Innovation for Sustainable Sheep and Goat Production in Europe

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Review of farm management innovations that can be tested on-farm

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Abstract
This deliverable collects potential farm innovations to increase sustainability as an early indication of what can be tested on sheep and goat case study farms. Some innovations need time to set up, monitor and assess their effectiveness so it is important to have a primary idea of what might be relevant to test on farms. This review is the result of the information gathered at workshops with the 18 iSAGE industry partners in Thessaloniki in April 2016 and Zaragoza in June 2016 and a project online survey.

At these workshops and survey, iSAGE partners discussed potential farm innovations but also included potential processing, marketing and organisation innovations. The latter were discussed because they are important for work package 2 for the farmer, supply chain and consumer surveys. The list of innovations include some indications on the potential applicability and barriers for testing and will be the start point for a selection process based on criteria such as best practice in some farm types, time frame for testing and budget availability.

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1 Introduction

The primary objective of iSAGE is to improve the overall sustainability and innovative capacity of the sheep and goat sector in Europe. This will be achieved by enhancing the efficiency and profitability of the sector at farm level, whilst increasing its societal acceptance and improving the delivery of ecosystem services. The specific aim in WP4 is to to identify innovation that can be used to re-design sheep and goat production systems in Europe. The latter will help the sector to address current and future sustainability challenges identified in WPs 1, 2 and 3. A selection of the innovations with potentially higher impact on sustainability will be tested in case study farms to assess farm level impacts.

This review of farm innovation provides an indication of what can be tested on sheep and goat case study farms. Some innovations need time to set up, monitor and assess their effectiveness so it was important to have an early idea of what might be relevant to test on farms in order to improve sustainability. The document mainly uses the information gathered from workshops with the 18 iSAGE industry partners in Thessaloniki in April 2016 and Zaragoza in June 2016 and an online survey.

The online survey asked which innovations the partners thought would benefit and impact sustainability of the sheep and goat sector. The survey also assessed the type and detail of farm data that the different associations participating in iSAGE record routinely. The questionnaire included different categories of data: technical, economical, environmental and animal health-welfare status. For most of categories, half (or less) of partners do record data routinely. The latter suggests that data recording may be the first 'innovative' step for the other half of partners. Moreover, an issue to address and consider is to record more data in order to monitor farm performance and make decisions for the future.

2 Innovations for EU sheep and goat sectors

The suitability of farm innovations for European sheep and goat sectors differs for each Member State and production area. The suitability of innovations depend on species (sheep, goat, combined), type of farming (milk, meat), systems (suckler or suckler-fattener / intensive or extensive), types of products (heavy lambs, light lambs), structures (small or large) and importance of the activity within the area (from very important to marginal). Therefore, the identification of innovations that can be tested on farm has to take into account a great diversity of situations.

The diversity in production systems was formed by diverse feed resources and feeding systems, breeds and markets. This diversity caused diversity in products reflecting a natural and typical image. On top of this variation, farmers need to constantly adapt to challenges. This adaptation can be assisted by farm innovations to keep farms competitive under different scenarios. Some common challenges to most sheep and goat production systems in Europe are:

a. Sheep and goat farming is very labour-intensive and requires specific skills. The sector is being hampered by a lack of technical services and training, and those results in very varied levels of productivity;
b. Rural populations are declining whilst farms are expanding. Therefore, labour is getting harder to find.
c. Relative to other agricultural sectors, sheep and particularly goat technology has remained relatively stagnant and neglected from the mainstream research.
d. Incomes are among the lowest in the agricultural industry and depend heavily on public support, with inadequate farm-gate prices and poor monetisation of by-products (wool, pelts, offal, etc.);
e. Increasing costs, particularly for fuel, electricity and feed, together with the electronic identification system to be introduced in 2010, which constitutes an additional cost perceived as being too high in the current situation;
f. Sheep and goat farmers are older than farmers in other sectors, sometime reluctant to make changes and young people are not interested in the business;
g. Big competition from Australia and New Zealand challenges international trade in Europe. Also China is becoming a big competitor, although its high demand represents also market opportunities such as for goat milk.

2.1 Farm innovations

To make and keep the sheep and goat sector competitive, more innovation and technology is required. These innovations need to be developed and tested using multidisciplinary approaches through partnership and co development with all industry actors (Dubeuf, 2011). The latest innovations available in the ruminant sector such as for feeding (precision feeding, novel feedstuffs, new pasture varieties adapted to climate change; Molina-Alcaide & Yáñez-Ruiz, 2008), reproduction (insemination programs…), breeding, and flock management (electronic identification: Caja et al., 2014) have mostly been tested for cattle but not so much for sheep and goats (Dubeuf, 2014). Additionally, the Common Agriculture Policy (CAP) for sheep and goats and how farmers receive support has influenced farm management and adoption of new innovations (Morgan-Davies et al., 2012).

2.2 Innovations for marketing

Although innovations specifically applied to product marketing are not covered in this review as practices to implement on farm, they were discussed at the above-mentioned workshops and the main outcome is presented later. Innovation for marketing such as promotion of sheep and goat products consumption contributes to increased consumption, improved profitability for producers and/or higher prices paid by consumers. Indeed, sheep-meat is at the high end of the food market, as are goat and sheep cheeses. The cost of these measures is limited, compared to the means allocated to direct support; and their use should be increased. However, in case of fresh and frozen meat, the list of products eligible for financial support for a promotional campaign (Council Reg. (EC) No 3/2008) is limited to products that belong to a national or EU quality scheme. Extending the scope of the measure to all sheep and goat products (meat and milk) is likely to support the

sector, no matter if they bear a quality label or not. Therefore, innovations for marketing may be very important for improving the sustainability of European sheep and goat sectors.

3 Innovations for iSAGE

After collecting information on innovations from the workshops and survey, the initial list was organized by grouping those innovations in major categories; then the result discussed at the workshop in Zaragoza and among WP4 partners, resulting in the list presented in this document that represent those that are most suitable to test on case study farms. The case study farms will be from 10 typologies:

i. Sheep: Intensive dairy farms (e.g. high input of purchased feedstuff)
ii. Sheep: Semi-intensive or extensive dairy farms (e.g. normally pasture fed animals)
iii. Sheep: Intensive meat farms (e.g. high input of purchased feedstuff)
iv. Sheep: Semi-intensive or extensive meat farms (e.g. normally pasture fed animals)
v. Sheep: Dual-purpose farms (Farms where the farmer sees value in 2 or more different products e.g. Meat and wool, meat and dairy).
vi. Goat: Intensive dairy farms (e.g. high input of purchased feedstuff)
vii. Goat: Semi-intensive or extensive dairy farms (e.g. normally pasture fed animals)
viii. Goat: Intensive meat farms (e.g. high input of purchased feedstuff)
ix. Goat: Semi-intensive or extensive meat farms (e.g. normally pasture fed animals)
x. Goat: Dual-purpose farms (Farms where the farmer sees value in 2 or more different products e.g. Meat and wool, meat and dairy).

These typologies will have diverse climates, feed, cultures, breeds and management but will require different types of innovations. Therefore, when describing potential innovations, we will indicate for which typology they are relevant. This review intends not only to list the potential innovations and the type of farms where they can be more suitable but also to identify some potential constraints associated with their implementation. Moreover, it will provide examples of projects and institutions that are working on developing and testing such innovations. The ultimate goal is to help iSAGE industry partners to make decisions about the innovations to test on case study farms (task 4.2.). Further, some farming practices may have been fully implemented in some farm typologies (or 'elite' farms) but yet they would represent an innovative practice in others. iSAGE will facilitate the transfer of the potential "innovations" to other partners but also will make the relative technology available to interested parties across Europe. Therefore, a wider implementation will also be considered in task 4.2.

Although this review only covers farm management innovations, other innovations related to product processing, marketing and organization were discussed and recorded as part of the project meetings and online survey.

The innovations include farm management and technology associated actions within the following categories:

3.1 Farm management

All innovations collected from workshops and the survey were categorized based on which typology/region they are relevant. These categories include dairy or milk (D/M), sheep or goat (S/G), climatic zone (Mediterranean only = MED, all = ALL), intensive or extensive (INT/EXT). Innovations were also rated according to their applicability (APP; L = low, M = medium and H = high) and suitable for organic farming (OF; Y = yes, N = No).

3.1.1 Pasture

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS	EXAMPLES
Improve grazing practices	D/M	S/G	ALL	EXT	H	Y	Good to include in 1 typology or in a few case studies. Requires minimum extra technology because it refers only to management changes/Time is required to measure impacts, i.e., pasture measurement or environmental impacts	Implementation of high-throughput feed evaluation techniques (NIRS, FTIR). FP7 Legume-Future
Improve pasture quality	D/M	S/G	ALL	EXT	H	Y	Time consuming, costly and difficult to assess without thorough measurements. Limited - only if farmers are doing already. Plenty of scientific literature but less experience on commercial implementation	Use of new plant varieties / species /mixtures with higher yield or resilience (Legumes, high sugar grasses, shrubs). FP7 project Multisward (www.multiswrad.eu)
Improve forage quality in semiarid areas	D/M	S/G	MED	EXT	H	Y	Limited – subject to being already implemented by farmers. Time consuming and costly; difficult to measure without thorough measurements	Improve forage harvesting and processing practices to rise its nutritional value / Use of silage enhancers
Better use of by-products	D/M	S/G	ALL	INT	H	Y	Some products are already used by industry partners; identify those farmers and make comparison with others that do not. High moisture content/ seasonal/Spoilage and conservation/ Anti nutritional factors/ effect on product quality/presence of phytochemical residues.	FP7 SOLID Project studies and results (www.solidairy.eu)

Improve meeting animal requirement and supply	D/M	S/G	ALL	INT	H		Requires farmer training to understand animal requirements and how to address them. Innovation could be technical advice by nutritionists. Difficult to measure impacts, however case studies with farmer feedback on how management changes might be satisfactory	Implementation of high-throughput feed evaluation techniques/Grouping animals with similar requirements/Use of Total Mixed Rations FP7 SOLID Project: forage feeding tool (www.solidairy.eu) as example developed for cattle.

3.1.2 Health

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS	EXAMPLES
More sound and scientific proven use of antibiotic alternatives in feeding	D/M	S/G	ALL	INT/EXT	H	N	Lack of scientific knowledge and high level of misunderstanding within the sector (feed additives, farmers and advisors). May be difficult to measure impacts within time frame of project.	Secondary plant metabolites/rumen anti-microbial (tannins, essential oils), FP7 Eurolegume project (www.eurolegume.eu)
Identification tests (faecal/saliva samples)	D/M	S/G	ALL	INT/EXT	L	Y	Easy tests to do on farm. May require vets/labs. Cost/Speed of the test/Sampling limitations.	Coccidiosis/liver fluke and other emerging diseases due to climate change
More regionally integrated plans in place	D/M	S/G	ALL	INT/EXT	M	Y	Initiate discussion about how regional plans can improve health management. Perhaps 1 bigger case study. Difficult to test on farms and measure impact / Bureaucracy	Engage with local health authorities (Brucellosis/ Tuberculosis /Maedi Visna)
Use of sensor RFID ear-tags as welfare indicators	D/M	S/G	ALL	IN/EX	M	Y	Sensors to measure acute stress to ascertain link between welfare and meat or milk quality / animal performance. Reduction in use of pharmaceuticals. Constraints - Cost and farmer training.	Prototype in Turkish case study farms measuring direct parameters, ie. body temp, heart rate, oxygen saturation and blood pressure.
Cortisol Hair analysis	D/M	S/G	ALL	IN/EX	H	Y	Measuring chronic stress indicators for resilience / performance and reduction in use of pharmaceuticals. Constraints - Access to suitable labs.	Fairly cost effective measure as welfare indicator caused by environmental and/or management factors. Links already evident for

								lamb meat quality in Turkish farms.

3.1.3 Reproduction

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS	EXAMPLES
Improved fertility through better quality of frozen semen	D	G	MED	INT	L	N	Can easily be tested on farms - especially those that already use. Might be expensive	Comparison/exchange knowledge between breeding / farmers associations within iSAGE
Assisted reproduction techniques	D	G	MED	INT	M	N	Lack of data regarding the number of farms using this method. It is not a common practice.	Comparison/exchange knowledge between breeding / farmers associations within iSAGE
Better use of rams and reproduction plans	D/M	S/G	ALL	INT/EXT	H	Y	Easy assessment. Difficult to measure objective impact in 3 years	Coordination of dairy goats selection programs and elite males by CABRANDALUCIA (www.cabrandalucia.com)

3.1.4 Breeding

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS	EXAMPLES
Routine data collection (recording programmes)	D/M	S/G	ALL	INT/EXT	H	Y	Critical - many farmers using some, can provide alternatives. Intensive case studies critical. Getting farmers to use routinely. Language barriers still to be resolved	Use of auto drafts which read tags, collect weights and draft animals into different groups (e.g. Litams)
Use of elite flocks (link to AI)	D/M	S/G	ALL	INT	L	N	1 or 2 case studies with farmers already using. Difficult to measure impact in 3 years.	Engage with breeding associations for getting data
New traits to increase resilience and hardness (longevity, fertility, health)	D/M	S/G	ALL	INT	M	N	Tested in WP5. Not required in WP4 farms.	

DNA data collection and use in programs	D/M	S/G	ALL	INT	M	Y	Linked to routine data collection. Difficulty of data analysis and interpretation.	

3.2 Farm technology

3.2.1 Information & training

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS	EXAMPLES
Integrated and easy-to-use tools	D/M	S/G	ALL	INT/EXT	H	Y	Informative production data recording. Difficulty to compare across methods	
Access to abattoir feedback on carcass quality and health	D/M	S/G	ALL	INT/EXT	L	Y	Depends on the data provided by the abattoir. Depends on if case study farms have access to feedback	
Tools to monitor BCS and pasture state	D/M	S/G	ALL	INT/EXT	L	Y	Easy to teach and tools available. Farmers need to do some extra work	
Application to decide max/min number of animals	D/M	S/G	ALL	EXT	L	Y	Easily applied. May be difficult to get farmers to change	The 'HAPPY GOAT' application (www.happygoat.eu)
Training on maximizing breeding programs and resources	D/M	S/G	ALL	INT/EXT	M	Y	Important and cheap to do. Requires time and patience to learn (and teach). It will be covered in WP5.	Regional courses organized by CABRANDALUCIA for goats farmers (www.cabrandalucia.com)

3.2.2 Gadgets / apps

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS
GPS control	D/M	S/G	ALL	EXT	M	Y	Very applicable. Expensive and difficult to safely use on animals, Difficult data interpretation or improvement
Drones	D/M	S/G	ALL	EXT	L	Y	Can use case study if identify farmers already using. Expensive
Temporary electric fencing in mountainous areas	D/M	S/G	ALL	EXT	M	Y	Very applicable. Difficult to measure impact. Can collect farmer experiences
Electric identification systems	D	S/G	ALL	INT	M	Y	Very applicable and already trialled
On-farm data collection linked to animal ID	D	S/G	ALL	INT	H	Y	Very applicable
Automatic animal handling	D/M	S/G	ALL	INT	M	Y	Very applicable. More developed for sheep than goats
Animals stress automatic sensors	D/M	S/G	ALL	INT	H	Y	Applicable for animal welfare, very important if works. Still needs some work for sheep/Not available on farm at the moment
App to collect animal welfare indicators	D/M	S/G	ALL	INT	M	Y	Applicable - linked to data measurement and stress sensors. Time constrains to develop and implement the app
Electronic microchip readers and automatic milk recording systems for individual milk production.	D	S/G	ALL	INT	H	Y	Very applicable and should be included in case study farms. More developed for sheep than goats

3.3 Product processing and marketing

3.3.1 Product processing

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS
Low fat / Omega 3 enriched products	D	S/G	ALL	INT/EXT	M	N	Difficult through nutrition means. Expensive as food technology
Freeze drying for longer storage and exportation to China	D	S/G	ALL	INT/EXT	H	Y	Expensive but highly demanded based on current and future demand from China
Goats milk (whole, semiskimmed-..)	D	S/G	ALL	INT/EXT	M	Y	Needs marketing to make consumers aware of
Vegetable rennet	D	S/G	ALL	INT/EXT	M	Y	
New products (youghurt, pudding)	D	S/G	ALL	INT/EXT	H	Y	Requires working on consumers to know the product
New, smarter packaging	D/M	S/G	ALL	INT/EXT	H	Y	
New cuts / products (some targeting young consumers)	M	S/G	ALL	INT/EXT	H	Y	
Innovation to increase halal slaughtering	M	S/G	ALL	INT/EXT	M	Y	Concerns about animal welfare may arise
High standard animal welfare measures to improve quality of product at processing	M	S/G	ALL	INT/EXT	M	Y	
Stress free slaughter for improved meat quality	M	S/G	ALL	INT/EXT	M	Y	

3.3.2 Product marketing

INNOVATION	D/M	S/G	CLIM	INT/EXT	APP	OF	TESTABILITY/CONSTRAINTS
Promote fresh sheep and goats products	D/M	S/G	ALL	INT/EXT	H	Y	These products are normally more expensive. Need to be a collaborated approach and target a big enough (and sustained over a period of time) population to have an impact in the sector
Better use of the environmental and social aspects of sheep farming in the marketing of sheep meat.	D/M	S/G	ALL	INT/EXT	H	Y	Need to be a collaborated approach and target a big enough (and sustained over a period of time) population to have an impact in the sector
Branding and provenance of products for more local and direct markets	D/M	S/G	ALL	INT/EXT	H	Y	
Attractive branding, greater differentiation of product,	D/M	S/G	ALL	INT/EXT	H	Y	
Improved labelling and product recognition in catering outlets	D/M	S/G	ALL	INT/EXT	H	Y	
Certification	D/M	S/G	ALL	INT/EXT	M	Already certified	Expensive
New recipe books	D/M	S/G	ALL	INT/EXT	H	Y	
More collaboration with export destination countries and development of export opportunities.	D/M	S/G	ALL	INT/EXT	M	Y	Requires involvement of multi actors at different levels
Increase internationalization	D/M	S/G	ALL	INT/EXT	M	Y	Requires investing time and skilled staff
Explore expanding alternative markets (middle east)	D/M	S/G	ALL	INT/EXT	H	Y	
Reko-market (makes a short chain from farm to consumers),	D/M	S/G	ALL	INT/EXT	M	Y	

4 Conclusions and future actions

iSAGE researchers and their 18 industry partners have identified potential innovations to increase farm sustainability that can be tested on case study farms. These innovations are a summary of workshop and online survey results and have been narrowed down based on their applicability to test on farms. However, the final list of innovations that will be tested and monitored on farm within the lifetime of the project will be selected based on:

- Farm production and financial records collected by sheep and goat groups and managed within work package 6 to identify what the 'leaders' in the goat and sheep industry do.
- The constraints, potential applicability and other considerations included in this report will be presented to the industry partners to discuss the most suitable innovations to test using either existing or new data. These points will be discussed at the next 6 monthly iSAGE meeting with stakeholders and industry partners as part of task 6.1., which is scheduled for January 2017.
- A clear separation will be made between purely innovative actions with little research conducted and those that have plenty of research published but problems are of implementation.

Therefore, this list of innovations is just the starting point for a selection process for testing some innovations on farm.

iSAGE and work package 4 will begin trialling these innovations in the first year of the project. These innovations will be expanded to include new innovations found from work package 1, 2, and 5. The testing of innovations will involve farm visits for the design of the study and data collection. Both the duration of the case studies and the frequency of the farm visits will depend on the type of the innovations to be tested and could run from 3 months for short term innovations/solutions or up to 3 years for long term innovations/solutions. iSAGE participants will first demonstrate the innovations to the farmer, collect information throughout the case study period with on farm visits and get feed back from farmers about how easy the innovation is to use and how effective it improved sustainability.