Deliverable No: 4.2

Summary of future challenges and update to the review of farm management innovations

Project acronym: **iSAGE**
Project full name: **Innovation for Sustainable Sheep and Goat Production in Europe**
Grant agreement number: **679302**
Start date of project: **1 March 2016**
Duration of project: **48 months**
Project website: **www.iSAGE.eu**

Working Package	4
Short name of lead participant	CSIC
Other Partners Participating	AUTH, CITA
Type* **(R, DEM, DEC, OTHER)**	R
Dissemination level** **(PU, CO, CI)**	PU
Deliverable date according to Grant Agreement	28/02/2019
Actual delivery date	28/02/2019 (updated version 11/6/2019)
Relevant Task(s)	4.1
Report version	2

*Type: **R** = Document, report (excluding the periodic and final reports); **DEM** = Demonstrator, pilot, prototype, plan designs, **DEC** = Websites, patents filing, press & media actions, videos, etc.; **OTHER** = Software, technical diagram, etc.

Dissemination level: **PU = Public, fully open, e.g. web; **CO** = Confidential, restricted under conditions set out in Model Grant Agreement; **CI** = Classified, information as referred to in Commission Decision 2001/844/EC.

Authors of this Report	**David Yañez-Ruiz[1], Alejandro Belanche[1], Gus Rose[2] and Daniel Martín-Collado[3]** *[1]The Spanish National Research Council (CSIC), Spain,* *[2]Aristotle University of Thessaloniki (AUTH), Greece* *[3]Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Spain* *Correspondence: david.yanez@eez.csic.es*
Date	28-02-2019

Abstract

European sheep and goat sectors have diverse challenges that are reducing participation, production and long-term sustainability. Before finding strategies to counteract these challenges, the diversity of the challenges needs to be characterised to understand which are the most relevant and easy to change. Additionally, the stakeholders responsible for driving this change also need to be identified to develop robust strategies to reverse the effects of the most important challenges.

A range of challenges were identified using a multi-stakeholder approach with stakeholders from European and Turkish sheep and goat sectors. These stakeholders were farmers, researchers and people that work in the sheep and goat industries, often representing farmer or breeding organisations.

The challenges were split into external threats and internal weaknesses using the SWOT framework. Internal weaknesses are those that need to be minimized internally on the sheep and goat farms whilst external threats are more difficult to minimize because they hamper the performance of the sector in general.

Based on the priority index, the top 10 most important challenges included 5 internal weaknesses and 5 external threats. The most important internal weaknesses were;

1) Low promotion of local breeds
2) poor business management training
3) Low professionalization
4) Slow adoption of innovations
5) Low adaptability of high producing breeds.

The external threats were

1) Low consumer education in product
2) :ow consumer knowledge in products
3) Researchers not address real problems
4) Unfair trade, lack of traceability
5) Poor recognition of public services

It was clear that internal weaknesses need more action from the sector itself (farmers and associations), while external threats require a strong involvement of Governments. Moreover, it was noted that a combined action of government, farmers and associations of producers should take place to address these challenges.

Table of Content

1 Introduction 4

2 Methodology 5

2.1 Multi-stakeholder consortium 5

2.2 The participatory process to collate, discuss information and design surveys 5

2.3 Statistical analysis of surveys outcomes and SWOT framework 9

3 Results and discussion from surveys 10

3.1 Relevance of challenges 10

3.2 Easiness to address challenges and priority index 29

3.3 Stakeholder to take action 30

4 Update of farm management innovations 31

5 Conclusions and recommendations 35

1 Introduction

Sheep and goats in Europe have important economic, environmental, social and cultural roles. The high-quality, traditional products are perceived to be produced in a sustainable and multifunctional form of agriculture that contributes to preserving the environment and social cohesion in rural areas.

Yet, the EU sheep and goat sector has been experiencing economic and structural difficulties in recent decades. These difficulties have caused a consistent decrease in livestock numbers following outbreaks of contagious diseases and policy changes in public funding schemes. The EU has about 98 million animals and a production that accounts for a small share of the total EU livestock output. Therefore, the sheep and goat sector does not ensure self-sufficiency. Many farmers are currently becoming discouraged and leaving the sector because of a combination of socio-economic reasons. Moreover, as sheep and goat farming is among the less remunerative agricultural activities, it does not encourage investments or new entrants from younger generations of farmers.

Some EU-level policy instruments provide support to this sector to deliver both food and public goods, such as landscape and biodiversity conservation. These instruments, however, struggle to support the industry because of its low profitability and location in less favoured areas. Therefore, EU stakeholders are demanding the inclusion of specific policy measures in current discussions on the Common Agricultural Policy post-2020 and the adoption of communication and promotion measures to strengthen the position of the sector for EU consumers' choices.

The project H2020 iSAGE (Innovation for Sustainable Sheep and Goats in Europe) envisages to contribute in making the European Sheep and Goat sectors more sustainable, competitive and resilient. Part of the project activities is to identify and quantify the importance of the current and future challenges that may compromise the sustainability of sheep and goat industry in Europe. Moreover, these challenges need to be linked with potential innovations that can be tested on farm. To identify and quantify these challenges, iSAGE uses a participative multi-stakeholder approach with industry and research institutions working together.

This multi-stakeholder approach is required when dealing with complex and multi-side systems as the European sheep and goat sector to understand how to create change, implement research, and facilitate new ways of thinking (O'Brien et al., 2013). Integration and perceptions of knowledge affect how problems are identified and framed, the capacity for generation of innovative and practical solutions, the relevance of outcomes to policy and the extent of participation in learning (Bracken and Oughton, 2013). Traditional assumptions of researchers as the sole producers of knowledge are increasingly being replaced by activities that include multi-way interaction and co-production of knowledge between researchers, decision-makers and other beneficiaries of science (Francis and Goodman, 2011).

This report describes the participatory multi-stakeholder process used within iSAGE to identify and quantify the main challenges that the sheep and goat sector faces in Europe, the perception of the relevance of such challenges throughout the different sector stakeholders, the difficulties to address such challenges and the different stakeholders that need to take action to address them. The identification and quantification of all these aspects considers the differences that might exist among production systems and goals within and across European regions and social sectors.

This exercise was run in parallel with the study conducted within tasks 2.1 and 2.2 which are described in Deliverable 2.1 (Report on participatory case study research on farmers). The objective of this study was to record farmers' views regarding farm characteristics and geographic,

demographic and other socio-economic changes in sheep and goat farming communities which are most likely to constrain or favour the development and the multidimensional sustainability of sheep and goat sector. The link with main outcomes from Deliverable 2.1 and those from 4.1 are discussed in section 3.1.

2 Methodology

2.1 Multi-stakeholder consortium

iSAGE multi-stakeholder network included farmers, farmer associations, researchers and industry organisations that work directly with farmers or farmer groups (www.isage.eu). The researchers and industry organisations in iSAGE have diverse roles and represent the sheep and goat industries in a variety of ways (Table 1). All these stakeholders took part in the participatory process described in detail below. The multi-stakeholder approach aims to provide the analysis with a comprehensive wide of the sector challenges that goes beyond unidirectional views of individual stakeholders.

Table 1 Types of sheep and goat organisations that are included in the iSAGE project.

Stakeholder type	Description	Number
Farmer/breeder group	Co-operative that assists and works with farmers or breeders directly i.e. manages breeding program, records data and advisors farm management	10
Farm	Commercial farms or breeders that work with research institutions	3
Industry	Large organisation that represents the commercial interest of farmers, including promotion, marketing and dissemination	4
University	Research group from a University that specialises in sheep and goats	5
Public research	Research group from a public organisation that specialises in sheep and goats	5
Farmer research	Non-profit, non-governmental research organization funded by farmer levies	3

2.2 The participatory process to collate, discuss information and design surveys

Identifying and quantifying challenges to European sheep and goat sectors followed several stages (Figure 1):

a) Stage 1 involved **collation of information** from work packages 1 and 2 within iSAGE, literature review of existing EU reports (IP/B/AGRI/IC/2007_043; Ares(2011)1350301 - 13/12/2011; 2017/2117(INI); specific description of the sheep and goat production sector in each participating

country (Greece, France, Spain, UK, Italy, Finland and Turkey) and semi-structured interviews with farmers.

The description of sheep and goat production sectors in each country identified challenges and priorities from researchers and industry representatives from 12 public and private organisations. The organisations compiled a list of challenges and priorities using a review of literature, national documents and surveys of stakeholders. These reports provided an indicative picture of the structural and technical characteristics of the sheep and goat sector (number of farms, number of animals, breeds, main production systems, etc.). Moreover, some generic information was provided regarding the main sheep and goat products and their consumption trends, the impact of agricultural policy on the development of the sector and applied management practices observed. This exercise gathered information that was presented in a first document for discussion (***Annex 1***). The main challenges identified in this exercise are presented in Table 2 and categorised as 'technical/social', 'environmental', 'market' and 'policy/financial'.

Table 2 Technical/social, environmental, market and policy/financial challenges identified during first review of iSAGE research and industry partners.

TECHNICAL / SOCIAL	**ENVIROMENTAL**
• Lack professionalization • Slow adoption technology • Poor Business management training • Low Competitiveness • Unattractive for young farmers • Fragmented sector	• Climate change threats, • Low adaptation of high productive • Future environmental policy Local breeds
MARKET	**POLICY/FINANCIAL**
• Volatility of commodity prices Uncertainty meat/milk prices • Low consumers demand • Low farm incomes	• Dependency on CAP and other subsidies • Future changes in CAP system

Additionally, 33 sheep and 14 goat farmers were interviewed using semi-structured interviews in Finland, France, Greece, Italy, Spain and the United Kingdom. Farmers were asked about the importance of farm management, environmental conditions, animal productivity, health, nutrition, pasture management, social issues, succession, future plans and policy support measures. The interviews were explorative and these questions were covered within four main topics

1) How changes in local area/environment have affected farms and their management
2) Constraints for the development of farms and how they will change farming in the future
3) Opportunities and threats for farmers
4) Priorities for sheep/goat farming that should be improved or studied

The results of the semi-structured interviews helped identify what farmers thought were the key challenges for their sheep and goat industries.

b) Workshop 1: A first workshop was held in Bilbao (24th May 2018) to discuss the first list of challenges and to collect suggestions for other challenges to be included. The workshop was done with 3 small groups of around 15 people each. Groups were arranged to have a homogenous distribution of researchers and industry representatives and the discussion was structured as follows:

1) Introduction to clarify all participants' expectations and the process,
2) Reflect on participants views on suggested challenges,
3) Propose other issues that are not covered by the presented list and
4) Summarize the main findings from the discussion to ensure the message was taken correctly.

Each discussion group discussed the four categories. There were common challenges identified by all groups and some challenges only identified by specific groups. Each discussion group lasted for 45 minutes.

The workshop was part of the National iSAGE meeting, held in Bilbao (24-25th May 2018) and involved 64 participants from 7 countries, 14 from academia and 14 from the industry. Table 3 includes the additional issues suggested to the initial list presented at the beginning of the workshop.

Table 3 Additional issues suggested by participants of workshop 1 in Bilbao.

Suggested additional issues
• Lack structured advice technical support • Society awareness of farmers role • Increasing resistance to parasites • Low female involvement in farming/rural depopulation • Land access (environmental regulation, urbanization) • Wildlife conflicts (wolfs, wild board) • Lack integration agriculture and livestock • Low access to capital • Lack traceability • Market concentration • No education on consuming local / sheep/goats products • How public service is measured • Policy implemented with no scientific evidence

c) Developing the Survey:

A survey was developed using the challenges identified from the outcomes of the reports from each country, the semi-structured interviews with farmers and the first workshop. Thirty challenges in total were selected based on previous analysis and the outcome of the discussions distributed in four areas as described in Table 4.

Table 4 List of challenges included in the assessment survey

TECHNICAL / SOCIAL	**ENVIROMENTAL**
• Lack professionalization • Slow adoption technology • Poor Business management training • Low Competitiveness • Un-attractive for young farmers • Fragmented sector • Lack of integration /cooperation • Female involvement • Societal awareness of farmers role • Researchers do not address relevant issues • Parasites resistance	• Climate change threats, • Low adaptation of high productive breeds to new environments • Future environmental policy may limit intensification • Conflicts with wildlife • Land access • Lack integration agriculture with livestock • Well established breeding programmes for local breeds

MARKET	POLICY/FINANCIAL
• Volatility of commodity prices Uncertainty meat/milk prices • Low consumers demand • Low farm incomes • No education on consuming local products • Unfair trade/lack traceability • Market control by few companies • Low farm income, access to capital • Lack society knowledge on sheep/goat farming	• Dependency on CAP and other subsidies • Future changes in CAP system • Recognition and valuation of public services of livestock farming • EU policy/measures launched with no scientific evidence

From the 30 identified challenges, the WP4 iSAGE team developed questions to ensure consistency in interpretations of questions and data collection. The types of knowledge exchange and evaluations were diverse so questions were kept mostly simple to help understand and score. Three questions were then developed for each challenge

1) Assess the perception of the **relevance** using the following scale: 1=Very low, 2=Low, 3=Medium, 4=High and 5=Very high
2) Evaluate the **easiness** of addressing each challenge using the following scale: 1=Very difficult, 2=Difficult, 3=Medium, 4=Easy and 5=Very Easy; and
3) Identify the main **stakeholders** (from a provided list) that should **take action** to tackle the problem. The list of stakeholders potentially to select included: Government, Associations of producers, Farmers, Consumers, Retailers, Academia and processing industry. Participants could select as many as necessary, not just one.

The survey was designed to be completed in 10-15 minutes and requested the following information: animal SPECIES of expertise (sheep or goat), PRODUCT (meat or milk), PRODUCTION SYSTEM (extensive, semi-intensive or intensive), name of ORGANIZATION and COUNTRY

The questionnaire was distributed among all project partners and was completed by 90 participants, which included researchers (40), co-operatives and breeding and producer associations (23). In addition 27 questionnaires were filled by National Advisory Committees nominated by each country participating in the project (UK, France, Italy, Greece, Finland, Turkey and Spain). The private sector (33) was represented by breeding associations, farmers associations, cooperatives and farmers and the public sector (57) was mainly represented by research organizations and universities. These Committees included 4-5 people recognised for their knowledge in their respective country of the sheep or/and goat sector and included policy makers, managers of cooperatives, veterinarians and researchers.

The criteria in the selection of the Committees´ members was set to balance between sheep/goats, meat/dairy, intensive/extensive systems according to the specific relevance in each country

d) Workshop 2

Preliminary results of the challenge survey were discussed during the iSAGE industry meeting in Birmingham on the 26th August 2018. Participants of the workshop were asked if they thought that outcomes of the assessment correspond with reality and if some important challenges were missing.

Additionally, workshop participants were asked what could be done with current innovation case studies to help facing challenges and what key outcomes they thought would be useful and if there were missing any gaps. During this discussion, industry partners where given a list of the most important challenges for the sector according to the survey. Participants where asked to propose action or activities that they thought could help address those challenges. For each action/activity proposed it was described

its limitations, the reason why it is not implemented to a large extend yet, the stakeholder that should lead those actions and the specific role that farmers and industry should play.

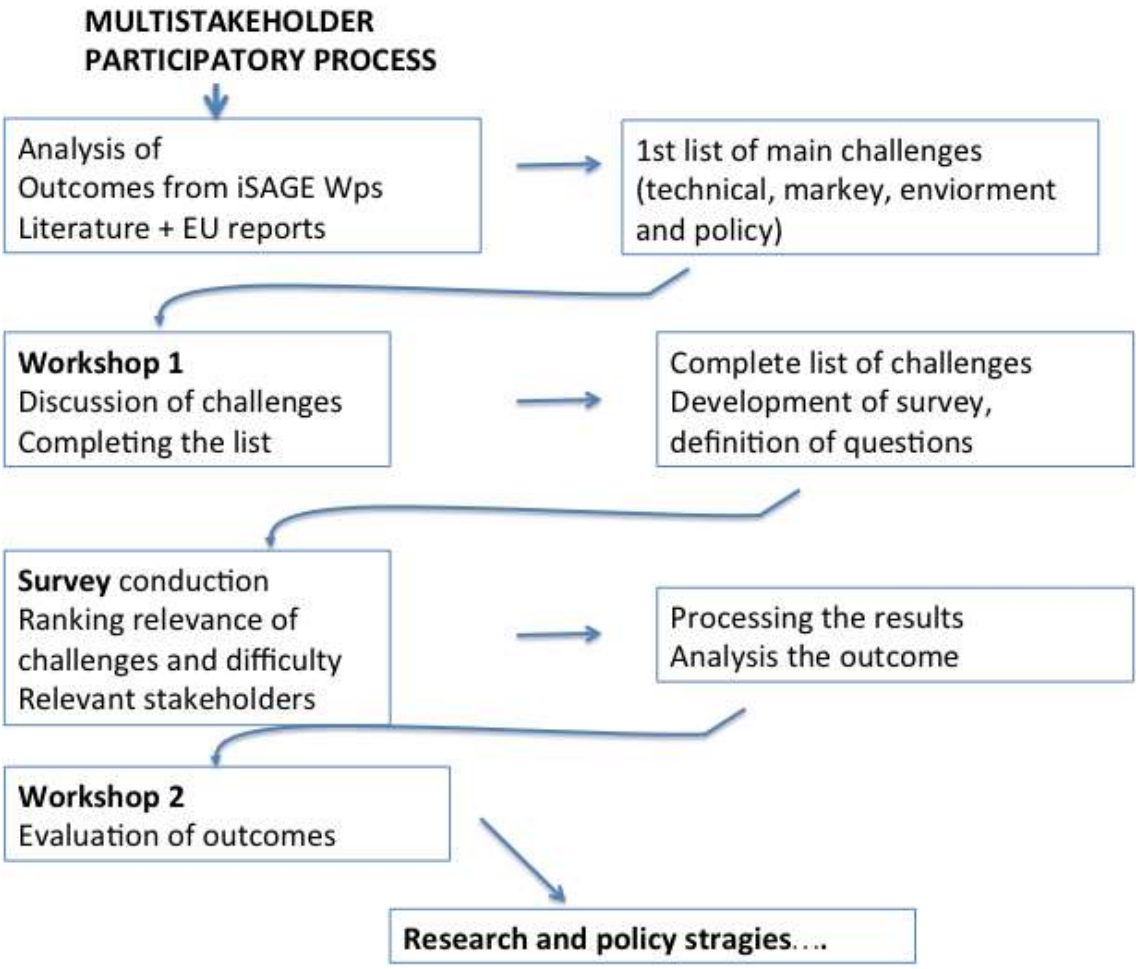


Figure 1 Graphical representation of the multi-stakeholder participatory process followed in iSAGE

2.3 Statistical analysis of surveys outcomes and SWOT framework

The Ninety stakeholders from European small ruminant sector were surveyed to determine the weaknesses and threats that affect to this sector. For the analysis, the countries were grouped into two main regions representing Mediterranean Europe (Greece, Italy, Spain and Turkey) and Central Europe (France and UK) to consider the social-geographical-climatic differences that might affect the importance of challenges.

Each individual challenge / threat was analysed using a multi-factorial ANOVA using the model:

$$Yijklm = \mu + Pr_i + Sp_j + Sy_k + Re_l + Se_m + Co_n + (Pr\times Sp)_{ij} + (Pr\times Sy)_{ik} + (Pr\times Re)_{il} + (Sp\times Sy)_{jk} + (Sp\times Re)_{jl} + (Pr\times Sy\times Re)_{ikl} + e_m$$

Where Y is the dependent variable which represent one challenge or threat, μ is the overall mean, Pr is the fixed effect of the type of product [dairy (n=61) vs meat (n=29)], Sp is the fixed effect of the livestock species [sheep (n=60) vs goats (n=30)], Sy is the fixed effect of the production system [intensive (n=25) vs semi-intensive (n=31) vs extensive (n=34)], Re is the geographical region [Southern Europe (n=69) vs Central Europe (n=21)], Se is the fixed effect of the sector [public (n=57) vs private (n=33)], Co is the random effect of the country considered as a block [France (n=14) vs

Greece (n=18) vs Italy (n=6) vs Spain (n=37) vs Turkey (n=8) vs UK (n=7)] and e is the residual error. Differences of $P < 0.05$ were considered as significant and $0.05 < P < 0.1$ was considered as a tendency.

A priority index (PI) was calculated to identify the priority threats and challenges in the European small ruminant sector that needs to be addressed. This index was calculated by multiplying the relevance of a given challenge and the easiness to address. This PI index identified challenges which are relevant and easy (or not very difficult) to solve, therefore those in which most effort should be invested.

Internal and external factors

The development of the sheep and goat sector is a complex problem as it integrates economic, social, environmental and technical challenges, and involves many different stakeholders. To solve complex problems we first need to understand how to face challenges and specifically how they can be controlled and by whom. One of the most widely used tools to make strategic decision to solve complex and multifaceted challenges is the SWOT analysis (Helms and Nixon, 2010). In this analysis, factors affecting a particular situation or problem were split into **internal** and **external** factors. Internal factors refer to the attributes of the sector that can be exploited (strengths) or should be minimized (weaknesses) to achieve a goal. External factors are features that foster (opportunities) or hamper (threats) the performance of the sector. The two groups of factors also differ by the degree of control that we have on them. External factors cannot be controlled or modified, while internal factors can be managed to alter the current situation.

We identifying internal and external challenges because they might have different strategies lead by different stakeholders to cope with them. We were dealing with challenges, in the analysis we referred to weaknesses and threats. We considered that internal challenges (weaknesses) are those issues that are related directly to farmers, farms and farming systems and therefore that are to a great extend under the control of farmers and farmers institutions; a) farm level, b) sector level, c) relative to some systems. Conversely external challenges (threats) are those that are theoretically out of the control of farmer and farmers institutions. External factors are grouped into

1) Social,
2) Market,
3) Political,
4) Production factors,
5) Environmental and
6) Scientific challenges.

3 Results and discussion from surveys

3.1 Relevance of challenges

Six out of 30 challenges were relevant or very relevant (average scores ≥ 4) (in order of relevance): 1) Uncertain meat & milk prices, 2) Volatile commodity prices, 3) Poor incomes / difficulty to access to capital, 4) low youth involvement, 5) high subsidy dependency and 6) uncertainty in future changes in subsidies. All (but low youth involvement) refer to external threats, which are out of the control, or are extremely difficult to be managed by farmers (and or farmer institutions), reflecting a perception of the sector of having a weak position to deal with the most important challenges that

the sector faces. This highlights the need to involve different stakeholders (specially governmental institutions) in the strategic solutions to propose.

The perception of the relevance of **internal weaknesses** differed between dairy vs. meat production systems and south vs central European countries, while **external threats** were mainly perceived differently among systems (**Table 5**). Participants from dairy systems perceived internal weaknesses associated to the sector and farm level more relevant than those from meat production systems. Likewise, internal weaknesses were considered more relevant in south vs. central European countries as well in extensive as compared to more intensive production systems. The goat sector, in comparison to the sheep sector, was perceived as having higher internal weaknesses derived from the farm structure, whereas the sheep sector was perceived as having higher external threats associated to the society. The farm intensification level had not effect on the relevance of internal weaknesses but it showed a decreasing relevance of the external threats as the level of intensification increased. Both sectors (public and private) had a similar view about the relevance of internal weaknesses and external threats as no differences were noted across sectors.

The sheep and goat sector is very fragmented and the main characteristics vary for each Member State, or even for each production area: 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), importance of the activity within the area (from very important to marginal) (Ares(2011)1350301 - 13/12/2011). Our survey indicated that this fragmentation may be more of a threat for the dairy sector, probably in relation to the complexity of the market as compared to meat. Also, the highly fragmented production models in Mediterranean countries, in comparison to those in central Europe, may explain the difference in perception across geographical locations countries.

For the four categories of challenges considered in the survey (**technical/social, market, environmental** and **policy**), the perception between the different expert groups varied substantially (**1Significance:** † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 6, **Table 7**, **Table 8** and **Table 9**).

These challenges were significantly more relevant for **dairy systems than meat systems**, with the exception of low consumer demand.

The consumption of lamb in Europe, particularly in northern Europe, is beset by a poor image and high prices. Sheep is perceived to be traditional meat that is difficult to cook and has a taste that's not to everyone's liking (Ares(2011)1350301 - 13/12/2011). In particular the consumption of lamb by young consumers is decreasing. Products such as leg of lamb or stewing lamb have no appeal to single people or young couples, as they are often family-sized portions and cuts that are complicated to prepare or need to be cooked for a long time. It is interesting to note that when new products are introduced to the market that are specially aimed at young consumers, such as ground lamb in the United Kingdom or émincé of lamb in Ireland, sales increase rapidly, which suggests low consumer demand can be addressed by offering new products.

All challenges were perceived as equally relevant between **sheep and goat sector**, with the exception of high subsidy dependency, limited land access, slow adoption of technology, low female involvement and low integration between livestock and agriculture. Interestingly, participants from sheep sector perceived the high dependency on subsidy as more relevant than those from goat systems while those from goats scored higher the problem of slow adoption of technology. The higher score on subsidy dependency in sheep vs. goats needs to be carefully considered at EU level (and probably across different regions) to assess the potential impact of future changes in CAP in case sheep farmers' income is less reliant on the subsidy support.

For the adoption of technology, in the last decade, the goat sector has undergone a series of changes that have evolved it towards greater development of farmers´ skills and professionalization of the sector. Despite this change, there is still great heterogeneity of production systems, breeds used and farmers' training levels. Goat production systems range from traditional systems, with flocks of meat or dual-purpose (meat and milk) animals, to more specialised systems in dairy production, featuring advanced technology. Family businesses are the norm and hired labour is rare. This may explain why livestock newly developed technology is still not being adopted in the goat sector as quickly as in the sheep sector.

Regarding female involvement, the expert group´s perception was that it represents a more relevant challenge for the sheep than for the goat sector. This observation, together with the greater relevance of this challenge in extensive systems seems to suggest that systems less suitable to mechanization (e.g. extensive dairy goats) have lower female involvement than systems with a greater automatization (e.g. intensive dairy goats).

Our results suggest that despite the differences between sheep and goats farming described above, they are similarly exposed and affected by most problems and barriers within the EU.

The relevance of a number of challenges depended on the level of intensification of the farm system. In general, the extensive farming systems were perceived as more vulnerable to a number or challenges and threats such as low competitiveness, low female involvement, increasing sanitary issues, low consumer demand, lack of traceability, climate change threats, wildlife conflicts or limited access to land. Moreover, the relevance of these challenges progressively decreased for semi-extensive and intensive systems suggesting that the intensification can help to tackle some of the abovementioned challenges and threats.

Differences in relevance between the country-region (south vs. central) were significant for many issues, especially with regards to technical/social and environmental challenges. Participants from

southern countries scored technical/social & environmental challenges as more relevant than those from central countries, with the exception of increasing sanitary issues, youth involvement and wildlife conflicts. These differences should be interpreted with caution as the interaction between country region and type of product was significant for many variables, which indicated that the differences across countries are not necessarily are explained only by region specific issues but by the relevance of dairy or meat systems within the country.

Whether the participant was working in public or private institution did not show any relevant significance on perception of relevance across the different categories, with the exception of those related to subsidy dependency and uncertainty in changes in future policies, which were scored as significantly more relevant within the public sector.

As mentioned in the introduction, a parallel study was undertaken in tasks 2.1 and 2.2 to gather farmers' views on the sector sustainability using qualitative and quantitative farmers survey across Europe. The results of the interviews showed that the improvement of the market for sheep and goat products was the most common priority that was identified by the interviewed farmers. On farm diversification, and in particular processing and direct selling, seem to represent a valuable source of income for some farmers, helping them to continue the agricultural production activity. Also, the interviewed farmers framed the climate change issue in different ways. Farmers related climate change with a number of different environmental/management problems, especially water scarcity, flooding, increased animal diseases, and manure management issues. A few interviewees believed that research could have a key role, but none of them mentioned any specific adaptive or mitigation measure that could be adopted on farm. Other farmers did not consider climate change as a factor that has an important impact on the sector, as they either believe that climate goes in cycles or have not observed any significant change over time.

The main relevant themes that emerged during the farmers' interviews were:

- Weaknesses: high labour requirements; low margins from a supply chain perspective; high production costs (intensive farms); low farmers' marketing skills/knowledge; lack of available land for grazing and new entrants; predators (dogs, wolves, bears, badgers, buzzards, ravens, crows) and climate change for some farmers (especially water scarcity and flooding)

- Threats: lack of generational turnover; environmental campaigns and misconceptions from the public about sheep/goat farming; urban encroachment /land being used for leisure activities, decrease in lamb meat consumption; decrease in farm subsidies

As expected, most of the issues identified in the interviews agree with those expressed by experts during the participatory exercise in WP4. However, what differed was the perception of the relevance for some of them:

a) While many farmers considered increasing training opportunities as crucial for postproduction operations, including processing and marketing, training in livestock and farm management was considered of secondary importance. This clearly contrasts with the high priority given to it in this study by the experts.
b) Farmers assigned limited relevance to reinvesting part of the turnover on the farm is an indicator of the lack of self-sufficiency and entrepreneurship of the small ruminants' sector and its inherently low sustainability.
c) A similar result was found for the innovation (learning and growth) dimension: most farmers gave low priority to innovations and generally believe that they already perform above

average on all multidimensional indicators. This again disagrees with the current study in which slow implementation of innovations was selected as one of the weakness to prioritized in the future.

The apparent contradiction between farmers and the experts' views on the relevance of some issues and how to address them deserves further attention in the lifetime of the project, to better address the main challenges in the sector, especially those that require changes in farm management practices.

Table 5. Effect of the type of product, species, production system, geographical location and farming sector on the relevance of internal weaknesses and external threats for the sustainability (1=Very low, 2=Low, 3=Medium, 4=High and 5=Very high).

	Product		Species		System			Region		Sector			P-value[1]									
RELEVANCE	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private	SED	Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
INTERNAL WEAKNESSES																							
Overall	3.62	3.20	3.41	3.63	3.40	3.63	3.42	3.63	3.00	3.48	3.49	0.128	**			***		†		**			†
Sector level	3.70	3.32	3.57	3.58	3.45	3.77	3.49	3.66	3.30	3.57	3.59	0.176	*			*		†		†			
Farm level	3.57	3.26	3.37	3.69	3.48	3.59	3.36	3.66	2.87	3.53	3.37	0.149		*		***		*	*	*			**
Farming system	3.55	3.00	3.24	3.65	3.25	3.47	3.38	3.58	2.71	3.32	3.46	0.168	**	†		***			*	*			*
EXTERNAL THREATS																							
Overall	3.70	3.58	3.66	3.65	3.47	3.65	3.81	3.63	3.76	3.62	3.72	0.127			*								
Society	3.72	3.59	3.73	3.56	3.46	3.74	3.77	3.61	3.88	3.63	3.75	0.146		*	†	†						†	
Sciences	3.20	3.07	3.03	3.40	2.84	3.32	3.24	3.25	2.86	3.05	3.33	0.300								†			
Production factors	3.78	3.84	3.70	4.00	3.46	3.65	4.19	3.80	3.81	3.82	3.77	0.218		†	**								
Market	3.96	3.87	3.95	3.89	4.00	3.81	3.99	3.90	4.04	3.86	4.07	0.149					†						
Environmental	3.43	3.40	3.43	3.38	2.80	3.37	3.91	3.33	3.71	3.47	3.32	0.205			***	*							
Political	3.64	3.25	3.53	3.51	3.43	3.58	3.53	3.54	3.45	3.49	3.57	0.233	*										

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 6. Effect of the type of product, species, production system, geographical location and farming sector on the **relevance** of technical and social challenges for the sustainability (1=Very low, 2=Low, 3=Medium, 4=High and 5=Very high).

	Product		Species		System			Region		Sector			P-value[1]									
TECHNICAL / SOCIAL CHALLENGES	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private	SED	Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	3.53	3.29	3.42	3.52	3.30	3.59	3.44	3.51	3.26	3.46	3.44	0.133	†		†	*	†	†		*			
Low farmer professionalization	3.54	3.34	3.40	3.63	3.52	3.55	3.38	3.71	2.71	3.54	3.36	0.188				***		*		*			*
Slow adoption of innovations	3.57	3.03	3.22	3.77	3.48	3.48	3.26	3.62	2.67	3.42	3.36	0.225	†	*		***			†	**			*
Poor business management training	3.59	3.41	3.47	3.67	3.42	3.73	3.44	3.63	3.24	3.62	3.39	0.215				†		*					
Low competitiveness	3.47	3.66	3.57	3.45	3.21	3.90	3.42	3.58	3.38	3.53	3.53	0.264			*								
Low youth involvement	4.11	3.93	4.07	4.03	3.88	4.29	3.97	3.93	4.48	4.11	3.97	0.276				*		†					
Low female involvement	3.11	3.17	3.35	2.70	2.76	3.52	3.06	3.32	2.52	3.16	3.09	0.245		**	*	***						***	
Increasing sanitary issues	2.67	3.03	2.81	2.78	2.36	2.61	3.30	2.46	3.76	2.85	2.72	0.287			*	***							
Social farmer recognition	3.80	3.41	3.75	3.53	3.48	3.74	3.76	3.57	4.05	3.61	3.79	0.266	*	†		†			*				
Sector fragmentation	3.75	3.03	3.36	3.80	3.60	3.63	3.33	3.66	3.05	3.49	3.55	0.248	**			*				**			
Researchers not address real problems	3.20	3.07	3.03	3.40	2.84	3.32	3.24	3.25	2.86	3.05	3.33	0.300								†			
Low cooperation between farmers	3.80	3.14	3.48	3.80	3.56	3.61	3.59	3.72	3.14	3.49	3.76	0.266	*			*				***			

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 7. Effect of the type of product, species, production system, geographical location and farming sector on the **relevance** of market challenges for the midterm farm sustainability (1=Very low, 2=Low, 3=Medium, 4=High and 5=Very high).

MARKET CHALLENGES	Product		Species		System			Region		Sector		SED	P-value[1]									
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private		Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	3.87	3.84	3.89	3.79	3.82	3.81	3.92	3.83	3.93	3.81	3.94	0.132											
Volatile commodity prices	4.00	4.34	4.25	3.83	4.16	4.23	3.97	3.99	4.52	4.12	4.09	0.223		†		*				*			
Uncertain meat milk prices	4.31	4.21	4.35	4.13	4.52	4.32	4.06	4.30	4.19	4.33	4.18	0.211											
Low consumer demand	3.05	4.10	3.63	2.90	3.00	3.74	3.35	3.35	3.52	3.21	3.70	0.251	***	†	*		†			*		**	
Low consumer education in products	4.03	3.34	3.75	3.93	3.92	3.73	3.81	3.90	3.52	3.86	3.73	0.225	**			†							
Unfair trade, lack traceability	3.93	3.41	3.67	3.97	3.76	3.32	4.18	3.84	3.52	3.70	3.88	0.246	*		***							†	
Market monopolised	3.61	3.52	3.55	3.63	3.56	3.39	3.76	3.48	3.90	3.26	4.12	0.265				†	***						
Difficulty of access to capital	4.02	4.21	4.07	4.10	3.96	4.03	4.21	4.07	4.10	4.12	4.00	0.230											
Low social knowledge about farming	3.98	3.55	3.87	3.80	3.68	3.74	4.06	3.74	4.19	3.86	3.82	0.257	*			†							†

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 8 Effect of the type of product, species, production system, geographical location and farming sector on the **relevance** of environmental challenges for the sustainability (1=Very low, 2=Low, 3=Medium, 4=High and 5=Very high).

ENVIRNONMENTAL CHALLENGES	Product		Species		System			Region		Sector			P-value[1]									
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private	SED	Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	3.48	3.17	3.29	3.56	3.11	3.35	3.61	3.44	3.19	3.34	3.45	0.134	*		**	*							
Climate change threats	3.87	3.45	3.58	4.03	3.48	3.58	4.06	3.68	3.90	3.82	3.58	0.230	*		*								
Low adaptability of high productive breeds	3.31	2.79	3.02	3.40	3.00	3.16	3.24	3.36	2.43	3.12	3.18	0.260				** *						†	†
Environmental policy against intensification	3.29	2.90	3.07	3.33	3.44	3.00	3.09	3.13	3.24	2.91	3.58	0.309					*						
Wildlife conflicts	2.98	3.34	3.28	2.73	2.12	3.16	3.76	2.97	3.52	3.12	3.06	0.289		†	** *	*						*	
Limited land access	3.54	3.48	3.33	3.90	2.96	3.26	4.18	3.52	3.52	3.51	3.55	0.299		*	** *								
Low integration of livestock and agriculture	3.62	3.00	3.20	3.87	3.40	3.39	3.47	3.52	3.10	3.42	3.42	0.201	* *	* *		*				*	†		
Low promotion of local breeds	3.74	3.21	3.52	3.68	3.36	3.86	3.47	3.88	2.62	3.43	3.79	0.310				**				***			†

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 9. Effect of the type of product, species, production system, geographical location and farming sector on the **relevance** of policy / financial challenges for the sustainability (1=Very low, 2=Low, 3=Medium, 4=High and 5=Very high).

POLICY / FINANCIAL CHALLENGES	Product		Species		System			Region		Sector		SED	P-value[1]									
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private		Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	3.86	3.59	3.85	3.64	3.48	3.93	3.85	3.75	3.85	3.89	3.58	0.188	†	*	*		†						
High subsidy dependency	4.10	3.90	4.18	3.73	3.76	4.16	4.12	4.04	4.00	4.35	3.48	0.205		**	†		***			*		**	
Poor recognition of public services	3.68	3.52	3.62	3.63	3.17	3.73	3.85	3.48	4.10	3.58	3.70	0.241			*	**							
Uncertainty in future changes in subsidies	4.07	3.77	4.02	3.89	3.61	4.28	4.00	3.98	3.94	4.20	3.63	0.232			*		**					†	
EU policy without scientific evidence	3.43	3.09	3.41	3.14	3.20	3.42	3.32	3.32	3.33	3.25	3.48	0.305		†			†						

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 10. Effect of the type of product, species, production system, geographical location and farming sector on the **easiness** to address internal weaknesses and external threats for the sustainability (1=Very difficult, 2=Difficult, 3=Medium, 4=Easy and 5=Very Easy).

	Product		Species		System			Region		Sector			P-value[1]										
EASYNESS TO ADRESS	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private	SED	Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
INTERNAL WEAKNESSES																							
Overall	2.45	2.57	2.52	2.41	2.63	2.47	2.40	2.47	2.53	2.50	2.46	0.109			†								
Sector level	2.24	2.27	2.26	2.23	2.37	2.18	2.23	2.21	2.37	2.18	2.37	0.147										*	
Farm level	2.63	2.71	2.71	2.56	2.85	2.64	2.52	2.64	2.70	2.80	2.41	0.123			*		**			†			*
Farming system	2.53	2.82	2.68	2.51	2.75	2.68	2.48	2.65	2.56	2.63	2.62	0.147	*										
EXTERNAL THREATS																							
Overall	2.36	2.25	2.30	2.37	2.39	2.32	2.29	2.44	1.96	2.30	2.36	0.089				***				*			*
Society	2.66	2.28	2.42	2.77	2.53	2.45	2.62	2.70	1.99	2.49	2.62	0.128	*	*	†	***						†	†
Sciences	3.00	3.03	3.05	2.93	3.00	3.00	3.03	3.03	2.95	3.14	2.79	0.169					*				†		
Production factors	2.02	2.14	2.08	2.00	2.34	2.03	1.87	2.09	1.95	2.01	2.14	0.139			**								
Market	2.04	1.89	1.99	1.99	2.01	1.98	1.99	2.11	1.61	1.88	2.19	0.141				***	*			*			†
Environmental	2.15	2.00	2.09	2.12	2.28	2.23	1.85	2.29	1.50	2.16	2.00	0.150			†	***	†			†			
Political	2.43	2.70	2.58	2.41	2.56	2.59	2.43	2.55	2.42	2.58	2.42	0.148	*				*					*	

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 11. Effect of the type of product, species, production system, geographical location and farming sector on the **easiness** to address technical and social challenges for the sustainability (1=Very difficult, 2=Difficult, 3=Medium, 4=Easy and 5=Very Easy).

TECHNICAL / SOCIAL CHALLENGES	Product		Species		System			Region		Sector		SED	P-value[1]									
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private		Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	2.52	2.48	2.51	2.50	2.65	2.46	2.44	2.53	2.43	2.51	2.50	0.093			†								
Low farmer professionalization	2.61	2.69	2.68	2.53	2.80	2.69	2.46	2.62	2.67	2.86	2.24	0.175			†		***						†
Slow adoption of innovations	2.66	2.62	2.70	2.53	2.76	2.60	2.60	2.62	2.71	2.70	2.55	0.187											
Poor business management training	2.61	2.83	2.72	2.60	3.00	2.62	2.51	2.67	2.71	2.82	2.45	0.162			**		*						*
Low competitiveness	2.41	2.34	2.34	2.48	2.58	2.20	2.42	2.45	2.19	2.22	2.69	0.183					**						
Low youth involvement	2.07	2.07	2.12	1.97	2.04	2.00	2.15	2.19	1.67	1.82	2.48	0.253				*	**			*			*
Low female involvement	2.56	2.59	2.45	2.80	2.80	2.32	2.62	2.33	3.33	2.60	2.52	0.246		†		***						***	
Increasing sanitary issues	2.88	2.66	2.74	2.93	3.18	2.86	2.47	2.98	2.29	2.77	2.84	0.261			†	**							
Social farmer recognition	2.56	2.07	2.27	2.67	2.44	2.32	2.44	2.62	1.67	2.37	2.45	0.212				***				*			
Sector fragmentation	2.07	2.10	2.18	1.90	2.08	2.10	2.06	2.12	1.95	1.96	2.27	0.236											
Researchers not address real problems	3.00	3.03	3.05	2.93	3.00	3.00	3.03	3.03	2.95	3.14	2.79	0.169					*				†		
Low cooperation between farmers	2.24	2.30	2.27	2.23	2.52	2.28	2.06	2.18	2.53	2.29	2.20	0.203			*								

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 12. Effect of the type of product, species, production system, geographical location and farming sector on the **easiness** to address market challenges for the sustainability (1=Very difficult, 2=Difficult, 3=Medium, 4=Easy and 5=Very Easy).

MARKET CHALLENGES	Product		Species		System			Region		Sector			P-value[1]									
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private	SED	Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	2.28	2.07	2.16	2.31	2.21	2.19	2.23	2.35	1.77	2.12	2.38	0.112				**	*			*			*
																*	*			*			*
Volatile commodity prices	1.80	1.48	1.70	1.70	1.80	1.44	1.87	1.83	1.29	1.60	1.88	0.206			*	**				*			
Uncertain meat milk prices	1.90	1.69	1.83	1.83	1.80	1.69	1.99	1.91	1.57	1.74	2.00	0.226					†						
Low consumer demand	2.62	1.97	2.22	2.77	2.32	2.25	2.58	2.63	1.47	2.39	2.39	0.207	*		*	**							†
													*		*	*							
Low consumer education in products	3.00	2.55	2.68	3.20	2.76	2.79	2.99	2.97	2.48	2.82	2.91	0.212	*	*		*						†	
Unfair trade, lack traceability	2.57	2.41	2.48	2.60	2.64	2.82	2.16	2.70	1.95	2.44	2.67	0.214			*	**		*		*			
															*	*		*		*			
Market monopolised	1.86	1.96	1.93	1.83	1.80	1.93	1.94	1.98	1.62	1.70	2.22	0.228				†	*						*
Difficulty of access to capital	1.87	1.93	1.90	1.87	2.00	1.94	1.76	1.96	1.67	1.77	2.09	0.151				*	*					*	
Low social knowledge about farming	2.69	2.55	2.55	2.83	2.64	2.68	2.62	2.81	2.10	2.51	2.88	0.209				**				**			*
																*							*

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 13. Effect of the type of product, species, production system, geographical location and farming sector on the **easiness** to address environmental challenges for the sustainability (1=Very difficult, 2=Difficult, 3=Medium, 4=Easy and 5=Very Easy).

	Product		Species		System			Region		Sector			P-value[1]									
ENVIRNONMENTAL CHALLENGES	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private	SED	Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	2.37	2.54	2.46	2.35	2.58	2.50	2.24	2.49	2.21	2.45	2.38	0.110	*		**	**							
Climate change threats	1.75	1.83	1.84	1.63	1.76	1.93	1.64	1.91	1.33	1.84	1.67	0.166				***							
Low adaptability of high productive breeds	2.71	2.85	2.83	2.63	2.87	2.90	2.53	2.76	2.76	2.86	2.59	0.227											
Environmental policy against intensification	2.55	3.00	2.75	2.60	2.61	2.87	2.62	2.71	2.71	2.76	2.64	0.232	*					†					
Wildlife conflicts	2.67	2.17	2.34	2.85	2.96	2.53	2.13	2.67	1.82	2.61	2.33	0.258			*	**						*	
Limited land access	2.20	2.34	2.31	2.13	2.68	2.17	2.00	2.25	2.24	2.29	2.18	0.202			**								
Low integration of livestock and agriculture	2.34	2.86	2.62	2.30	2.72	2.40	2.45	2.51	2.52	2.60	2.36	0.185	**		†		*						
Low promotion of local breeds	2.62	2.85	2.72	2.64	2.77	2.76	2.57	2.70	2.69	2.54	2.91	0.257					*			*			

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 14 Effect of the type of product, species, production system, geographical location and farming sector on the **easiness** to address policy / financial challenges for the sustainability (1=Very difficult, 2=Difficult, 3=Medium, 4=Easy and 5=Very Easy).

POLICY / FINANCIAL CHALLENGES	Product		Species		System			Region		Sector		SED	P-value[1]										
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private		Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	2.31	2.38	2.35	2.30	2.44	2.25	2.33	2.39	2.16	2.33	2.34	0.117				*							
High subsidy dependency	2.00	2.24	2.13	1.96	2.17	2.03	2.06	2.10	2.00	2.00	2.21	0.140	*				†	*	*				
Poor recognition of public services	2.49	2.28	2.40	2.47	2.54	2.23	2.50	2.52	2.10	2.40	2.45	0.165			*	**							
Uncertainty in future changes in subsidies	2.16	2.38	2.30	2.11	2.39	2.12	2.21	2.25	2.18	2.24	2.22	0.189											
EU policy without scientific evidence	2.59	2.64	2.59	2.64	2.70	2.65	2.48	2.71	2.32	2.71	2.39	0.228				*	*					*	**

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 15. Effect of the type of product, species, production system, geographical location and farming sector on the **priority index** for the sustainability.

TECHNICAL / SOCIAL PRIORITIES	Product		Species		System			Region		Sector		SED	P-value[1]									
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private		Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	8.88	8.15	8.57	8.80	8.74	8.80	8.43	8.88	7.88	8.71	8.53	0.465				*				†			
Low farmer professionalization	9.10	9.07	9.07	9.13	9.80	9.50	8.19	9.65	7.24	9.98	7.55	0.758				***	**				†	**	
Slow adoption of innovations	9.33	7.90	8.58	9.43	9.28	9.02	8.43	9.42	7.05	9.16	8.36	0.817				**			†	†			
Poor business management training	9.36	9.86	9.52	9.53	10.29	9.83	8.71	9.81	8.62	10.33	8.18	0.905					*	†					
Low competitiveness	8.31	8.45	8.24	8.59	8.17	8.40	8.45	8.67	7.38	7.93	9.09	0.893											
Low youth involvement	7.92	7.41	8.02	7.23	7.52	8.00	7.71	8.06	6.76	6.93	9.18	0.880					**			†		*	
Low female involvement	7.30	7.76	7.88	6.57	6.88	7.87	7.47	7.61	6.90	7.74	6.94	0.932											
Increasing sanitary issues	6.90	7.66	7.23	7.07	6.91	7.00	7.53	6.78	8.29	7.27	7.03	0.703				*						†	
Social farmer recognition	9.57	6.76	8.25	9.50	8.16	8.65	9.06	9.39	6.29	8.30	9.30	0.954	**			***				**			
Sector fragmentation	7.44	6.10	7.02	6.93	7.08	7.21	6.73	7.45	5.57	6.64	7.55	0.807				*				*			
Researchers not address real problems	9.54	9.03	9.18	9.77	8.48	9.87	9.59	9.74	8.19	9.54	9.09	0.935				†							
Low cooperation between farmers	8.19	7.07	7.76	7.97	8.74	7.90	7.15	7.85	7.79	7.75	8.00	0.740										*	

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 16. Effect of the type of product, species, production system, geographical location and farming sector on the **priority index** for the sustainability.

MARKET PRIORITIES	Product		Species		System			Region		Sector			P-value[1]									
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private	SED	Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	8.80	7.89	8.36	8.80	8.40	8.33	8.74	8.98	6.97	8.02	9.34	0.493				***	**			†		*	
Volatile commodity prices	7.02	6.45	7.12	6.27	7.12	6.16	7.24	7.17	5.71	6.37	7.64	0.900				†							
Uncertain meat milk prices	8.23	6.86	7.90	7.57	8.16	7.32	7.94	8.23	6.33	7.49	8.30	1.004				*							
Low consumer demand	7.69	7.24	7.07	8.58	6.18	7.75	8.27	7.96	5.88	6.94	8.45	0.748		*	**	**	**			†			
Low consumer education in products	12.12	8.38	10.11	12.53	10.80	10.35	11.52	11.54	8.86	10.87	11.00	1.003	***			**						†	
Unfair trade, lack traceability	9.97	7.97	8.78	10.40	9.88	9.31	8.93	10.12	6.71	8.74	10.33	1.003				***	†			*			
Market monopolised	6.79	6.64	6.66	6.90	6.56	6.43	7.15	6.92	6.19	5.48	8.88	0.833					***					†	
Difficulty of access to capital	7.31	7.93	7.53	7.47	7.60	7.68	7.29	7.72	6.81	7.09	8.24	0.616					**						
Low social knowledge about farming	10.26	8.66	9.42	10.40	9.36	9.61	10.15	10.28	8.00	9.12	10.82	0.820	†			**	†			†		**	

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 17. Effect of the type of product, species, production system, geographical location and farming sector on the **priority index** for the sustainability.

ENVIRNONMENTAL PRIORITIES	Product		Species		System			Region		Sector		SED	P-value[1]										
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private		Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	8.21	7.98	8.02	8.37	8.01	8.36	8.03	8.49	7.03	8.15	8.11	0.484				**			*				
Climate change threats	6.37	6.07	6.28	6.27	5.80	6.57	6.36	6.67	5.00	6.58	5.76	0.699				*							
Low adaptability of high productive breeds	8.98	8.22	8.85	8.53	9.17	9.03	8.10	9.06	7.47	9.22	7.97	1.094											
Environmental policy against intensification	8.06	8.17	8.00	8.32	8.74	8.00	7.69	8.09	8.12	7.51	8.97	0.835											
Wildlife conflicts	7.07	6.28	6.66	7.12	6.22	7.23	6.81	7.04	5.82	7.12	6.30	0.848							†				
Limited land access	7.53	7.41	7.19	8.07	7.84	6.63	8.00	7.64	7.00	8.09	6.48	0.898					†						
Low integration of livestock and agriculture	8.42	8.21	8.16	8.73	9.00	7.87	8.30	8.66	7.38	8.84	7.55	0.641				*	*						
Low promotion of local breeds	10.48	9.15	9.78	10.63	9.73	10.41	9.89	10.18	9.31	9.42	10.88	1.229					*						

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 18. Effect of the type of product, species, production system, geographical location and farming sector on the **priority index** for the sustainability.

POLICY / FINANCIAL PRIORITIES	Product		Species		System			Region		Sector		SED	P-value[1]										
	Dairy	Meat	Sheep	Goat	Int.	Semi.	Ext.	South	Central	Public	Private		Pr	Sp	Sy	Re	Se	Pr×Sp	Pr×Sy	Pr×Re	Sp×Sy	Sy×Re	Sy×Re
Overall	8.90	8.38	8.95	8.31	8.43	8.83	8.87	8.92	8.13	8.97	8.33	0.599		†									
High subsidy dependency	8.17	8.41	8.73	7.21	8.22	8.35	8.18	8.26	8.21	8.67	7.55	0.663		**			†						**
Poor recognition of public services	9.10	7.93	8.66	8.83	8.13	8.30	9.50	8.82	8.38	8.56	8.97	0.841			†								
Uncertainty in future changes in subsidies	8.69	8.73	9.11	7.93	8.26	9.04	8.76	8.84	8.18	9.27	7.84	0.904					†						
EU policy without scientific evidence	8.49	7.33	8.29	7.82	8.11	8.58	7.72	8.71	6.50	8.19	8.05	0.820				**							

[1]Significance: † P<0.100, * P<0.05, ** P<0.01, *** P<0.001

Table 19. Heatmap describing the **priority indexes** and the **relevant actors** required to address the main challenges and threats in the small ruminant sector for the sustainability.

				Degree of implication required for each actor (in %)						
	Priority Ranking	Priority Index	Number of actors	Government	Farmers	Associations of producers	Academia	Processing industry	Consumers	Retailers
INTERNAL										
Low promotion of local breeds	2	10.0	2.5	27	28	23	22	0	1	0
Poor business management training	4	9.5	3.0	29	25	26	11	5	2	2
Low farmer professionalization	7	9.1	3.5	28	21	28	17	6	0	0
Slow adoption of innovations	8	8.9	3.4	21	27	26	19	6	1	1
Low adaptability of high productive breeds	9	8.7	1.9	14	25	25	34	3	0	0
Low integration of livestock and agriculture	14	8.4	2.7	32	26	21	15	2	3	1
Low cooperation between farmers	18	7.8	2.0	7	50	40	1	1	0	1
Low youth involvement	20	7.8	3.4	28	23	30	6	5	6	2
Low female involvement	24	7.4	1.9	30	29	28	7	1	4	0
Sector fragmentation	26	7.0	3.3	11	26	30	4	19	2	8
EXTERNAL										
Low consumer education in products	1	10.9	3.4	29	7	22	10	14	10	8
Low social knowledge about farming	3	9.7	4.1	21	12	23	17	6	15	6
Researchers not address real problems	5	9.4	2.8	20	19	20	33	5	2	2
Unfair trade, lack traceability	6	9.3	3.6	23	11	17	4	19	10	16
Poor recognition of public services	10	8.7	3.2	36	20	13	11	3	15	2
Uncertainty in future changes in subsidies	11	8.7	2.6	48	18	14	10	3	6	1
Social farmer recognition	12	8.7	4.7	19	19	18	11	9	16	8
EU policy without scientific evidence	16	8.1	1.6	51	1	16	31	0	0	0
Environmental policy against intensification	17	8.1	2.3	44	13	17	17	6	1	1
Uncertain meat milk prices	19	7.8	4.0	19	13	12	3	25	8	21
Low consumer demand	21	7.5	3.9	8	9	11	9	21	22	22
Difficulty of access to capital	22	7.5	3.3	33	17	15	7	13	6	9
Limited land access	23	7.5	2.2	55	21	19	5	0	0	0
Volatile commodity prices	27	6.8	3.5	28	13	9	1	27	8	14
Wildlife conflicts	28	6.8	2.3	39	29	13	13	0	7	0
Market monopolised	29	6.7	3.1	26	12	13	2	20	6	20
Climate change threats	30	6.3	3.2	28	20	15	25	9	2	2
OTHERS										
Low competitiveness	13	8.4	3.9	16	24	15	7	16	6	14
High subsidy dependency	15	8.3	2.8	43	20	20	4	3	8	1
Increasing sanitary issues	25	7.2	2.2	15	33	23	29	0	0	0

3.2 Easiness to address challenges and priority index

The assessment of perception on how easy the different challenges are to be addressed showed that on average none were scored as 'easy' or 'very easy'. Out of the 30 challenges considered, 7 were perceived as 'difficult' or 'very difficult' (≤ 2) and these were (in order of difficulty):

1) Volatile commodity prices,
2) Uncertain meat & milk prices,
3) Climate change,
4) Poor incomes access capital,
5) Market monopolised,
6) Subsidy dependency and
7) Fragmented sector.

The degree of difficulty to address a challenge or threat seems to be more inherent to the challenge than the type of production system. As a result, the perception of the easiness to address the challenges was not substantially affected by the type of product and species whereas the production system, geographical region and sector seem to play a role in determining the difficulty to address those challenges.

The **priority index** was calculated to identify those challenges that had been scored as relevant and not very difficult to address, so strategies can be developed to prioritize efforts towards them. The index calculation ranged from 6.31 and 10.9. The 10 challenges that had the highest scores (above 8.70) were (in ranking order):

1) Low consumer education about products
2) Low promotion of local breeds
3) Low social knowledge about farming
4) Poor business management training
5) Researchers not addressing real problems
6) Unfair trade, lack of traceability
7) Low professionalization
8) Slow adoption of innovations
9) Low adaptability of high producing breeds
10) Poor recognition of public services

Half of the top 10 challenges were internal weaknesses and the other half were external threats.

The analysis of the differences between the established groups (Tables 15-18) showed that the country region (Mediterranean vs. Central Europe) was the only factor that significantly differed in perception. Thirteen out of the 30 challenges assessed were significantly scored higher in priority

index in Southern compared to Central European countries, among them, 5 were included in the top 10 list presented above and were:

1) Low consumer education in products
2) Unfair trade/lack traceability,
3) Low social knowledge about farming,
4) Low professionalization and
5) Slow adoption of technologies.

This suggests that actions to tackle these (or some) of the mentioned challenges should be analysed with a country/regional perspective before they are implemented.

On the other hand, for the other comparison groups (sheep vs. goats, dairy vs. meat, degree of intensification and public vs. private organizations) there were no significant differences in priority index (Tables 15-18). Therefore, the top priorities can be addressed without making major distinctions between these groups.

It is important to note that the most relevant challenges to tackle according to the Priority index are related to increase society knowledge of sheep and goat productions with aims to increase demand for products. This view holds on a strong sector hypothesis that is that the low demand of products is not due to the product features themselves but to consumers not having an informed opinion on sheep and goat products "true" features.

3.3 Stakeholder to take action

The respondents chose Government (27.6%) as the actor to address most of the challenges and threats followed by farmers (20.3%), association of producers (20.0%) and the processing industry (12.8%) while a small proportion indicated that the processing industry (8.24%), consumers (5.62%) and retailers (5.42.%) were needed to address the challenges and threats.

The average number of actors required to address the challenges and threats varied from 1.6 to 4.0 out of the 7 actors considered. The top 10 challenges (Table 19) required a combined action of three main actors (Government, Farmers and Associations of producers). The Academia was particularly required to address specific topics such as "Research not addresses real problems" and "low adaptability of high producing breeds". The processing industry was identified to address the "unfair trade, lack of traceability" threat whereas the consumer must take action to address the "low social knowledge about farming" and "poor recognition of public services" challenges.

The answers of the third question in the survey in relation to what stakeholders are relevant to address individual challenges indicated that the majority of the **external threats** should be addressed by Governments, while those related to market need action from both processing industry and retailers. Interestingly, although to a lesser extent, farmers and associations of producers were also selected as stakeholders to contribute to address such threats. The research community was identified as key player to address very specific challenges such as EU policy launched without

scientific evidence, climate change threats and, not surprisingly, researches not addressing real problems.

As for **internal weaknesses**, the two main groups selected to take action were farmers and associations of producers, although Governments were also identified as relevant stakeholder. According to participants, the academic community should be involved in addressing some specific weaknesses: 'Low professionalization', 'Slow adoption of innovations', 'Poor business management training', 'Low adaptability of high productive breeds', 'Low integration of livestock and agriculture and Low promotion of local breeds'. Finally, Processing Industry, Consumers and Retailers would be relevant to solve internal weakness, with the exception of sector fragmentation that requires the involvement of the processing industry.

4 Update of farm management innovations

iSAGE project is using 2 actions to help the sector deal with some of the key challenges explained in the previous section (Figures 2 and 3). First to understand the impact of global challenges and how to counteract it and second use multiple innovation case studies deal with specific challenges which mainly relate to internal weaknesses of the sector.

The main threat related to the lack of society awareness on the role of sheep and goal farmers and the services that sheep and goat farming provides to society is dealt with in WP2. To help the sector deal with this challenge WP2 will help to get a deep understanding of the reasons for decline sheep and goat products consumption, will identify the determinants of such decline and the expected place of sheep and goat products in the society and diets. This better understanding will allow WP2, at the end of the project, to identify and describe innovative approaches to animal and supply chain management and marketing which presumably will be based on making explicit and highlighting the value of sheep and goat systems and farmers public services to boost its recognition by the consumer.

WP3 investigates climate change threats to sheep and goat farming. Specifically WP3 is identifying and quantifying the main effects of climate change on pasture (productivity, quality and diversity) and animal (productivity, quality, welfare and health) to make the sector aware of the concrete impact so that it can design an adaptation strategy in balance with the expected level of impact.

Finally, WP5 will specifically deal with the development of breeding programmes of local breed by assessing the capacity of local animal breeds (resource populations) and develop management practices to deliver resilience, sustainability and competitiveness to sheep and goat farming systems across the EU and beyond. This WP will also help increase the resilience of sheep and goat by developing breeding strategies and tools that will enable European sheep and goat farmers to enhance animal welfare, resilience and adaptability.

The specific outcomes of WP2, 3 and 5 that are of interest to face sector challenges are and will be described in detail in the deliverables D2.2, D2.3, D2.5, D3.2, D3.3, D5.2, D5.3 and D5.4.

Figure 2. Internal challenges (weaknesses) that are being dealt with in iSAGE actions. Challenges covered by iSAGE activities are marked with the project logo

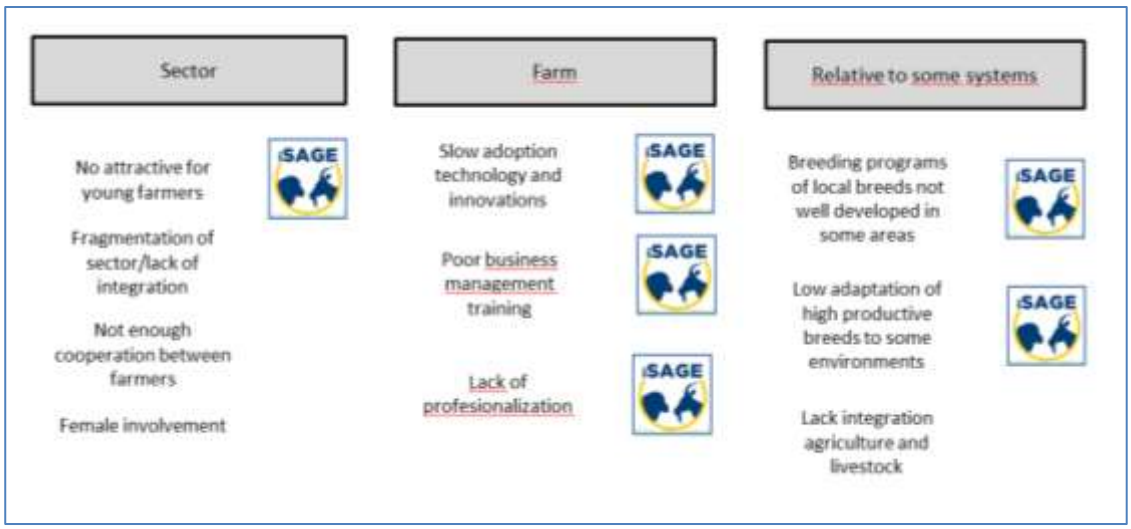
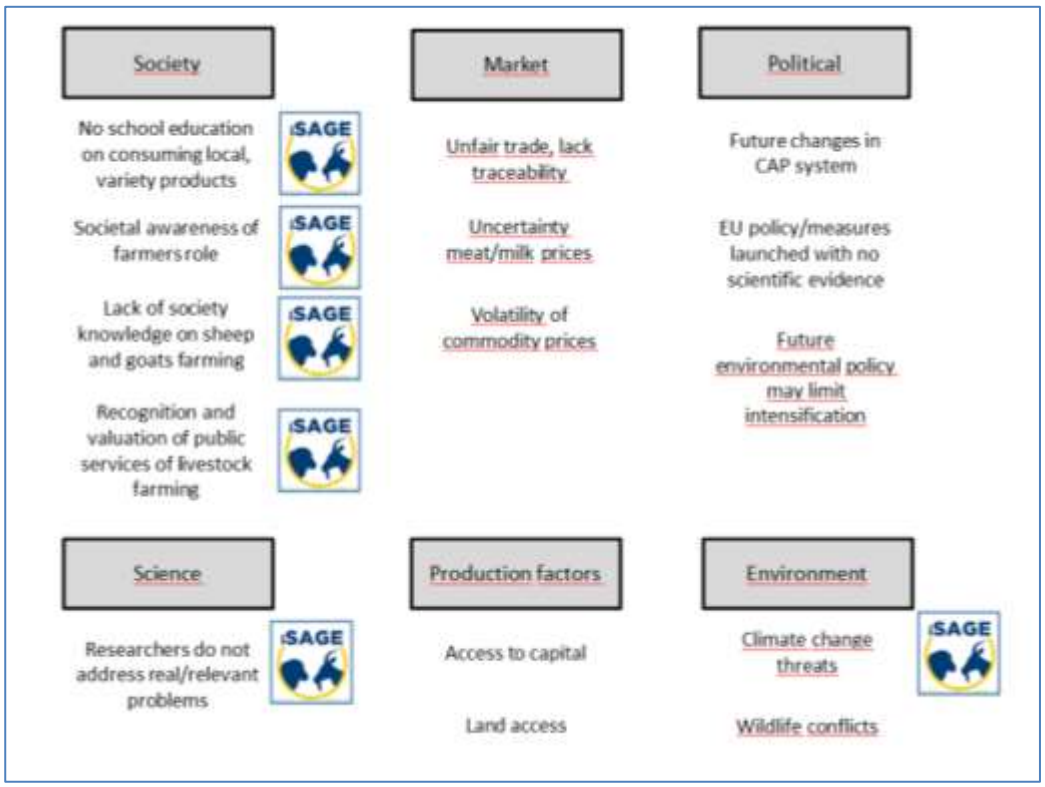


Figure 3. External challenges (threats) that are being deal with iSAGE actions. Challenges covered by iSAGE activities are marked with the project logo



In addition, farm innovation case studies in Task 4.2 are evaluating how innovation can face some of the challenges described above. Each innovation was chosen by the partners according to their main interest and expertise to face the challenges that they considered critical for their specific case (i.e country, species and production system). The innovation case studies are included in table 20 and the relationship between those innovations and the challenges identified in the project are indicated in table 21. Most innovation case studies deal with internal challenges, as they can be controlled by farmers and farmers' institutions which are actually the type of partners involved in

the innovations. The results of the innovation case studies in terms of their impact and advice for addressing the challenges will be reported in future project deliverables.

Table 20. Challenges addressed by innovation case studies in each participating country

		Challenge	Finland	France	Greece	Italy	Spain	Turkey	UK
INTERNAL WEAKNESSES	FARM	**Lack of profesionalization**	X	X	X	X	X	X	X
		Slow adoption technology and innovations	X	X	X	X	X	X	X
		Poor business management training			X		X		
	SECTOR LEVEL	**No attractive for young farmers**							X
	Relative to some farming systems	**Low adaptation of high productive breeds to some enviornments**	X				X		X
		Breeding programs of adapted/local breeds not welldeveloped in some areas	X				X		X
EXTERNAL THREATS	SOCIETY	**Societal awareness of farmers role**			X				
		Low consumers demand			X				
		Lack of society knowledge on sheep and goats farming			X				
		Recognition and valuation of public services of livestock farming			X				
	ENVIRONMENT	**Climate change threats**						X	

Table 21. Innovation case studies being implemented in iSAGE project

Innovation type	**Innovation name**	**Partners** (bold is responsible partner)	**Countries**
Breeding & genetics	Evaluation of reproductive performance of crossbreeds of Romanov and Turkish Native Breed	ATAUNI	Turkey
Breeding & genetics	Potential, drivers and constraints of genomic selection in sheep and goat sector	**INIA,** ASSAF.E, AGRAMA, ARDIEKIN, CABRANDALUCIA, FRIZARTA, AUTH, IDELE, CAPGENES, CNBL	Spain, Greece and France
Breeding & genetics	Analysis of farmers perception of the drivers and constrains for the uptake of a new selection index for ewe productivity	**LUKE** and PROAGRIA	Finland
Breeding & genetics	Assessing parasitic resistance of UK local and newly introduced sheep breeds in organic/low input and conventional farms.	**ORC** and AHDB	UK
Breeding & genetics	Assessment of ROA GENE effect on Rasa Aragonesa breed productivity	**OVIARAGON** and IAMZ-CIHEAM	Spain
Breeding & genetics	A new longevity breeding goal for Lleyn sheep	**SRUC** and AHDB	UK

Forage, feeds, pastures & grazing	Better utilization of farm forage– reduce reliance on imported concentrates and forages on the farm	**IDELE**, CNBL, CAPGENEES	France
Forage, feeds, pastures & grazing	Assessment of feeding alternatives in sheep and goat farms in Turkey	OHU-NIGDE	Turkey
Forage, feeds, pastures & grazing	Carbon efficiency and footprint comparison for various farming systems	OHU-NIGDE	Turkey
Forage, feeds, pastures & grazing	Grazing in arable rotations	ORC and **NSA**	UK
Health and welfare	Training and implementation of farm management application (AWIN)	**AUTH**, IGENTHES	Greece
Health and welfare	Managing Haemonchus burden in lambs using a copper oxide bolus	**ORC** and NSA	UK
Individual recording	Extension activities for individual recording	**ACOP,** AUTH, and FRIZARTA	Greece
Individual recording	Mobile flock management of intensive sheep farm	ATAUNI	Turkey
Individual recording	Basic reproductive performance recording in intensive dairy goat farming	**ATAUNI** and PAN	Turkey
Individual recording	Assessment of Eskardillo: a platform based on individual data collection to improve decision making and management in dairy goat farms.	**CSIC,** CABRANDALUCIA	Spain
Individual recording	Individual data collected from RFID for several purposes	**IDELE**, CNBL, CAPGENEES, INRA	France
Other	Controlled weaning in organic goat rearing	**ICEA,** ACOP, AUTH	Italy and Greece
Other	Portable milking machine in different farming systems	OHU-NIGDE	Turkey
Other	Assessment of Young Ambassador programme	**ORC** and NSA	UK
Other	Assessment of Flock Health Programme	**ORC** and NSA	UK
Production systems	Ecological knowledge transfer and sharing expertise from Transhumance	OHU-NIGDE	Turkey
Production systems	Small ruminant farmers' perception on climate change impact and assessment of adaptation innovations	RRAP	Turkey

Products and marketing	Participatory Guarantee System for Brogna sheep Association in Lessinia	ICEA, ACOP	Italy and Greece
Products and marketing	Functional food production from goat milk and lamb meat	ATAUNI	Turkey
Products and marketing	Marketing innovations for transhumance dairy products	**AUTH,** FRIZARTA	Greece
Reproduction	Testing of a new sheep and goat AI speculum	**INIA,** ASSAF.E, AESLA, AGRAMA, INIA, ARDIEKIN, CABRANDALUCIA, OVIARAGON, IDELE, and FRIZARTA	Spain and France
Reproduction	Controlling reproduction in sheep and goats and developing easycare breeds	**ATAUNI** and PAN	Turkey
Reproduction	Testing assisted reproduction technologies in dairy goats and maternal sheep	**ATAUNI** and PAN	Turkey
Reproduction	Drivers and farmers perception on hormonal control uptake in extensive farms in Turkey	RRAP	Turkey

5 Conclusions and recommendations

The high heterogeneity in the small ruminant production systems across Europe is reflected in the variability observed in the perception of relevance of the challenges and threats that face this sector. Based on the expert group's surveys it was observed that the geographical region (Southern vs Cental Europe) is one of the main drivers that determine the relevance and difficulties to address the main challenges of the small ruminant sector. The type of product (meat vs dairy) and level of intensification can also modulate the relevance of these challenges whereas the type of livestock species (sheep vs goats) is much less relevant.

The use of the priority index as an indicator of the relevance and easiness to address the small ruminant challenges identified the 10 most important challenges to face.

1. Low consumer education in product – external threat that needs action mostly from Government and associations of producers
2. Low promotion of local breeds – internal weakness that needs action mostly from Government, farmers, associations of producers and academia
3. Low consumer knowledge about farming – external threat that needs action mostly from Government and associations of producers
4. Poor business management training - internal weakness that needs action mostly from Government, farmers and associations of producers.

5. Researchers not address real problems – external threat that needs action mostly from academia.
6. Unfair trade, lack of traceability – external threat that needs action mostly from Government and associations of producers.
7. Low professionalization –internal weakness that needs action mostly from Government, farmers and associations of producers.
8. Slow adoption of innovations – internal weakness that needs action mostly from farmers and associations of producers.
9. Low adaptability of high producing breeds – internal weakness that needs action mostly from academia.
10. Poor recognition of public services – external threat that needs action mostly from government.

It was clear that internal weaknesses need more action from the sector itself (farmers and associations), while external threats require a strong involvement of Governments. Moreover, it was noted that a combined action of government, farmers and associations of producers should take place to address these challenges.

The on farm management innovations being tested within iSAGE in different case studies cover a wide range of challenges described in this report, especially those related to internal weaknesses of the sector. The results from such innovation case studies will provide information and tools to the sector to better deal with these challenges in the future.