in%20grasland.pdf)	ADLO-research project 'Optimal application of organic chicken and ruminant manure for a healthy organic crop'. The desk research originating from this contains valuable information concerning manure application on farms for the different subsectors and concerning the manure flows in the sector as a whole. DAIRYMAN project, Germany comparing trail hoses, slurry injection and swivel equipment

DENMARK – COW FARMS **1. SUBJECT AREA**	**2. Issues/discussions/suggestions**	**3. Ongoing research**	**4. Examples of existing information – much in native languages**
Animal health and welfare			
Bedding materials	Alternatives to straw bedding eg wood/sawdust/compost	Ongoing research by Ilka Klaas, Copenhagen University	Some available from other countries
Animal breeding	Breeds for organic systems	(not so much in dairy)	
FEEDING			
Protein Self-sufficiency	Calculate potential and reliability of protein crops under Danish conditions	Yes, in Denmark and other countries, advisory service, VfL leads: http://www.vfl.dk/Projekter/Okoprotein/Projektbeskrivelse/projektokoprotein.htm	Available - referred to in the ICROFS report on 15 years of organic research from 2012, http://www.icrofs.org/pdf/2012_web_UK_oekoanalyse.pdf
Calf feeding	Feeding milk to calves at grass		
FORAGE PRODUCTION	Varieties specifically good for organic production		
	Long term pastures – 5-6 year leys		
	More protein species in pastures	See below	Some from other countries
	Herbs in pastures	*http://www.icrofs.org/Pages/Research/darcofIII_ecovit.html* *http://www.icrofs.org/Pages/Research/organicrdd_ecoserve.html*	Some from other countries Earlier ICROFS research: http://www.icrofs.org/Pages/Research/darcofII_orggrass.html
ENVIRONMENT			
Climate change	Climate change ”stable school” discussion groups	Extended lactation in dairy production to benefit climate, animal welfare and productivity - http://agro.au.dk/reprolac/	
Energy Use	Biogas and windmills		Previous ICROFS research: http://www.icrofs.org/Pages/Research/darcofII

			l_bioconcens.html
	Demonstration of energy minimisation; practical and technical implications of various innovations		Advisory services has established program on this
Water use	Suggestion: Reuse water from roofs		
Biodiversity	Develop strategies for wildlife areas in combination with agricultural field management.		Some results in earlier ICROFS project: http://www.icrofs.org/Pages/Research/darcofIII_refugia.html
MARKETING	Develop & market meat from "nature areas"	Ongoing ICROFS project: Superb and Marketable Meat from Efficient and Robust Animals (SUMMER)	Other countries will have some experience
FARM STRUCTURE	Collaboration between arable and dairy farms		Limited so far
	Reducing stocking rate		

FINLAND **1. Subject area**	**2. Issues/discussions**	**3.Ongoing research**	**4.Existing information -** This information is mainly in Finnish.
Forage quality and quantity	*How to reach higher yields and quality in forage production* → New plant species like lucerne in perennial leys and white lupin or faba bean with cereals as whole-crop silage		http://www.mtt.fi/mttraportti/pdf/mttraportti59.pdf
Protein self-sufficiency	*How to reach higher protein self-sufficiency on farm* -> New crops for home-grown protein feed? -> blue lupin testing *The quality of silage is not at high enough level. Clover is the main element on grasslands in organic farming, but it does not maintain/persist well enough in the leys after several years of organic farming -> Use of manure in autumn and early-cut trials in spring*		http://www.mtt.fi/mttraportti/pdf/mttraportti59.pdf ---
Balanced crop rotations	*Crop rotations often include too much forage and too little grain compared to the forage and feed demands of the cattle. How could these be balanced better?* -> workshops of farmers, researchers and advisors to find solutions		---
Diet planning	*The targets of good animal husbandry are higher milk yield, longer life of cows and better health of animals. How all this can be achieved by better diet planning and how is housing environment affecting these?* -> workshops of farmers, researchers and advisors to find solutions		---

GREECE **1. SUBJECT AREA**	**2. Issues/discussions/suggestions**	**3.Ongoing research -** no information on ongoing research	**4. Examples of existing information – much in native languages**
Animal health and welfare			
	Etiology, epidemiology and risk factors of subclinical mastitis Etiology, epidemiology and risk factors of neonatal losses		Available, needs to be made accessible to Greek farmers
	Parasitological status of extensively reared herds		
Animal breeding	Description and typology of goat herds in Greece Milk quantity and quality of different dairy goat breeds		
FORAGE PRODUCTION/Grazing management	Grazing management of goats on grasslands and shrublands in mountainous areas and the nutritional value of the accumulated plants		
	Forage production and utilization with emphasis on the finding of alternative sources of protein		Some information available in other countries
PRODUCT QUALITY	Milk quantity and quality i) of different dairy goat breeds ii) of goats accumulating a variety of herbs during grazing		
	Development of novel products (i.e. cheeses) from the processing of goat milk		Experience in other countries

ITALY **1. Subject area**	**2.Issues/ subject**	**3.Ongoing research**	4. **. Examples of existing information – much in native languages**
Feeding	Plant drought resisance. Nutritional value of pasture plants		Plant improvement for semi-arid rangelands : possibilities for drought resistence and nitrogen fixation (Johnson,Rumbaugh, Asay) Climatic change in mountain regions : a review of possible impacts (Beniston) Temperate grasslands and global atmospheric change : a review (Sousanna, Luschert) Crops and pasture response to climate change (Tubiello, Sousanna, Howder) Pure stands vs four species mixture : agronomic and ecological implications in Mediterrean rainfed conditions (Porqueddu,Dettori , Brophy , Connoly) Selection of sponteneous genotypes with high pasture value and for multiuse systems (Vangiu, Nonnoi, Spanu , Salis)
Soil management	Biodynamic techniques	Use of microbiological products in agriculture (Simionato, Parolin) www.ilbrolo.it/	Research at biodynamic and organic farms (formulations, methods of cultivation, organic matter) (Ponzio, Neri) www.agri.marche.it/.../fertirrigazione/.../Presentazione_Ponzio_01.pdf
Breeds	Back crossing		
Health	Herbal plants for grazing		The use of herbs in pastures : an interview survey among bio dynamic and organic farmers with dairy cattle (Smidt, Briner)
Environmental issues			Regional information on environmental issues: www.regione.emilia-romagna.it/temi/territorio Agro-silvo pastoral system in Italy : integration and diversification (Parandini , Nori)
Marketing			

ROMANIA - SUMMARIZING THE COLLECTED SUBJECTS CONSIDERED BY THE FARMERS AS RESEARCH NEEDS – *this table is arranged slightly differently because many of the topics require research at one level, but knowledge transfer to the smaller farmers, and several issues were raised that need approaches other than research to address them.*

ROMANIA	Subjects	Research & development (R & D) or technology transfer (TT) needed	Other approaches more relevant
ANIMAL HEALTH AND WELFARE			
	- solutions for better animal housing in low-input systems (complying with technology requirements)	TT	
ANIMAL FEEDING			
	- nutritive value of less known by-products from processing factories (alcohol, starch, biofuels)	R & D & TT	
	- update the feeding value of genetic-improved forages	R & D	
	- harmonizing the national feeding system with the international ones	R & D	
	- increase the efficiency of farm animals' feeding	R & D & TT	
	- alternatives to expensive or variable price feeds	R & D & TT	
	- methods/procedures for fast evaluation of the nutritive value of feeds	R & D & TT	
	- feeding strategies for drought periods / need for drought-resistant plants	TT	
	- knowledge on ensiling, diets optimisation, nutritive value	TT	
	- knowledge in using macro-minerals (more acute than in conventional farms)	TT	
ANIMAL BREEDING, GENETICS AND REPRODUCTION			
	- impact of multiple ovulation and embryo transfer on the maximisation of genetic progress in cattle	TT	
	- conservation of vulnerable farm animal breeds	R & D	
	- artificial insemination should be more available	-	administrative measures
	- increase the accuracy of estimating breeding value of farm animals	R & D	
FARM MANAGEMENT			
	- solutions to counteract the ageing, insufficiency, low qualification of work force	-	administrative measures
	- solutions to counteract the low prices obtained for milk (from collectors/processors)	TT	administrative measures
	- ensuring appropriate feed supply (in general, in some periods, in some areas)	TT	

ROMANIA	Subjects	Research & development (R & D) or technology transfer (TT) needed	Other approaches more relevant
	- national agricultural policies more adapted to the farmers' needs	-	administrative measures
	- access to specific equipment (especially low-capacity / cheaper / adapted to small farms)	-	administrative measures; awareness of existing technologies
	- solutions to lower energy / fuel costs	TT	
TECHNOLOGIES			
	- need for centralized milking (related to efficiency, quality, price of milk)	-	administrative measures
	- solutions for disposal of manure	R & D & TT	

SPAIN **1. SUBJECT AREA**	**2. Issues/discussions/suggestions**	**3. Ongoing research**	**4. Examples of existing information – much in native languages**
Animal health and welfare			
	Losses of neonates in extensive systems		Information available eg from www.cabrandalucia.com: Federation of Andalusian Goat Breeding Associations www.cabraespaña.org: Spanish web site for goat producers
	Management in the milking area to reduce risk of infection		Information available eg from www.cabraespaña.org: Spanish web site for goat producers
FEEDING	Nutritional strategies to reduce cost without affecting milk yield and quality		
	Appropriate nutritional supplements under different physiological conditions		Information available eg from www.cabraespaña.org: Spanish web site for goat producers
	Practical use of by-products as feeds	Work in SOLID WP3	
FORAGE PRODUCTION/Grazing management	Producing high quality conserved forages		Available
	Novel forages/grains to grow on farm		Some information available from other countries
MARKETING	Strategies to increase income from milk and cheese		
	Marketing strategies for kid meat		

UK 1. SUBJECT AREA	2. Issues/discussions/suggestions	3. Ongoing research	4. Examples of existing information
Animal health and welfare			
Antibiotic use and mastitis control Desire to reduce dependence on antibiotics, particularly for the control of mastitis.	Alternative treatments Dry cow management Genetic susceptibility Case studies of farms with low antibiotic use Data from farms with milking machine solutions to mastitis control	Developing a decision tree for mastitis control, Nottingham University (DairyCo) LOWINPUTBREEDS project Newcastle Louis Bolk Institute in the Netherlands may start case studies of farms with low antibiotic use. (Antibiotic use on organic dairy farms: http://www.cvi.wur.nl/NR/rdonlyres/E8288614-D024-41BE-928D-2AD7503DB42F/108061/Whitepaper.pdf; http://www.kennisonline.wur.nl/kennisonline/projecten2010/Project.aspx?Id=19688 Belgian work on development of feed additives for disease management in organic farming	http://www.mastitiscontrolplan.co.uk/ http://www.extension.org/pages/18645/milk-quality-on-organic-dairy-farms
Longevity and the influence of breeding	Use data from farms with crossbreeding	Newcastle University EU LOW INPUT BREEDS project	IOTA research report for advisors
Detailed comparisons between breeds/crosses		SOLID Project Work Package 2	
Feeding calves	How soon calves benefit from grazing, benefits of feeding yoghurt to calves, *rearing calves on cows*		Some research but possibly not well transmitted to farmers
Soil: The key to organic farming		PROSOIL project http://www.aber.ac.uk/en/ibers/	PROSOIL project http://www.aber.ac.uk/en/ibers/research/maj

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		research/major_research_projects/prosoil/	or_research_projects/prosoil/
	The "10 year barrier" – organic systems seem to perform well for 10 years, then soil reserves become depleted.		
	How to release P locked up in clay soils		IOTA research report for advisers P-LINK project
Managing soils (physical aspects) when outwintering cattle.	How far can you push the boundaries when outwintering?	DairyCo compaction trial at SAC Outwintering, Harper Adams University	http://www.britishseedhouses.com/files/Out-wintering16pp.pdf
Maintaining good soil condition under permanent pasture.	Effects of subsoiling grassland	SAC DairyCo funded compaction project PROSOIL project http://www.aber.ac.uk/en/ibers/research/	
Soil analysis	Rapid analyses and understanding analyses Maintaining Soil Organic Matter Trace elements	Bangor University – immediate assessment of manures	IOTA research report for advisers
FEEDING Feeding protein			
Alternative sources of protein to soya. Are we overfeeding proteins?	*What are the effects of reducing protein content of diet?*	DairyCo SAC forage legumes trials DairyCo Nottingham /Harper Adams - Reduced protein diets and rationing DairyCo/Reading University - Reducing protein in diet –long-term impact	Lupins: www.dairyco.org.uk/non_umbraco/download.aspx?media=4940

UK **1. SUBJECT AREA**	**2. Issues/discussions/suggestions**	**3. Ongoing research**	**4. Examples of existing information**
FORAGE PRODUCTION			
Management of clover Earlier growth and better persistence of clover How to manage and maintain clover		BGS nutrient wise Demonstrations	http://www.britishgrassland.com/rgcl
Performance of individual grass and clover varieties in organic systems and under grazing.	Performance in organic systems in different regions of different varieties and mixtures	DairyCo/NIAB performance of grasses under low/zero and high N input Kingshay selection of grasses/clovers by cows	
Availability of varieties for organic systems			
Swards for drought conditions	Chicory/plantain/clover mix as a possibility for providing grazing in dry conditions.	Chicory trial plots IBERS Aberystwyth	
Establishment of maize (and peas)	Suitable bird/badger deterrents for organic seed	(DairyCo Kingshay starling control)	
FORAGE UTILISATION			
Why does forage not perform as you expect? How was silage that performed well produced? Why do “good diets” not perform well in summer? How often to review diet, how to know when to change – especially in summer How to deal with changing forage availability/quality – either at grass or of conserved forage What are the best ways of supplementing grass from LI and organic grazing? The analysis does not necessarily reflect the effects of the physical structure of the diet. Can there be better analyses of alternative forages?		DairyCo/ Reading University Analysis of high clover forages	These very important questions need more consideration of how we might address them on farm