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FoPIA-Surefarm Case-study Report Spain

Work Performed by Partner's P9 and P1., UPM and WU

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Brief summary

Introduction

The case study area is in the North East of Spain in the province of Huesca. Agriculture accounts for the 12% of the gross added value of the region, percentage much higher than that at national level (3%). The extensive sheep sector is a traditional agricultural practice that is strongly decreasing. The number of farms has decreased from 2.902 (1995) to 1.221 farms in Huesca (2015) and the number of ewes from 811.590 (1995) ewes to 491.621 (2015). The size of farms (600 - 2,300 ewes) is increasing mainly due to lack of new generation of farmers and the exit of the smaller farms.

The actors belonging the farming system are: the farmers, farmers' associations, cooperatives, local distributors, veterinarians, research institutes/ universities and public administration.

A diverse range of challenges emerge from the assessment of the sector: i) economic challenges: stagnation of the meat current prices, increasing inputs costs, low profitability, growing competition for access to land, growing competition with more profitable livestock sectors (intensive systems); ii) Environmental challenges: Wildlife protection (wolf and bear), diseases and drought; iii) Social challenges: reduction in meat consumption, negative public opinion on livestock farming, aging population and reducing access to social services in rural areas; iv) Institutional challenges: decreasing CAP payments with no positive action towards extensive farming, increasing bureaucracy and administrative control.

Main results

24 people attended the FoPIA-Surefarm workshop from different sectors: 9 farmers and farmers' association, 6 people from the value chain (veterinaries, cooperatives and distributors) and 9 people representing the public sector (Research institutes and Universities and local public administration).

The stakeholders identify three clear functions of the farming system: ensuring economic viability, the production of food, and the maintenance of natural resources in good conditions. To resemble the performance, the essential functions, the following indicators are chosen by the participants: sheep census/ number of farms (food production), gross margin (economic viability), percentage of pasture on total utilized agricultural area (natural resources), rural population (improve quality of life). The analysis of the indicators' performance over the last 20 years, show that most of them follow a negative trend and that they have been doing so predominantly.

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Several strategies have been identified to deal with challenges in the sector. The strategies can be grouped as follows: modernization and innovation, diversification, scale enlargement, intensification, production associationism, sale associationism and institutional aids to remunerate the provision of public goods.

Regarding the contribution of the strategies to resilience capacities, stakeholders consider that the strategies to deal with challenges affecting the sheep census, gross margin and on total utilized agricultural area have mainly contribute to adaptability. Some examples of these strategies are: intensification, increasing farm size, improving animal handling, improving product quality and promotion. Robustness enhancing strategies are also identified to deal with challenges affecting the population in rural areas and number of farms, such as improving management and nutrition, hiring immigrant people, and relying on public aids.

Although all the attributes have been scored relatively high on relevancy, showing that the sector may be need a broad spectrum of attributes to ensure resilience, the most relevant resilience attributes in the case study are the reasonable profitability, support rural life, diverse polices, and socially self-organized. The lower important indicators to the participants are the exposedness to disturbances, appropriately connected with actors outside the farming system and diversity response.

Conclusions

The results and discussions in the FoPIA workshop reveal that the perception of the relevance of the provision of public goods of the extensive sheep farming, mainly those related with environment and keeping rural population, has been increasing over the last years. The farming system’s actors consider that the relevance of the positive contribution of sector to the environment is almost the same than that of food production. Policies have not supported properly this essential function as this function has been gaining relevance.

The performance of the indicators of the system was very low. The system went through very difficult times over the last 20 years which has caused a shift in adapted strategies. The sector has encountered many challenges, and many farmers exited the system. The remaining farms are improving and reorganizing the system. Strategies such as increasing the size farm, investing in new technologies to improve farm management and animal handling, improving product quality, promotion and sales management are some examples of strategies performed by farmers in the region. Currently the system has moved towards a more intensified system whereby the share of traditional practices such as transhumance has strongly decreased.

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The system shows to be mainly adaptable. The robustness of the system is rather low. The system has been relying on its reserves and modularity throughout the years but it became clear that those general resilience principles currently are very low performing and that new strategies are needed in order to sustain the current functions.

Main resilience attributes need to be highlighted in the sheep extensive sector: i) Reasonable profitability, that enables robustness (keep savings and low debts for hard times) and facilitates investment towards adaptability (new technologies to reduces costs and increase productivity; ii) Support rural life, to keep families and skilled labor force in rural areas; iii) Diverse polices that support farmers to deal with the low profitability and enhance the contribution of the sector to the environment and rural development; iv) Coupled with local and natural, to ensuring the availability in quantity and quality of pastures and biodiversity; and v) Socially self-organized-, an important attribute for intensive and skilled labor sectors. Shepherding requires farmers to be a lot of time the animals and to have the knowledge enough to do it in a proper way. An adequate knowledge transfer is key for the sector.

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1 Introduction

1.1 General introduction

The location of the case study; ´extensive ovine production system´ analysed within this report is in Huesca province, in the North of the Spanish state of Aragon (in the North-East of Spain). The region covers about 15,000 km2 and has a varying geomorphology. Two main regions can be distinguished in Huesaca:1) The Pyrenees and pre-Pyrenees that cover less than half of the province (about 6,000 Km2)., with the most mountainous area in the north. Due to geomorphology agricultural activities in this area are confined to livestock extensive farming. 2) The south of the region is characterised by the plains of the Ebro depression (about 9,000 Km2). In this area extensive sheep farming and crop faming share the land. Extensive sheep farming is different in these two regions. The analysis focuses on the extensive farming in the south region of Huesca.

Climatically, the region is equally varied. In the north the average annual temperature is 5 degrees Celsius, in the south of the province the average annual temperature is 14 degrees Celsius. While the highest temperatures are found in the south of the province, the highest annual precipitation is in the north (1500 mm). In the south annual precipitation is 400 mm. The vegetation also follows this variety of environmental factors.

Agriculture forms an important part of the economy of Huesca. Most of the agricultural practices take place at the foothills of the mountains and the lower plains. However, the province knows a long history of ovine production and the practice of transhumance (extensive ovine production) (Navarro, 1992). While in history the ovine sector was a strong economic motor in this region, it´s importance has declined heavily in the last 20 years (Gobierno de Aragon, 2016). This decline is caused by various challenges that are currently present in the region.

One of those challenges is the vast population decline that has occurred over the last century (Bosque & Navarro, 2002). The province currently has a population of 219.000 people. The decrease has led to a lack of social services, labour and knowledge about agriculture. The population density declined by 54% since 1860 (Bosque & Navarro, 2002). Just as the human population, the sheep population in Huesca strongly decreased. In 1995 there were 2.902 farms, while in 2015 the number of farms decreased to 1.221 (a decrease of around 60%) (Gobierno de Aragón, 2016). This decrease of farms coincides with a decrease of 40% in total sheep count to a total of 491.621 sheep in 2015. At the same time the amount of sheep per farm has increased with about 50% to an average of 403 sheep per farm. This is partly due to the improved reproduction

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techniques, sanitary methods and the increased presence of partial housing (Pardos et al. 2008). The increase in heads/farm is also caused by the low succession rate (every time a farmer exits the system his sheep go to another existing farmer). Despite the strong decrease in the total sheep census over the last 20 years, the total production of meat has slightly increased. Even though the meat prices have remained rather equal and relatively low in current terms. While the costs of production increased. One of the reasons the meat price has not increased is that the sheep meat is losing popularity (the sheep meat consumption decreased from 2,1 kg/head in 2011, to 1,6 in 2015) (Martin-Cerdeño, 2018). An increase in exports to countries outside the EU has mitigated these negative effects somewhat (MAPA, 2016). Another challenge for the sector was the change in policies, regulations and an overall increasingly complex administration. Of which the most important was the change in the common agricultural policy (CAP). The change towards a partly decoupled and later fully decoupled payment has impacted heavily on farm income, and the CAP modulation as well (Pardos et al., 2008). Decoupled payments have been increasing, while coupled payments have been decreasing. Next to economic, social and institutional challenges, the sector is subject to a range of environmental issues. There has been an increase in drought events, of which the drought of 2007-2008 caused severe economic damage (Hernández-Mora et al., 2013). There has been an increase in human-wildlife conflicts. As wolves and bears are protected, their numbers have increased. This changes the incentives towards extensive sheep farming. As in stables, the sheep are safer. Table 1 summarizes the main challenges identified along the field work in the region.

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Table 1: Main challenges of farming system. (Information from interviews in case study area)

	Economic	Environmental	Social	Institutional
Shocks	Economic crisis	Diseases	Sickness of family members	
		Drought		
Long-term pressure	Low profitability	Climate change	Reduction in meat consumption	Increasingly strict rules for nature protection
	Growing competition for access to land	Wildlife protection (wolf and bear)	Decreasing population	Changes in objectives and rules of the agricultural policies
	Growing competition with intensive livestock systems	Erosion	Reducing access to social services	Decreasing CAP payments.
		Increasing disease pressure	Aging population	Increasing bureaucracy and administrative control
			Negative public opinion livestock farming	

Under the pressure of the aforementioned challenges, the farming system adapted new forms and strategies. For example, an increasing number of farmers abandoned their traditional way of farming. Traditionally farmers would move their sheep over the vast pasture lands of the pre-Pyrenees (transhumance). In 2004 about 30.000 sheep were held in a system of transhumance in between the Sierra Turolenses and the pasture of Levante, it was 45.000 ten years before, and about 100.000 in the middle of 20th century. Nowadays many farmers moved to a more intensified system (García-Manteca et al., 2018). Furthermore, a change from sheep farming to pig farming was observed. At last, to cope with the decreasing popularity of sheep meat, new sales initiatives are established such as the PGI label (protected geographical indication).

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1.2 Farm types

Firstly, a classification can be made of the farms by categorizing their number of livestock. Small farms typically have less than hundred sheep, middle farms between 10 and 499 sheep and larger farms have more than 500 sheep (Aragon.es, 2019). This division creates almost three equally represented groups within the case study area. Secondly, a division can be made based on the lands that farmers have access to (iSAGE, 2016). In the southern regions of Huesca, farmers mainly have access to rainfed, arid lands. In the middle regions, farms have access to mixed rainfed lands and in the northern part of the Huesca province farms can mainly access mountain lands (whereby the practice of transhumance is used).

From the interviews that were held in the region preliminary to the workshop it was found that many farms are mixed and combine the production of ovine with other agricultural activities. Traditionally both arable agriculture and livestock farming are combined with the extensive ovine production systems in this region. But recently they adapted more intensive practices in combination with the extensive ovine system. Many farmers hold fattening pigs for example. Furthermore, many farmers produce crops. Also, they produce olives and almonds in the region.

1.3 Workshop details

The workshop took place on the 31th of January from 10:00 to 16:00, in the lobby of a hotel in Huesca. There were 2 short breaks, and a lunch was served at 16:00. The workshop was assisted by 6 researchers/students.

Participants for the workshop were selected trough a careful selection process to get all faming systems actors represented in the focus group. The UPM team counted on the support of the main “gatekeeper” in the region, the local government officers. Participants were invited trough phone calls. The workshop was attended by 24 participants (Table A1) from different stakeholder groups. The main stakeholder groups were; farmers, value chain and institutions. Within the farmers group all stakeholders that own a farm or worked for a farmers’ organisation were included. For the value chain group, stakeholders such as; veterinarians, cooperatives and providers were included. The last group (institutions) is represented by stakeholders such as public administration and universities. When dividing the stakeholders within the stakeholder groups it was attempted to create three groups with comparable numbers of participants.

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2 Farming system

As part of the workshop preparation, a map was made of the different important stakeholders within the case study area (Figure 1). The farming system consists of all actors that mutually influence each other (Meuwissen et al., 2018). In the centre of the system are the farmers. They are closely connected to the farmers associations and organizations. Together these stakeholders form the farmers group within this report. Public administration, universities and research institutes form the institutions group. The value chain group within this report is represented by; the cooperatives, the feed providers, the veterinarians and the distributors.

In the FoPIA guidelines it is described that participants should be asked for feedback on the farming system. However, for time sake this was excluded. Due to the relative simplicity of the farming system participants agreed with the proposed farming system.

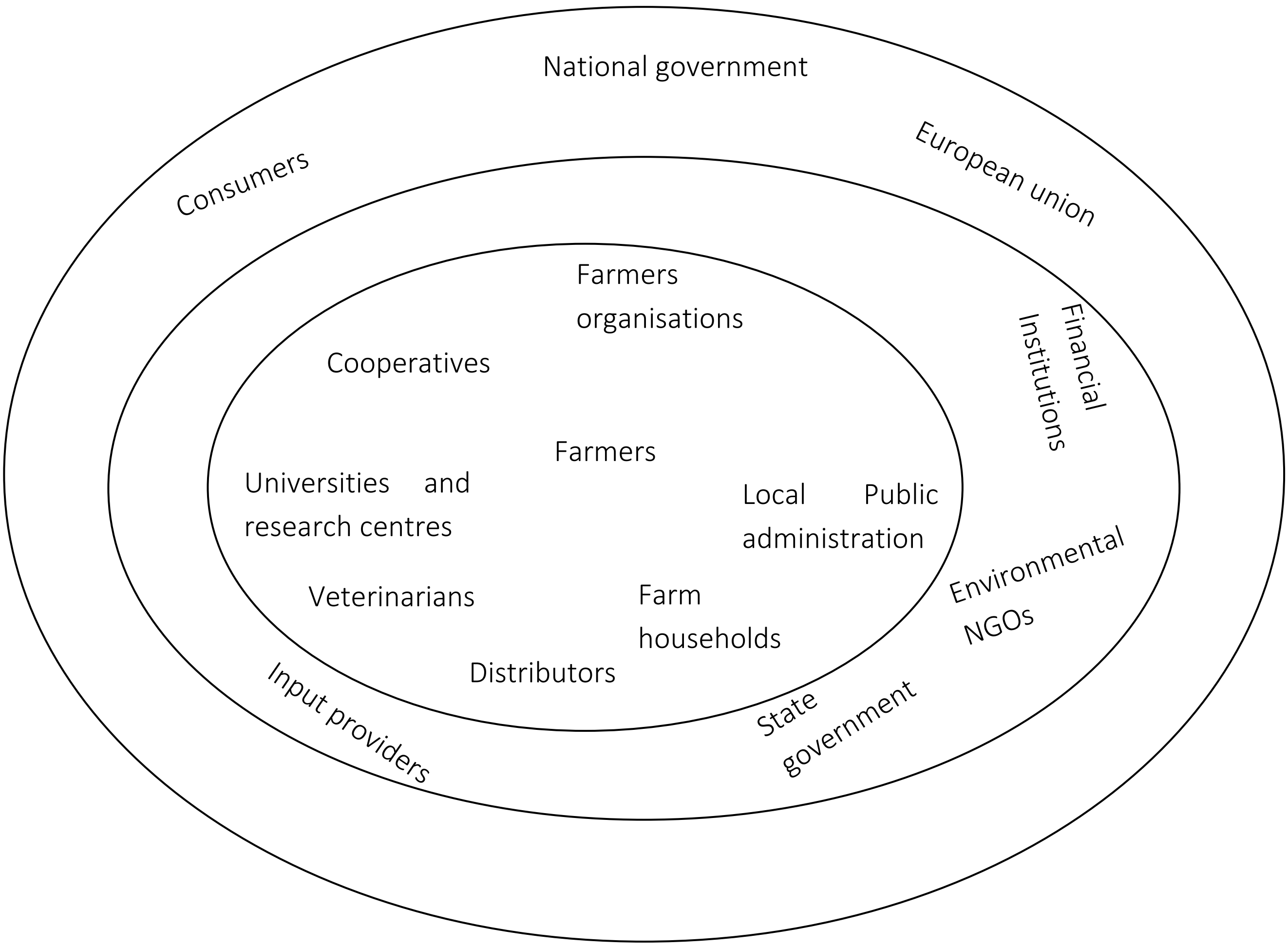

Figure 1. (Updated) farming system visualisation after feedback from participants

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3 Functions

According to the participants of all the stakeholder groups of the workshop the most important function of the farming system is economic viability (Figure 2). The scores of this function also coincide with the highest standard deviation (Table A2). Secondly, most stakeholder groups agree that food production is important. However, the value chain group scored animal health & welfare as equally important. The third most important function of the system is maintaining of natural resources. As described before, the value chain group does not concord on this. All stakeholders agree on the low importance of the function of other bio based-resources (leather and wool).

There was a clear consensus about the main essential function of the farming system in regards of ensuring the economic viability of the farms and farmers, followed by food production. Even the provision of private goods has been identified as more important than the provision of public goods, it is worth to highlight that an interesting discussion took place around the relevance of the economic viability to contribute be balanced territorial development (public good). Furthermore, most of the participants agreed on the relevance of the provision of public goods of the sector, related to its contribution to natural resources and biodiversity conservation and the attractiveness of the area. Participants agreed that livestock extensive faming contributes to natural resources to a greater extent than other agricultural specializations do. In regards the quality of life functions, the sector is not able to create job because its low profitability and it is very time demanding. These characteristics explain the low score given by farmers to this essential function.

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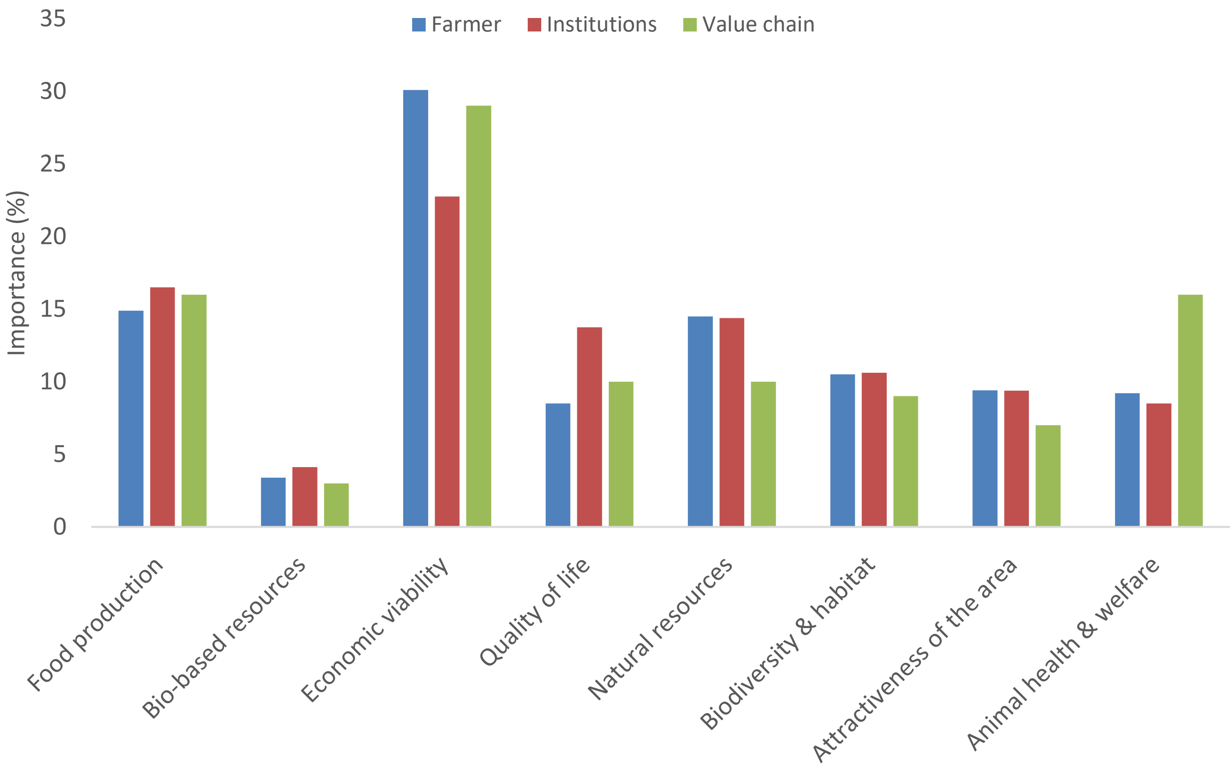

Figure 2. Bar graph with scoring per function, aggregated by stakeholder group. 100 points needed to be divided over 8 functions (n=24)

4 Indicators of functions

4.1 Indicator importance

As part of the preparation of the workshop the FoPIA team came up with several indicators in order to analyse the performance and importance of the functions of the farming system. At least two indicators per essential function were identified and assessed by the team before the workshop: Sheep census and meat production as indicators of delivering healthy and affordable food products function; wool production and leather production as indicators of delivering other bio-based resources; Gross margin, lamb price and feed costs as indicators of ensuring economic viability function; number of ovine farms and total labour as indicators of improving quality of life in farming areas function; Proportion of pastures on total agricultural area and number of heads under transhumance as indicators of maintaining natural resources in good condition; Variety of breeds and scarified animals under Protected Geographical Indication as indicator of ensuring that rural areas are attractive places for residence and tourism and Spending on zoo-sanitary products

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and compliance with animal welfare rules as indicators of ensuring animal health & welfare function.

The participants were asked to score the importance of those indicators to represent the functions. Participants from the different stakeholder groups of the workshop seem to agree on the importance of most indicators. After correcting the input data for the importance of the function and the different number of indicators per function it can be seen that "the gross margin" was the most important indicator for all stakeholder groups (Figure 3). The farmers and the value chain representatives also agreed that "the price of lamb meat" is the second most important indicator. The institutions scored "the percentage of pasture over the total area of utilized agricultural land" as the second most important (Table A3). The farmers and the value chain representatives scored "the feed costs" as the third most important indicator. The institutions do not agree on this and scored "the price of lamb meat" as the third most important indicator. Furthermore, all stakeholder groups agreed that "the wool and leather production" were the least important indicators. The largest differences between the participants scoring can be found for "feed cost, spending on zoo-sanitary products and the percentage of pasture over the total utilized agricultural area". The highest standard deviation was found for "gross margin, feed costs and the price of lamb meat (Table A3)".

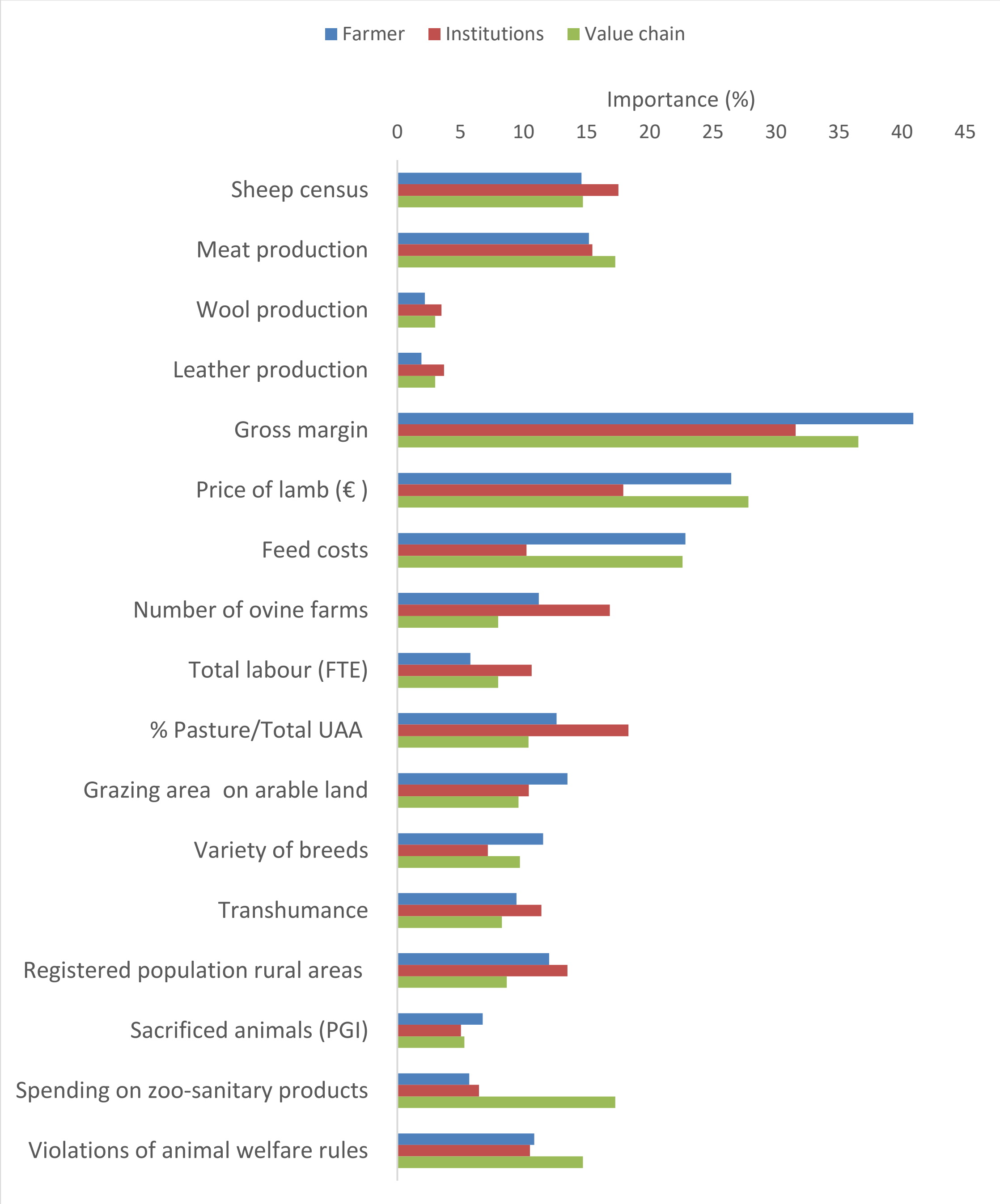

Figure 3. Bar graph with scoring of importance per indicator, aggregated by stakeholder group. Per function, 100 points were divided over the indicators. Values are transformed to include the importance and number of indicators of the function that the indicators represent. (n=24)

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4.2 Indicator performance

After the indicator scoring exercise participants were invited to comment on the proposed list of indicators. There was quite some discussion about the indicators. In combination with the graphical output and the feedback it was decided to make some changes to the indicator list.

There was a debate about indicators of the natural resource's conservation and biodiversity protection. The contribution of the extensive farming is well-known among the participants and they are truly interesting to show this function to population /policy makers. They think that it is difficult to prove it because of the lack of data and research. There is a pressing need of defining indicators to measuring the contribution the transhumance and grazing to biodiversity, the contribution of grazing to reducing forest fires, an allowing other ruminants to pasture in mountain areas). Keeping ovine breeds variety in the region was proposed by the team as a proxy to measure the biodiversity. Participants considered that this indicator is not the best option to measure the biodiversity but they were not able to propose an alternative.

Regarding the indicator "pasture area over the total agricultural area" the main problem is that the land considered as "pasture land" is not really being grazed. Considering this issue, it is important to consider just those hectares that famers and other actors know that are really grazed. There is a big problem with pasture are not grazed because there are more and more scrubs. This trend contributes to lose a source of feeding (sometimes the animals cannot go through the pasture land because of the scrub), and biodiversity and makes the forest fires more likely.

After a consensus was reached about the indicators, the participants were asked to score the current performance of the indicators (Figure 4). The best performing indicators were, according to the participants, "spending on zoo-sanitary products, compliance with animal welfare rules and slaughtered animals (PGI)" respectively (Table A4). The farmers scored "the spending on zoo-sanity products" as the best performing indicator. Institutions scored "the number of animal welfare compliance" as the best performing indicator. For the value chain group, "the grazing area on arable land and number of slaughtered PGI lambs" were the best performing indicators. The biggest difference within the scores could be found for the indicator; "total available labour". Farmers scored this indicator particularly high compared to the other two stakeholder groups. The lowest performing indicators were; "registered population in the rural areas, sheep census and wool production respectively". Farmers scored the indicators "sheep census, percentage of

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pasture of the total utilized agricultural area and total registered population in the area" as the lowest. The institutions also scored "the number of ovine farms and wool production" low. The value chain group scored "sheep census, meat production and registered population" respectively as the lowest performing indicators.

The highest standard deviations were found for "leather production, total available labour and the grazing area on arable land" (Table A4).

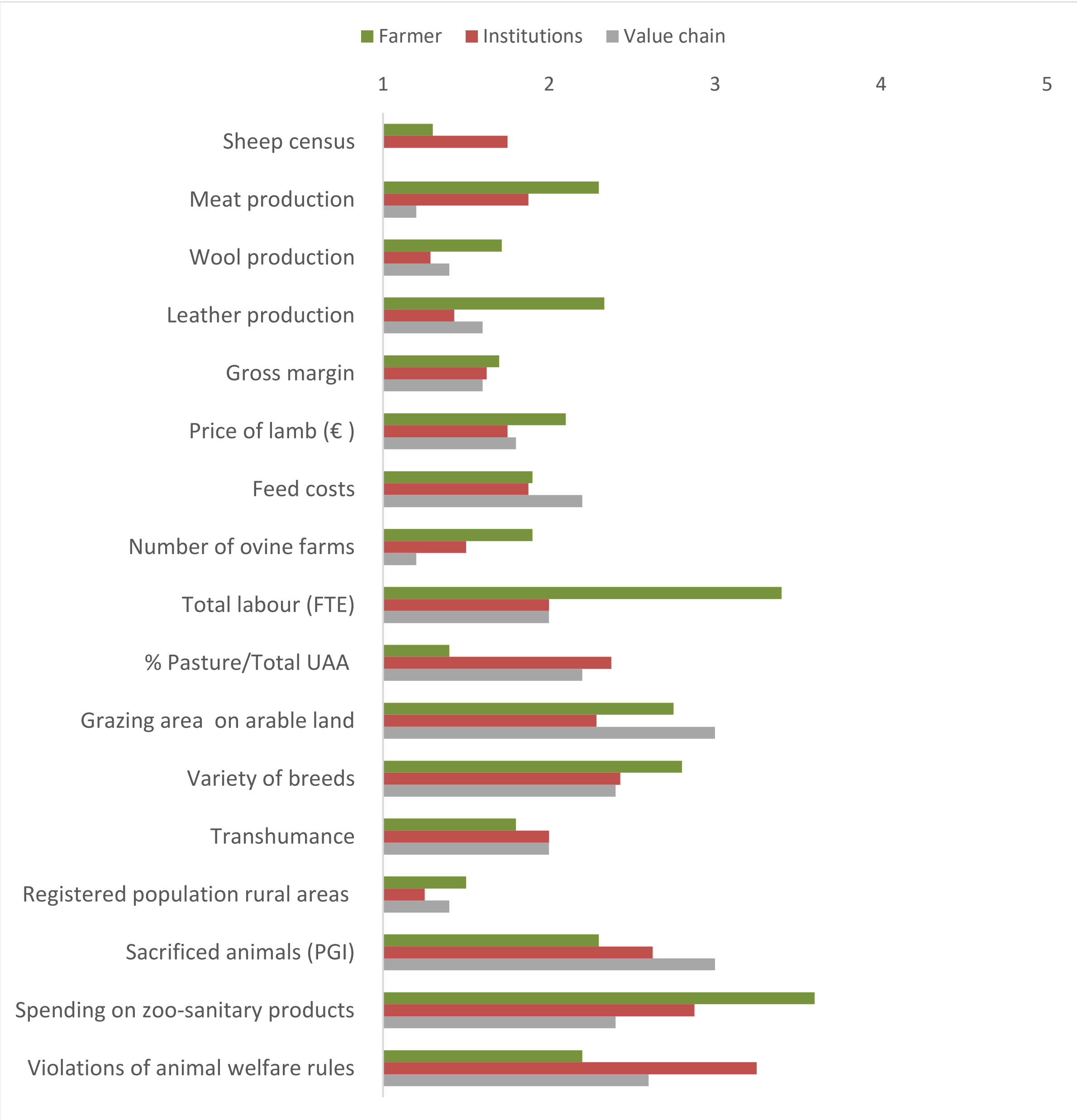

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Figure 4. Bar graph with scoring of performance per indicator (from 1 to 5), aggregated by stakeholder group (n=24).

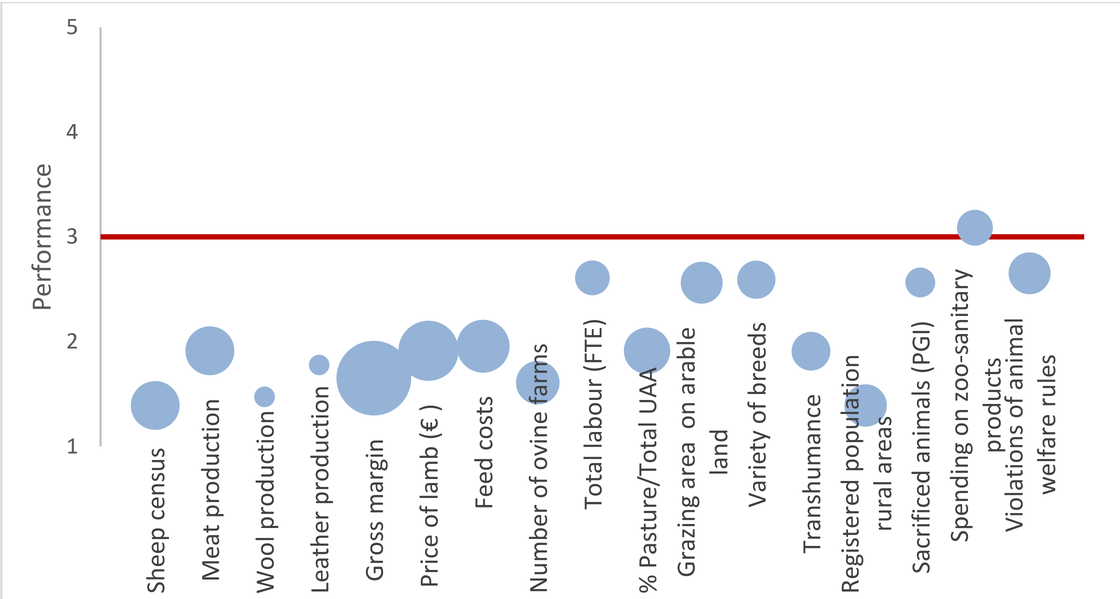

*Figure 5. Bubble graph presenting averaged scores on performance of **indicators** (from 1 to 5), while also indicating their importance (size of the bubbles), relative to each other (n=24).*

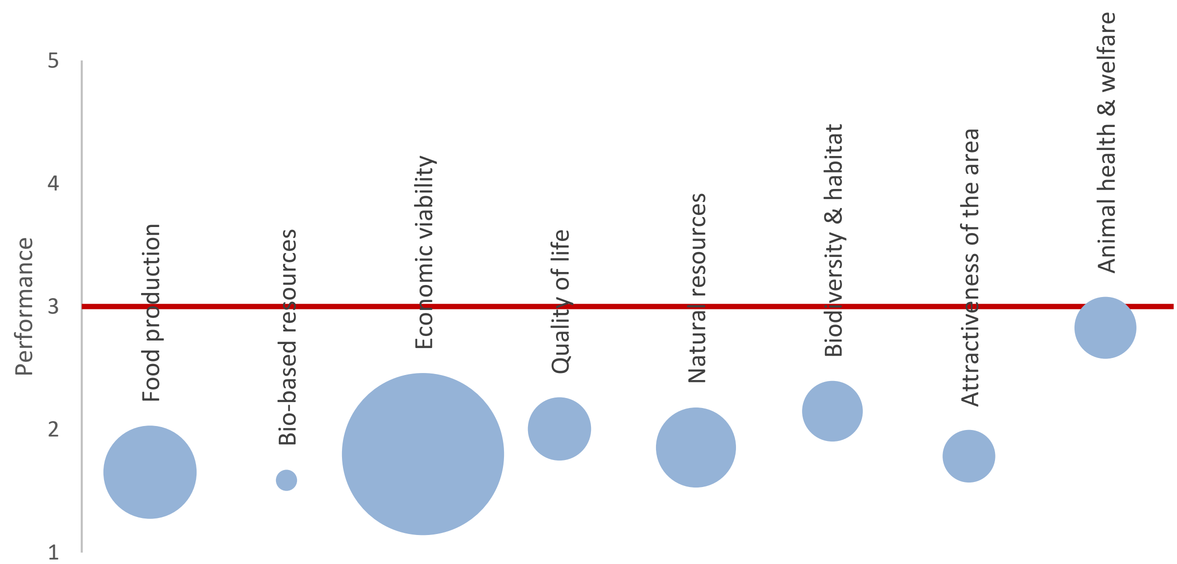

*Figure 6. Bubble graph presenting averaged scores on performance of **functions** (from 1 to 5), while also indicating their importance (size of the bubbles), relative to each other (n=24).*

4.3 Indicator selection

After scoring the indicators on performing and combining those results with the importance of the functions the indicators represent. a selection of indicators was made in consensus with the participants of the workshop, to further assess their development over the last 20 years.

Based on figure 5/6 and the discussion that arose among the participants and the workshop moderators, the most important indicators were selected. Finally, 5 indicators were selected, these indicators were: gross margin (economic viability), sheep census (food production), percentage of pasture over the total utilized agricultural area (Natural resources conservation), and number of ovine farms (quality of life) and registered population in rural areas (attractiveness).

5 Resilience of indicators

To assess the development of the selected indicators, participants were asked to draw a curve of the indicator performance over the last 20 years. This exercise was done in groups of five and in each group, there was a moderator.

5.1 Registered population in rural areas

Within this group the participants decided to draw the curve from 1990 onwards, instead from 2000. There reasoning was that the most important changes in population numbers were between 1990 and 2000. Overall the population has decreased since 1990 until 2018 according to the participants. Whereby in the first 10 years (1990 – 2000) the decrease is strongest. In the second 10 years (2000 – 2010) the decrease is lower and from 2010 onwards the population numbers were more stable (Figure 7).

The participants noted that this indicator can be misleading as many people that are registered in the area are not actually living there. Reasons for this can be tax benefits or temporal residency (foreign workers). Furthermore, they argued that the real number of inhabitants could be as little as a 3th of the registered population.

One of the reasons the participants found for the strong population decrease in the first period (1990 – 2000), was the strong economic boom in Spain during this time. During this period there was a lot of employment available in the neighbouring cities with attractive salaries. This created an incentive for the inhabitants to abandon the area. Another reason the participants found for the inhabitants to leave the countryside was the higher quality of life that could be found in the cities. In cities there was a higher availability of services and leisure activities. Furthermore, in the same period there was an outbreak of brucellosis affecting the livestock. This led to large scale clearing of sheep herds. As farmers were left without income after the clearing, they often moved to the cities for work.

During the second period (2000 – 2009) there was a decrease in availability of social services, security and sanitary services that further increased the emigration from rural areas. Especially the women and their children move to the cities were there was more safety and were they had access to schools. The decoupling of the CAP was another challenge for farmers during this period. The decoupling was accompanied by increasingly complex regulations and bureaucracy, which again led several farms to closure. Furthermore, during this period, participants said that the rising disease pressure among livestock further decreased the population due to closure of farms. During the last period (2010 – 2018), the economic crises that hit the whole country, decreased the incentives to leave the countryside, as there were little jobs available elsewhere. The participants noted that there were even people returning to the countryside, to work in their family's agricultural exploitations. Due to the lack of technological advancement still people left during this period. However, due to other people returning to the area the total population remained stable.

As a response to the decreasing population and a lack of workers there was an increase in foreign workers from countries such as Romania, Morocco and Poland. Another strategy was to reduce the time spend taking care of the herd by adopting technologies such as electric fences, cattle crushes and calves births control. Also, the remaining farmers bought the sheep of leaving farmers. They adopted a strategy of scale enlargement. Lastly, due to the increased disease pressure farmers improved the health of their animals by investing in better sanitary procedures and better feed.

As can be seen in figure 7 and 8, the participants were not able to precisely resemble the development and the performance of this indicator. It can be seen that they see the population decrease as more static and much less dramatic than it actually is. This is interesting, as during the workshop the issue of depopulation was often discussed. For the current performance of the indicators exercises the participants scored this indicator very low (1.4) (Table A4). Which might indicate that the smaller group working on this indicator was less aware than the complete group.

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The strategies that were found could be summarized into 3 categories: **Modernisation and innovation:** Modernisation of farms. **Scale enlargement:** Contracting foreign labour. **Intensification:** Improve management and nutrition.

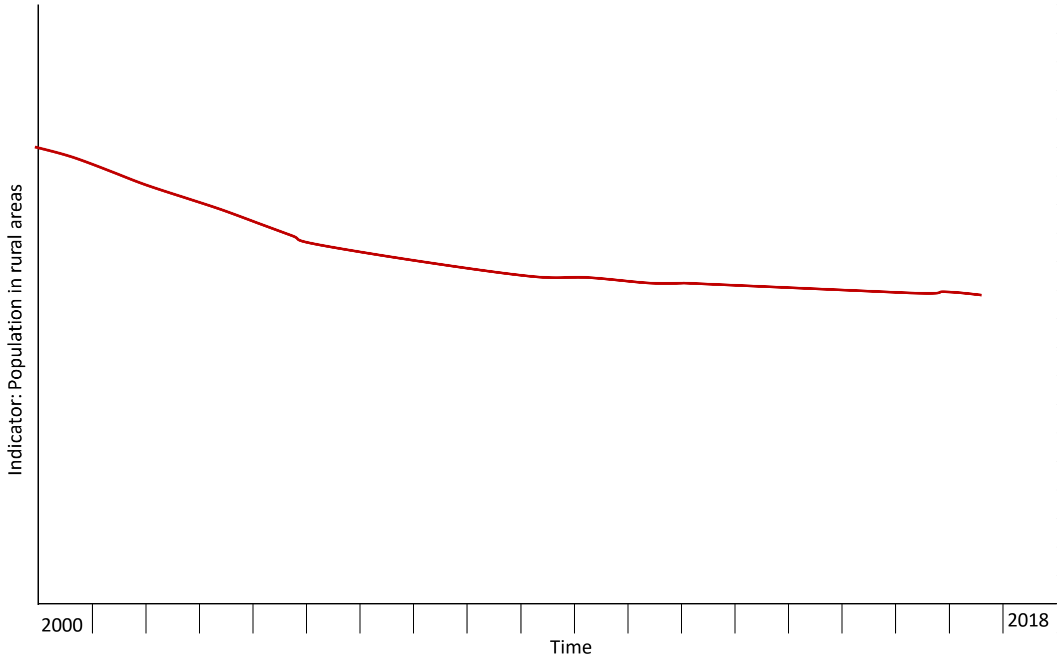

Figure 7: Development of registered population in rural areas drawn by workshop participants

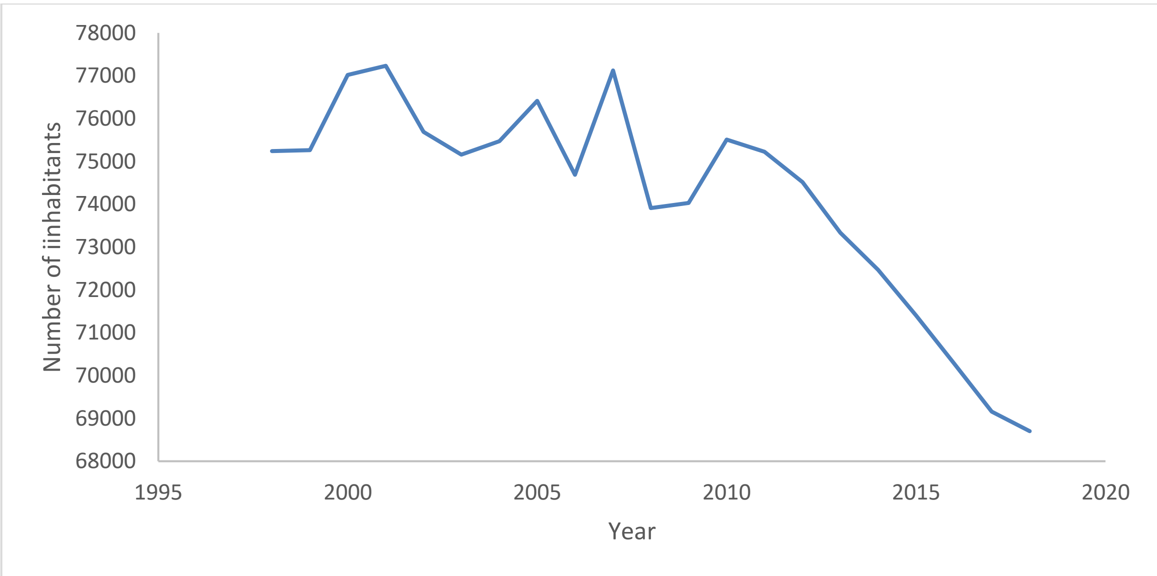

Figure 8: Registered population in rural areas (towns of less than 2000 people) in the Huesca province. Source: Instituto Aragonés Estadística, 2019

5.2 Percentage of pasture over total utilized agricultural area

The group of participants that drew the development of the percentage of pasture over the total utilized agricultural area over the last 20 years, firstly discussed if they had to draw the total area of pasture or the area of grazed pastured. They finally decide to only take grazed pasture lands into account. They argued that grazed pastures have a stronger positive contribution towards the environment and the maintenance of natural resources. Because the not grazed pastures are poorly maintained and sometimes the harvest is moved away from the land, the soils deteriorate and lose organic matter. Furthermore, on these lands there is a loss of biodiversity compared to grazed lands and an increased risk of wildfire because weeds and shrubs are not controlled.

Another discussion arose about the difference between the level of analysis (between farm level and provincial level). Finally, it was chosen to assess the indicator at a provincial level and use farm level examples to explain the indicator development. Finally, the group drew a decreasing line from 2000 to 2014 (Figure 9). In 2014 the area of grazed pasture started to increase again according to the participants.

The ovine crises already manifested before the year 2000. From 1990 onwards, there were increasing problems of aging population, lack of shepherds, price volatility, and low profitability that especially affected the smaller exploitations. During these years (1990 – 2000) many of the small-scale farms (<100 sheep) disappeared, diversified, converted into other farms or relocated to other areas. According to the participants that was the first big wave of loss of pasture lands. In the beginning of the years 2000 and onwards, there was a large discrepancy between the amount of sheep and available pasture due to the high rate of farmers abandoning their farms. This led to abandoned pasture lands. In the year 2005, the decoupling of 50 % of the CAP premiums occurred. This led to a second wave of abandonment of especially small farms, sheep census and thus a loss of grazed land. In the year 2010, the Cap was fully decoupled, which again led to large abandonment. This was for many inhabitants of the region a final reason to leave the countryside. Large scale abandonment of pasture lands was the result. Many of the pasture lands are administratively registered as grazing land in order to receive CAP payments, while in reality, those lands weren´t grazed. The large-scale abandonment of grazing lands led to increasing risks of fires, degrading landscapes and a lower quality of life for the inhabitants. In 2014 new CAP reforms improved the profitability of sheep farming, which is why an increment of pasture land could be seen from 2014 onwards.

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It became clear throughout the assessment of this indicator that many farmers abandoned their farms. The main strategy to overcome the problem with the over availability of pasture lands was to increase the size of the exploitations. Through scale enlargement (both in number of heads and area of grazed land) a larger area could be grazed with less farms. Another strategy was to increase specialization towards ovine production.

The participants were capable to largely resemble the performance of the percentage of pasture on total utilized agricultural (Figure 9&10). In the first years they found a steady decline, while in the latter years they found an increase in pastures. In literature something similar was found. The participants scored the current performance of this indicator quite low (1.9) (TableA4).

The strategies that were found could be summarized into 3 categories: **Diversification:** Diversification. **Scale enlargement:** Increase herd size, increase area of pasture. **Intensification:** Specialisation of farms.

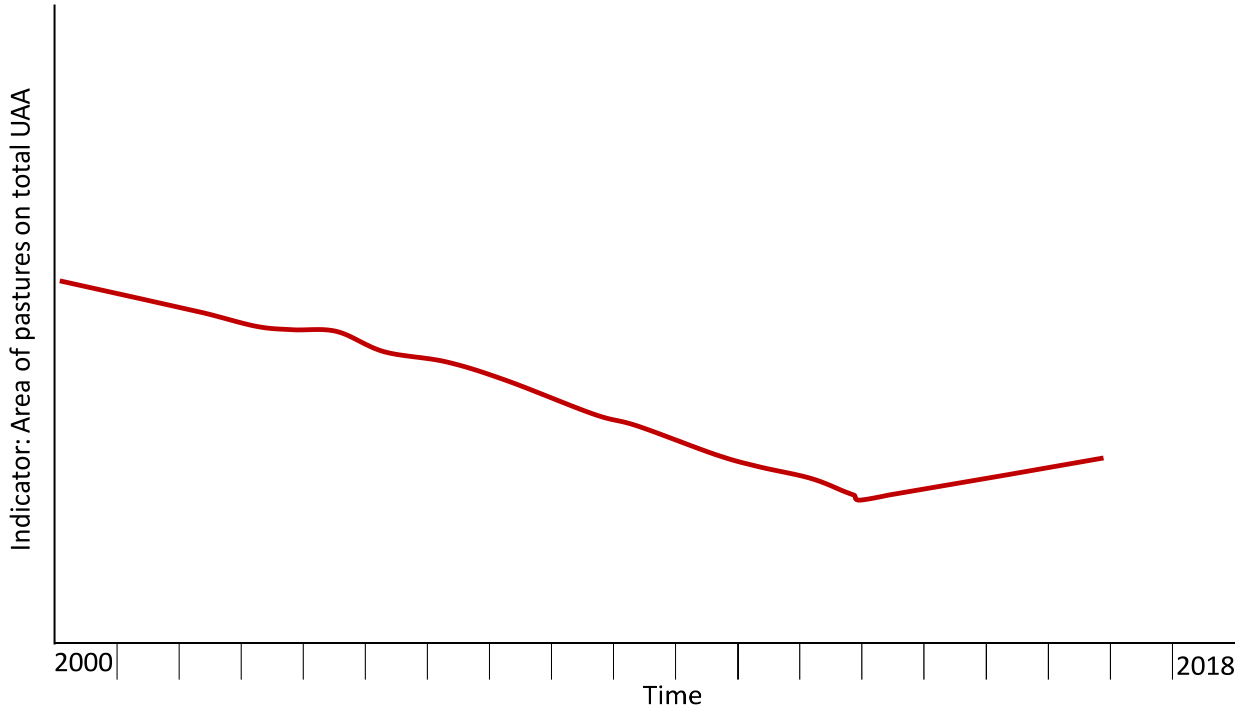

Figure 9: Percentage of grazed pasture of total utilized agricultural area in Huesca, drawn by the participants.

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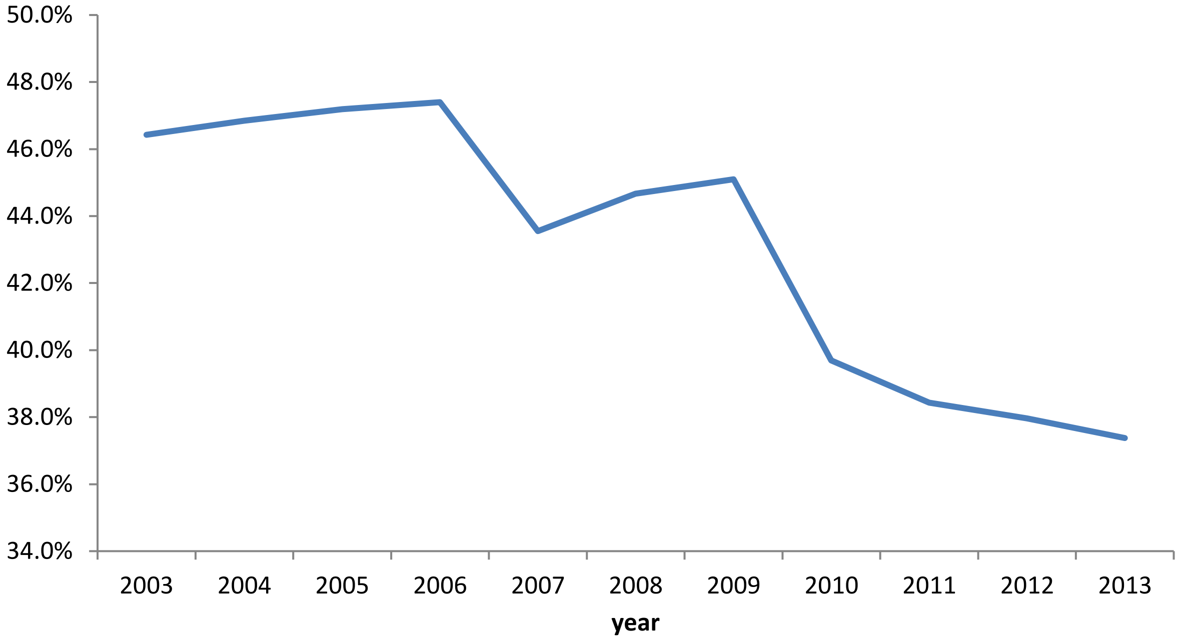

Figure 10: Percentage of grazed pasture of total utilized agricultural area in Huesca. Source: MAPA

5.3 Gross margin

The group that assessed the development of the indicator; "gross margin", found that the gross margin has decreased a lot over the last 20 years (Figure 11). According to them, the gross margin starts rather high, and increases until 2003. This was due to the approved financial aid from the 2000 agenda. The CAP was only partially decoupled by then. From 2003 to 2009, when the CAP was fully decoupled, there was a steep decline in the development of the gross margin. From 2015 onwards, the participant concluded that this steep decline changed to a more flattened one. The participants also added that after 2018 the gross margin started increasing again.

The group decided that the first big challenge occurred in 2003, when the CAP was decoupled. The reduction in agro-environmental premiums leads to a large fall in the gross margin. In 2007, the participants explained that, the decrease in gross margin is exacerbated by the rise in prices of raw materials and consequently of feed, fertilizers and diesel. Other challenges the participants found were the large droughts in 2012, 2014 and 2017. Also, there was an increase in the renting of grazing land caused since 2014 because of the establishment of the pasture allowance coefficient (not all grazing land is eligible to receive direct payments, which has led to competition for leasing pastures that are eligible for intensive cattle grazing that need them to collect premiums even if they do not use them). Lastly, the rise in labour cost affected the gross margin.

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The participants that analysed the gross margin found the following strategies; abandoning of the sector (decreasing the number of farms) and increasing the size of those that remained, modernization and innovation, genetic improvement and productivity, merger of cooperatives, commitment to quality and PGI, reorganising the value chain and promotion of sheep meat consumption.

The participants drew a declining line until around 2014. From there the gross margin stabilizes, to later increase a bit again (Figure 11). Although their graph does show some similarities with the real gross margin (Figure 12), the participants seem to hold a less positive perception to the increase of the gross margin. This is affirmed by the low score (1.7) the participants gave the current performance of the gross margin (Table A4).

The strategies that were found could be summarized into 5 categories: **Modernisation and innovation:** Modernisation and innovation. **Scale enlargement:** Contracting foreign labour. **Intensification:** Improve genetics. **Associationism:** Interprofessional cooperatives. **Sales associationism:** PGI.

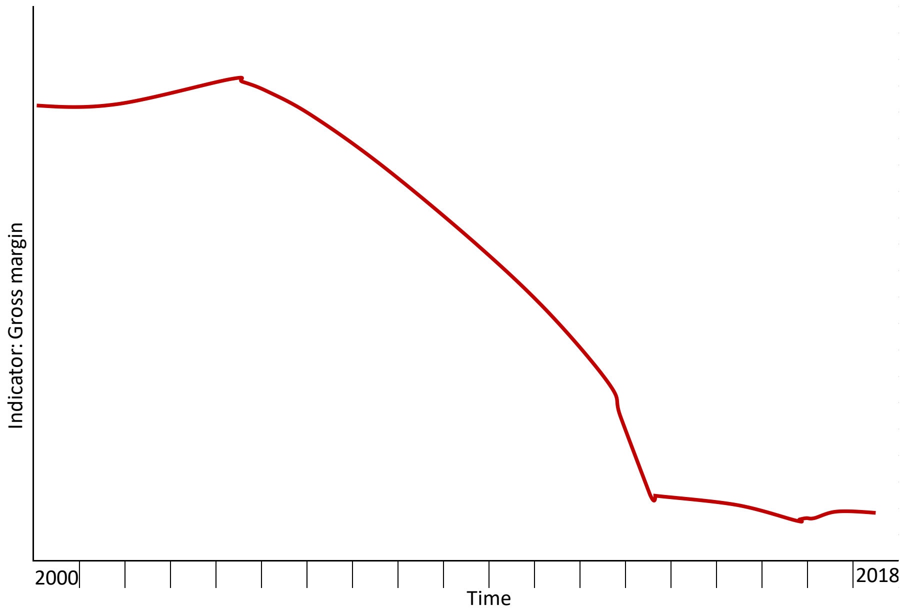

Figure 11: Development of gross margin/head in Aragón as drawn by the participants.

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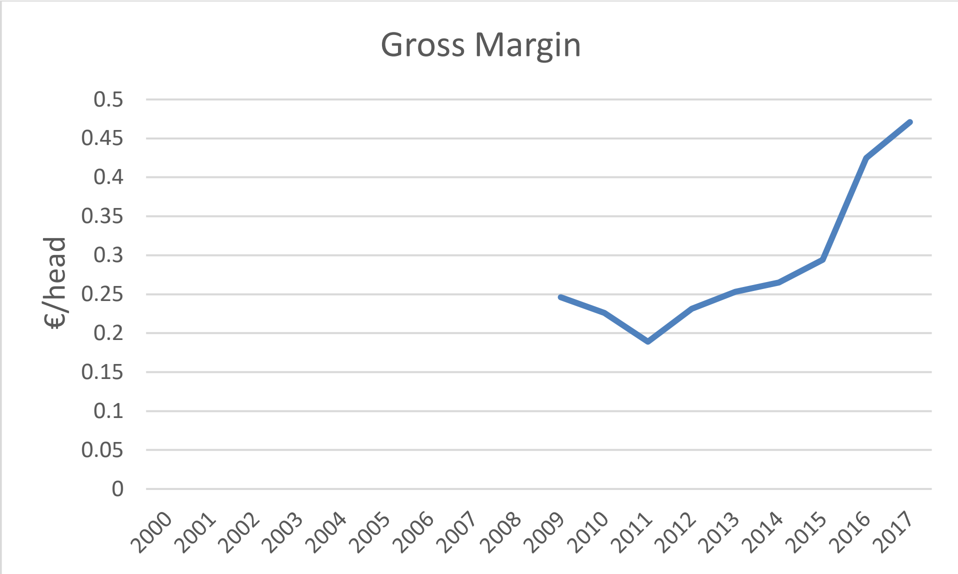

Figure 12: Gross margin/head in Aragón. Source: ECREA, incomes-direct costs.

5.4 Sheep census

As shown in figure 13 the five participants in this group preferred to consider a period comprise between 1986 and 2018. Although they weren't able to draw some particular movements reported by temporal series from statistical database, they agreed to draw quite precisely the overall trend. Specifically, that trend is characterized by a first significant and continuous increase up to 2000, a second short phase of stability 4-5 years long, and a final negative drastic trend that is still going on.

The agricultural policy has been the main argumentation along the debate, with particular regard to the CAP reform in 2000, the second CAP intervention in 2003, the introduction of a new sanitary normative for slaughters in 2004, and the complete decoupling of aids in 2007. Nonetheless, participants agreed that from 2007 onwards the low profitability and the reduction of consumption have been crucial factors, and that in the last five years high competition has been a relevant determinant of the negative evolution.

While a first strategy after reduction of CAP coupled aids at the beginning of 21th century was the use of agro-environmental measures of the second pillar, the strategy of cooperation has mitigated the negative trend, at least in a first phase. Then, and especially from 2007 on, the main strategies have been the increase of livestock per farm and the quality production (organic, local etc.). In the last years, most of the farms adapted one of these strategies: the farming of typical races or the industrial production, in order to survive to the high competition.

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When looking at the curve the participants drew for this indicator (Figure 13), it can be seen that the participants were not able to identify a clear development of the numbers that were resembling reality (Figure 14). However, their input does take into account a large decrease in the numbers of sheep. Furthermore, the participants score the current performance of the sheep census as very low (1.4) (Table A4).

The strategies that were found could be summarized into 4 categories: **Diversification:** Product differentiation, Variety of breeds. **Scale enlargement:** Increase herd size of farms. **Intensification:** moving from extensive farming to intensive farming. **Institutional aids:** Start of CAP, Agro-environmental measures.

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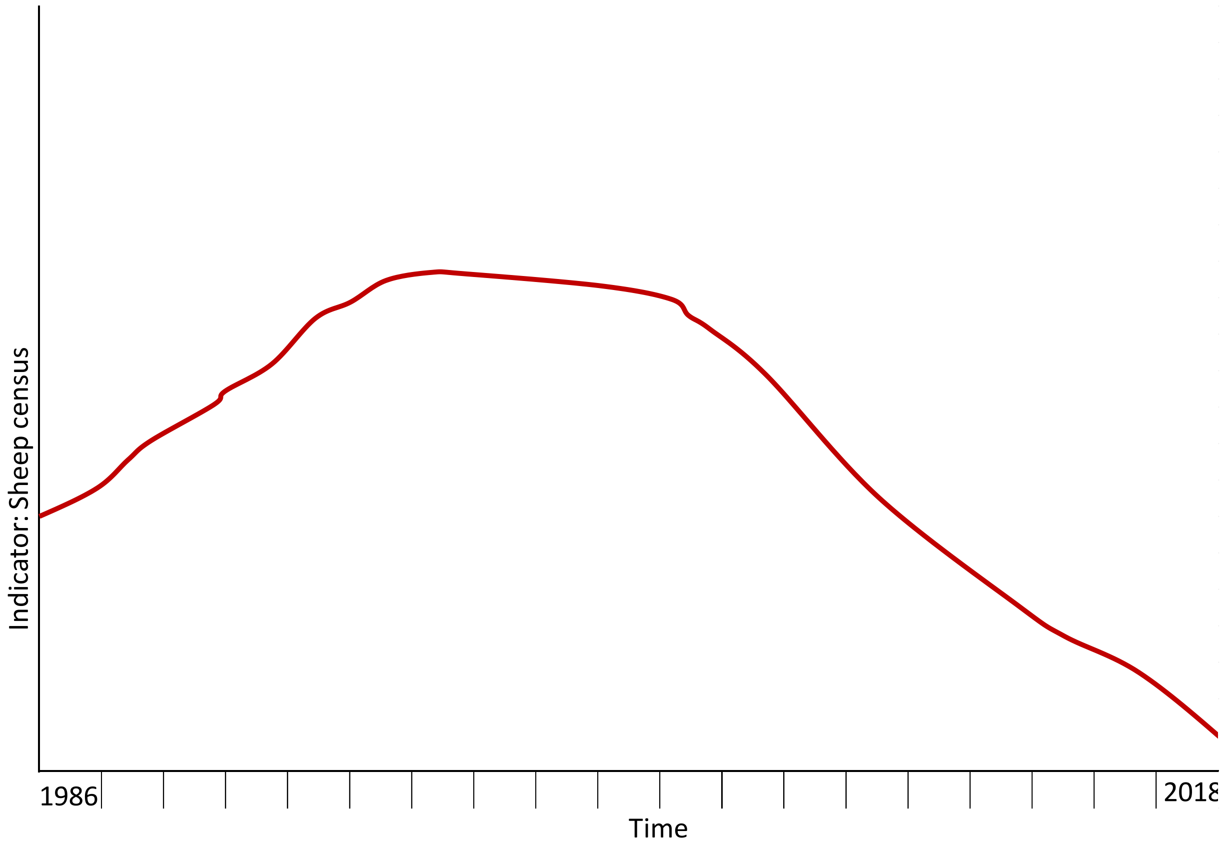

Figure 13: Sheep census in Huesca drawn by the participants

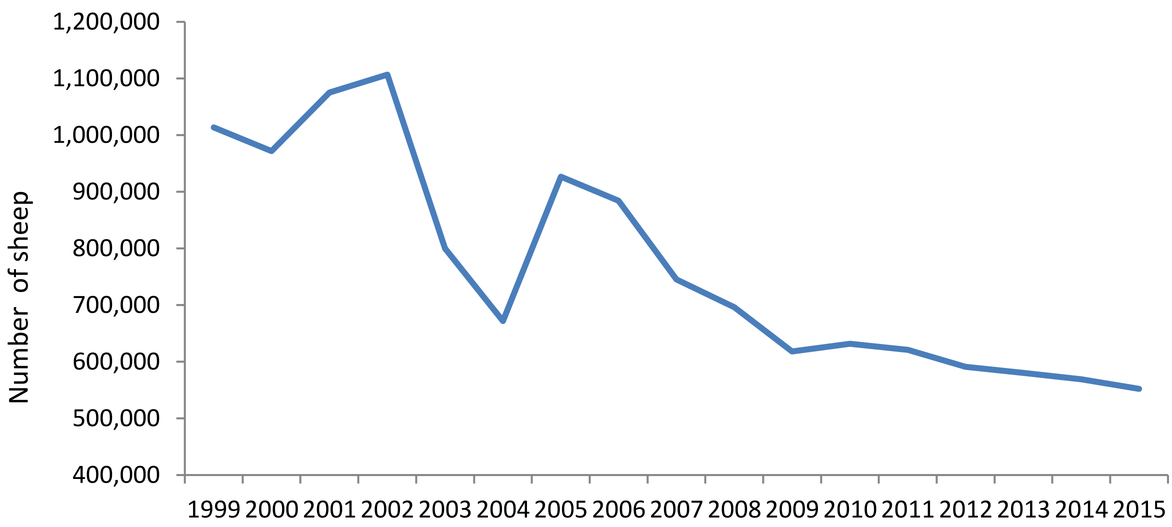

Figure 14: Sheep census in Huesca Source: MAPA

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5.5 Number of ovine farms

The participants of the group drew a straight decreasing line from the 2000 until the year 2018 (Figure 15).

The most important challenge that caused the decrease in sheep farms according to the participants was; the decoupling of the CAP in the years 2003/2004. Other important challenges were; the low profitability of the farms, low availability of help from administration offices, increased competition from other meats and animal proteins, changes in consumer habits, globalisation of the markets and the lack of skilled labour.

The most important strategies that were found were; increasing the scale of the farms, grouping of farms through cooperatives, and improve commercialisation of the products through cooperatives.
In order to receive more help, the farmers pressured the administrative representatives in order to change the policies. In order to cope with lack of skilled labour, new shepherds were trained.

The graphs of the participants and the data from the literature are almost similar (Figure 15&16). Both follow an almost straight decline. The participants scored the current performance of the number of ovine farms with a 1.6 as very low performing (Table A4).

The strategies that were found could be summarized into 5 categories: **Modernisation and innovation:** Management systems. **Scale enlargement:** Size of farms, Pasture formation. **Associationism:** Grouping of farms. **Sale associationism:** Marketing associations, Promotion of consumption. **Institutional aids:** More public support.

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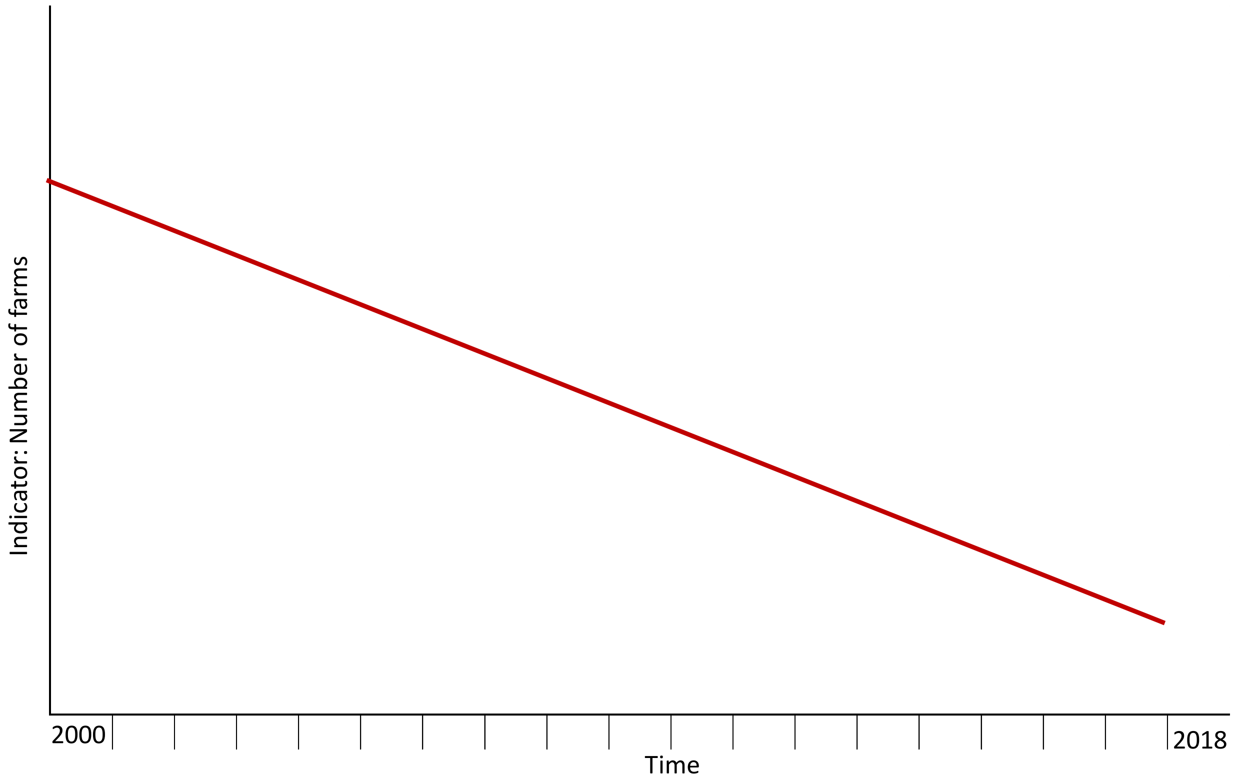

Figure 15: Number of sheep farms drawn by the participants.

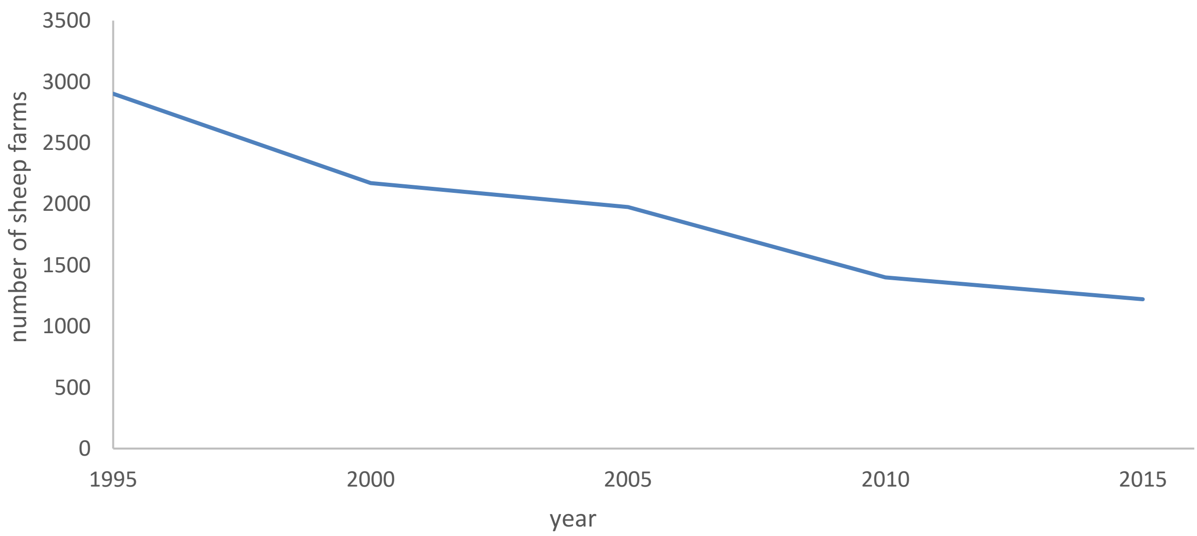

Figure 16: Number of sheep farms in Hoya de Huesca Source: Gobierno de Aragon

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6 Resilience attributes

6.1 Case-study specific strategies

After the historical dynamics exercise, a list of the challenges and coinciding strategies was made. The participants were then asked to score the implementation of the strategies (Figure 17) and the contribution of the strategies to the three resilience capacities (Figure 18).

The participants were quite positive about the implementation of the strategies within the system (Figure 17). According to them most strategies were at least moderately applied, and sometimes even stronger.

For the Registered population within the rural areas, all strategies were strongly implemented according to the participants of that group. For the percentage of pasture over the total utilized agricultural area the participants scored the implementation of diversification and increasing the herd size highest. For the gross margin the participants scored modernisation and innovation and increasing the dimension of the exploitations as the strongest implemented strategy. The sheep census group scored the implementation of increasing the size of the farms and the start of CAP as the highest. Two strategies that scored low were; the variety of the breeds within the system and the product differentiation. For the number of ovine farms group the highest scoring strategy was improved management systems. Within this group the strategy of grouping farms together scored relatively low. Furthermore, the strategy of forming new pasture lands scored very low (1 = not applied).

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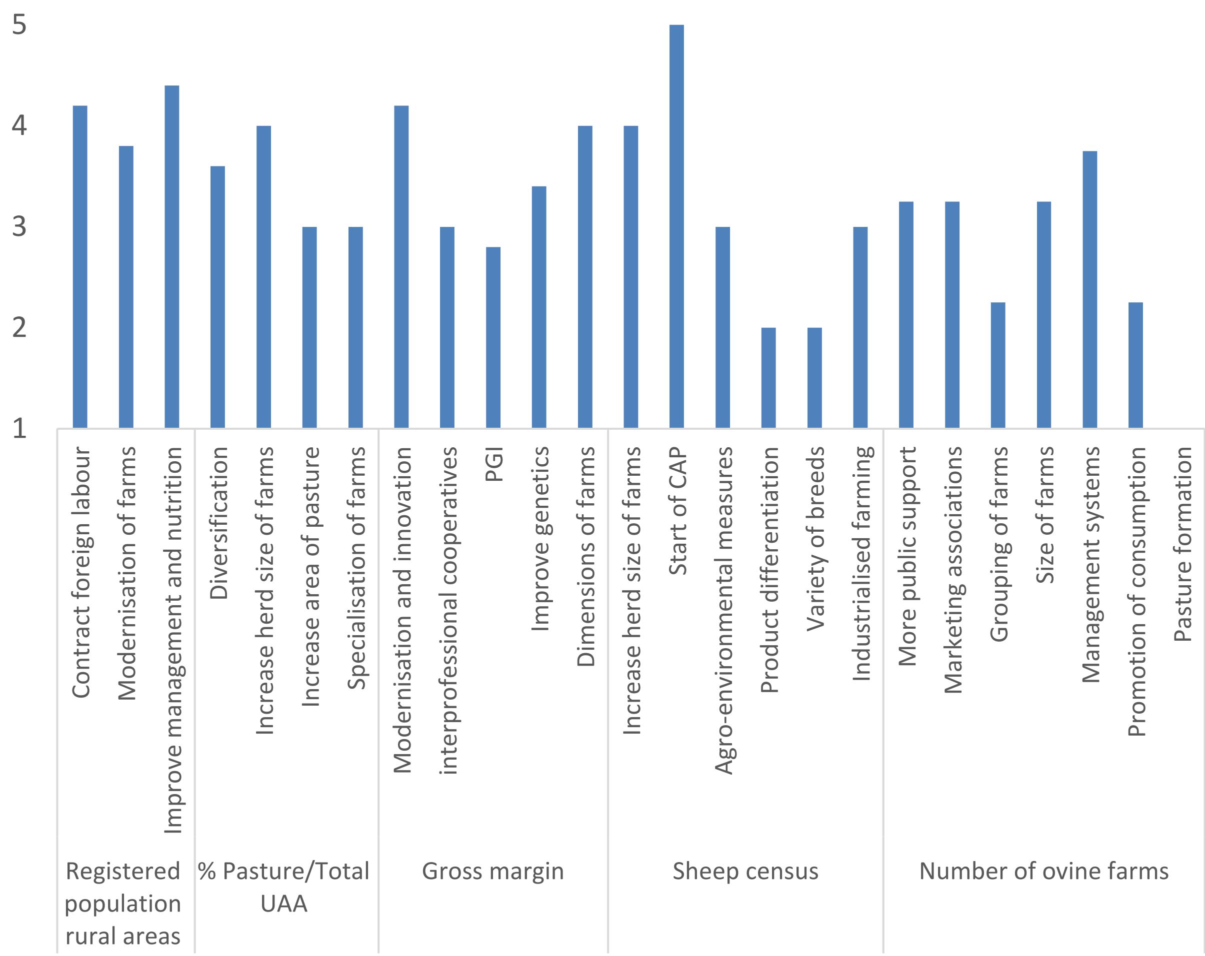

Figure 17. Bar graph showing level of implementation of strategies. 1 = not applied, 2 = slightly applied, 3 = moderately applied, 4 = adequately applied, 5 = perfectly applied (n=24).

After the participants of the workshop scored the implementation strength of some of the strategies, they were asked to give their opinion about how these strategies affect the three resilience capacities (Figure 18). Overall the participants agree that most strategies mainly contribute towards robustness and adaptability.

With regard to the registered population in rural areas the participants scored the contracting of foreign labour and the improving of the management and nutrition as mainly contributing towards robustness. Farmers have been forced to hire foreign labour. They do not have any other option but hiring foreign population. There are foreign people who have experience enough and interest to work with them. Increasing feeding costs and more likely droughts have also pushed farmers to improve management nutrition. They, supported by veterinarians, already have the

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knowledge to implement it. While, the modernisation of farms, according to them, contributes mainly towards adaptability. The strategy of contracting foreign labour did not contribute towards transformability. However, the other two strategies, modernisation of farms and improving the management and nutrition, according to them, have a high contribution towards the transformability of the system.

With regard to percentage of pasture over the total area of utilized agricultural lands" the participants scored the specialisation of the farms as the highest contributor towards robustness and adaptability. While, they scored the diversification of farms as the highest contributor towards transformability. All the strategies they found, according to them contribute to all three resilience capacities.

Regarding the gross margin, the participants scored the contribution towards transformability for all strategies as zero. The establishment of interprofessional cooperatives scored the highest in regard to its contribution towards robustness. For adaptability the highest score was received by the improvement of the genetics of the sheep. However, all strategies were scored with a comparable contribution towards adaptability.

Referring to the sheep census a different image is observed, again participants were of opinion that all strategies they found contributed towards all three resilience capacities. For robustness the highest contributing strategy was the CAP support. The strongest contributor towards adaptability was the strategy of increasing the variety of breeds. However, also here most strategies have a comparable contribution towards adaptability according to the participants. The contribution of the strategies to transformability capacity is much lower than adaptability and robustness.

For the number of farms most strategies contributed towards all three resilience capacities. As shown previously, the strategies contribute to transformability to a lower extent than adaptability and robustness. The strongest contributor for robustness was the strategy of increasing the size of the farms. This was also the strongest contributor towards adaptability according to the participants. The strongest contributors towards transformability were the strategies based on public support and the grouping of farms. We can find an exception in the score of the "pasture formation". It negatively contributes towards all three resilience capacities. This is explaining by

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the fact that participants score a new policy measure that limited the CAP payments for pastures. It is not a strategy.

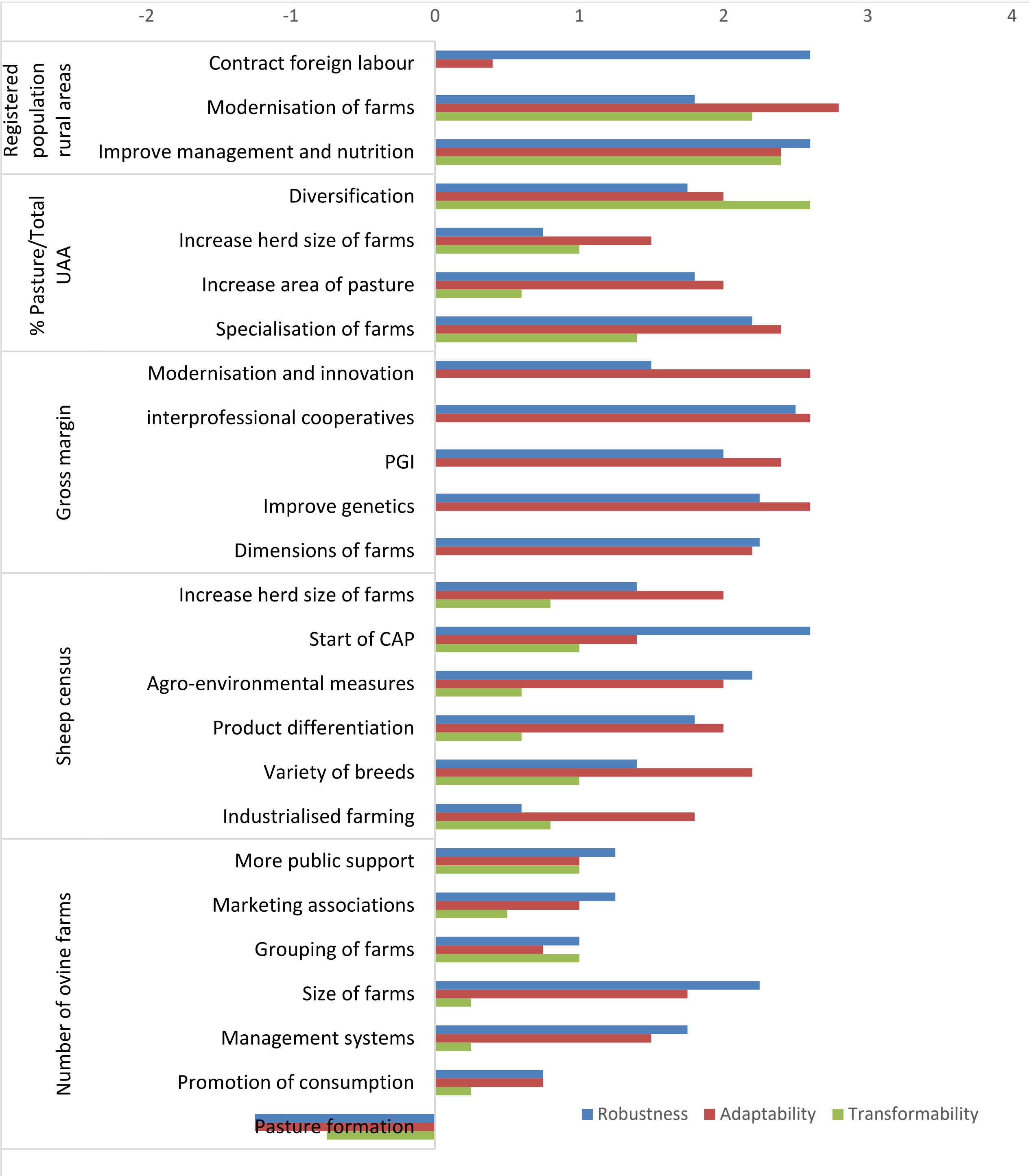
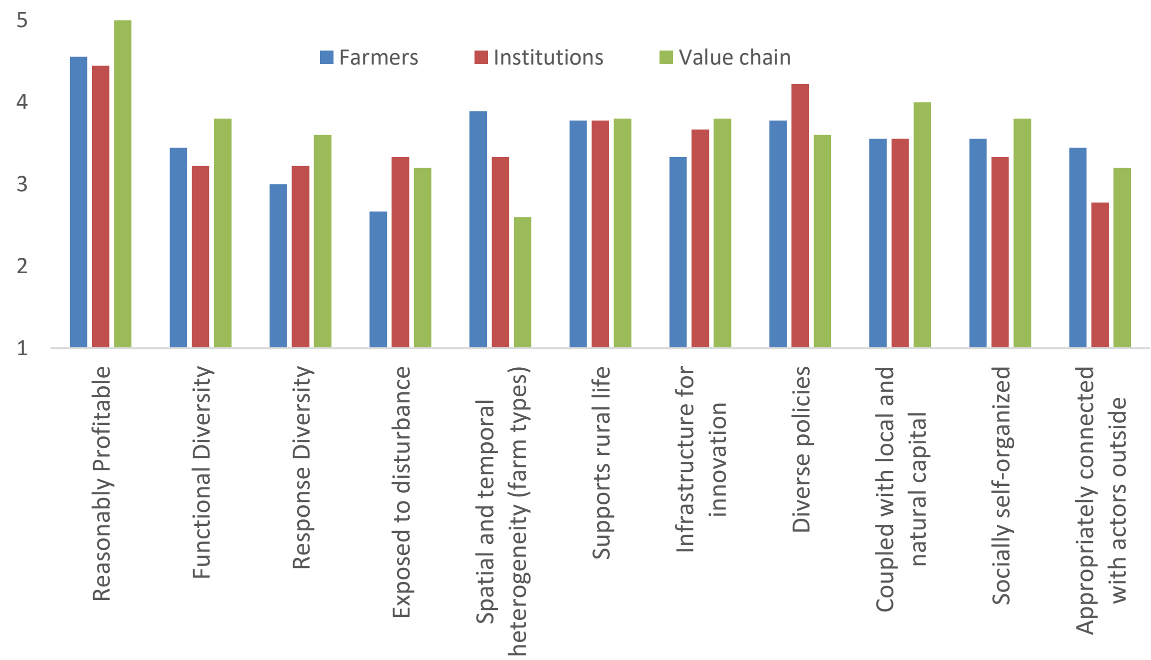


Figure 18. Bar graph showing average scoring of effect of strategy on robustness, adaptability and transformability of the farming system. A 0 implies no relationship, a 1 or -1 a weak positive or negative relationship, a 2 or -2 an intermediate positive or negative relationship, and a 3 or -3 is a strong positive or negative relationship (n=24).

6.2 General resilience attributes

In the guideline, the exercise includes two questions: 1) to score to what extent the resilience attributes apply in the farming system? and 2) to score the contribution of these attributes towards the three resilience capacities. Due to the this activity was the last activity in the workshop, it was complicated to fulfil and the participants were tired after the whole session, the second part of this activity was not able to be carried out and the participants were asked just to score to what extent the specific resilience attributes apply in the farming system (Figure 19).

Interestingly, all stakeholder groups scored most attributes as relevant to a moderate extend or higher. Furthermore, all stakeholder groups seem to broadly agree with each other within this exercise. The highest scoring attributes on relevancy were the reasonable profitability (mean = 4.6) (Table A7), diversity of policies (3.9), supporting rural life (3.8) and coupling with local and natural capital (3.7). The lowest scoring attributes for relevancy were; exposed to disturbances (3.0), appropriately connected with actors outside the farming system (3.1) and response diversity (3.2). The biggest stakeholder disagreement was about the attribute; spatial and temporal



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heterogeneity (Figure 19). The farmers think this is more relevant to the systems resilience than the institutions and the value chain.

Figure 19. Bar graph showing relevancy of the attributes for the farming system. Relevancy is scored as 1 = not at all, 2 = small extent, 3 = moderate extent, 4 = big extent, 5 = very big extent (n=24).

7 Discussion

7.1 Functions of the farming systems

Economic viability, food production and maintaining natural resources are the three most characteristics functions for this system. All stakeholders seem to agree on this, except the value chain group. They see animal health and welfare as a more important function than maintaining natural resources. Within these characteristic functions, the most characteristic indicators were sheep census (food production), gross margin (economic viability), percentage of pasture on total utilized agricultural area (natural resources). For the animal welfare, an important indicator was the spending on zoo-sanitary products. This selection is based partly on the outputs from the forms the participants had to fill in (Figure 5) and partly on the discussion that arose after the results were shown to the participants. Other indications that are characterising for the system are the number of ovine farms (quality of life) and the registered rural population (attractiveness of the countryside). These two indicators were not select based on the scores of their importance given by the participants, but rather on their poor performance. The population decrease was a major challenge for the region and indicators that indicate these developments have a strong causal relation with other indicators for the system. When looking at the farming system characteristics it can be concluded that it is a highly (extensive) production-oriented system, that has as its main function to provide income for the stakeholders within the system and relies heavily on local natural resources in order to do so.

7.2 Perceived current performance of indicators

As can be seen in Figure 4 and Table A4 the scores of the performance of the indicators were generally very low. This is an indication that the system is not performing well and that the current situation is not sustainable. Especially the scores for the indicators under the functions about the provision of private goods scored low. However, it could be that the workshop participants hold a too negative perception on the performance of their system. In order to assess the stakeholder

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perceptions, the scores of the current performance of the most important indicators by the participants were compared with available data.

7.2.1 Registered population in rural áreas

It could be concluded that for this indicator there was a discrepancy between the perceived current performance and the reality when looking at the results for the dynamic indicator exercise. The participants stated that especially in the latter years the population decrease stabilized. In fact, the depopulation rate strongly increased in those years. The rural areas of Huesca have been under heavy depopulation in the last 30 years (Instituto Aragonés Estadística, 2019). When looking at the results for the current performance (Table A4) it can be stated that the complete participant group had a more apt opinion about this indicator than the group that worked specifically on this indicator.

7.2.2 Percentage of pasture on total utilized agricultural

It could be concluded that the participants agree with literature that the performance of this indicator was low. From the expert interviews that were held prior to the workshop it was found that there still is a lack in pastures, which is especially problematic during drought periods. As a consequence, the housing period for livestock has increased (Pardos et al., 2008), and the amount of livestock and farms generally decreased. The decreasing use of pasture is connected to a number of factors, such as the cost of feeding (low feed prices decrease the incentive for grazing), droughts, wolf attacks and CAP payments. Also, the access to pasture has decreased, causing higher renting costs. In 2007-2008, the increase in feeding cost and droughts could have caused particular trends.

7.2.3 Gross margin

It could be concluded that the participants of the workshop are less positive about the increase in gross margin, than what was found in literature (Figure 12). However, the were right about the strong decreases in profitability over the last 20 years. It was found that farm net income of ovine farms in Aragon was largely dependent on subsidies. In 2002 the share of subsidies in total profit in farms was between 60 and 84% (Manrique et al., 2006). The main costs consisted of feed and labour, the main output product is lamb meat (Lozano et al., 2014). Drivers for change in farm income are thus strongly linked to changes in subsidies and changes in feed prices. The price of meat is also important for the income although to a lesser extent, as the CAP is not completely decoupled. There were also a couple environmental factors influencing farmer income, that are

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droughts and wolf attacks. A particular case of drought regards the period 2007-2008, while wolf attacks are a more recent issue.

7.2.4 Sheep census

It could be concluded that the performance of the sheep census is too low according to both the participants and literature. There are still many challenges present to overcome this problem. The ovine sector in Aragon has been strongly influenced by the different CAP reforms (Pardos et al., 2008). In the CAP reform of 1992, extensive agriculture was strongly encouraged. Farmer received a subsidy for each head in their flock, and not necessarily for the products they produced. This was a driver for growth in the ovine sector. However, in the last 20 years the number of ovine herds of Hoya de Huesca shrank with more than 60% (Gobierno de Aragón, 2016). The decrease in the total ovine population was 50% over the last 20 years. This means there has been a slight increase in the herd size in Hoya de Huesca. The decrease of both the total number of heads and the number of herds was slightly higher than the average of the total Aragon region. The biggest decrease of number of heads occurred around 2002 – 2003. This was just after a short increase due to the FMD (foot and mouth disease) in the United Kingdom in 2001 (De Rancourt et al., 2006). The FMD pushed the prices for lamb meat up. In 2003 the new CAP reform was established, farmers were no longer subsidized per sheep. This drove the profits further down (García, 2017). One of the main drivers for the decreasing size of the ovine sector is the decreasing profit farmers can make per sold product. Lately the rate of succession and the age of the farmers has become another challenge (Ezquerra, 2011).

7.2.5 Number of ovine farms

It could be concluded that the participants are aware of the problems around the high number of exiting farmers. Furthermore, it seems that the trend of farmers abandoning their farms has not yet come to an end and it can be expected that many more will leave. From the expert interviews that were held prior to the workshop it was noted that the number of farms has decreased in the last 30 years, while on average farms increased in size. The main cause for this was the decrease of profitability due to factors such as low selling prices, increasing costs, reduced consumption, higher profitability in other sectors and higher competition due to market liberation.

7.3 Robustness, adaptability and transformability of the farming system

Within this chapter it will be concluded if which of the resilience capacities this farming system shows. First the strategies will be discussed. Secondly, the general resilience and the main

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processes of the system will be assessed. Finally, a short conclusion will be given about the resilience capacities based on the workshop results and the prior paragraphs.

7.3.1 Strategies

When looking at the strategy groups in which the strategies found by the participants are summarised, it can be seen that each strategy group has a different influence on the three resilience capacities. The strategy of modernisation and innovation is most likely to contribute strongly towards the adaptability and slightly towards the transformability of the system. Modernisation and innovation are very similar concepts. In fact, the concepts of innovation are often seen as a part of modernisation (Diederen et al., 2003; Grin et al., 2004). Meuwissen (2018) states that a system that is open for innovation Is likely to be more transformable. However, it is also argued that there are different rates of innovation (Martin et al., 2013). Radical innovation is the highest class and encompasses changes to a system output for example. Such a drastic change is a typical characteristic of a transformation (Meuwissen et al., 2018). It is also argued that less drastic innovations contribute towards the adaptability and robustness of a farming system (Meuwissen et al., 2018). Robustness and transformability are less relevant in this case, as the strategies under the group of modernisation and innovation mostly focussed on adapting to and coping with changing circumstances in the farming system, without drastically changing inputs or outputs.

The strategy of diversification contributes mainly towards the adaptability and the transformability of the system. Cabell and Oelofse (2012) state that the functional diversity of a system provides a source for renewal in case of unforeseen challenges. High functional diversity leads to a high diversity of knowledge and skills which will help the system adapt and transform. It is however, interesting that during the workshop it was often mentioned that one of the major challenges is the lack of skills and knowledge.

The strategy of scale enlargement contributes towards robustness. However, this strategy is often debated to be of a negative influence on a systems resilience, as it decreases the redundancy and the modularity (Resilience Alliance, 2010; Cabell & Oelofse 2012). However, Hoekstra et al. (2018) state that scholars assessing these subjects often hold different opinions regarding this strategy. There are those that follow the control rationale, whereby a single variable is improved by optimizing other variables, and those that follow the resilience rationale. These rationales are often very opposed to each other, while in fact a combination of both could be beneficial. In order

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to overcome the low profitability of the system in Huesca, this strategy provided an outcome. By increasing the sizes of the farms both in number of sheep and area, the cost of production could be decreased enough to make the system reasonably profitable gain. This allows the farmers to build reserves, which can later be used to cope with (economic) challenges. A characteristic that is debated to contribute strongly towards the robustness of a system (Cabell & Oelofse, 2012; Meuwissen et al., 2018).

Intensification is very similar to the strategy of scale enlargement and is also discussed under the control rationale (Hoekstra et al., 2018). However, part of this strategy group are the strategies of specialisation and industrialisation. Specialising and industrialising a farming system contributes negatively towards the adaptability and transformability. It is even debatable if this strategy delivers a positive contribution towards robustness. This highly depends on the rate to which a system is intensified (Hoekstra et al., 2018). Industrialised farming is often referred to as the highest possible intensification rate of a system (fully on the side of the control rationale). It is important to notice that both the strategy of intensification and scale enlargement can improve the systems robustness to a certain rate but form a threat to resilience when taken to extremes. It should also be noticed that, most of the strategies found by the participants were assigned to these two strategy groups. Furthermore, the workshop participants found these strategies to be contributing highly towards the adaptability and transformability of the system and they also scored the implementation of these strategies particularly high (Figure 17). Both literature and the author of this report disagree with them. However, as Meuwissen et al. (2018) state that "creating of safe operating space" is a characteristic of improving the adaptability of the system, it could be that by improving the profitability of the system (by reducing costs and increasing production) the participants felt more freely to experiment with new strategies and therefore address this to an improvement towards the adaptability.

Another strategy group was associationism. The strategy of creating new organisations and associations for improving the sales, social networks and the exchange of knowledge and skills, contributes towards all three resilience capacities. This strategy can be strongly linked towards the attribute of social self-organisation (Cabell & Oelofse, 2012) and the optimal redundancy of the farming system (Cabell & Oelofse, 2012; Meuwissen et al., 2018). The capacity of social actors within a farming system is found to contribute towards the adaptability of a system. If a system is optimally redundant, Meuwissen et al. (2018) state that a farmer can exit the system without posing a threat to the other farmers within the system. During the workshop it became clear that this is not the case currently. However, as the creation of new social organisations is rather recent this can change in the future. As a redundancy in organisations can provide more extensive networks over larger areas, and thus result in more local independency of farmers.

Finally, the strategy of providing farmers with institutional aid, mostly contributes towards robustness as this provides a reasonably profitable farming system (Cabell & Oelofse, 2012). However, Cabell & Oelofse (2012) also state that it is a threat towards the robustness of a system when farmers rely too much on financial aid. Furthermore, the provision of financial aid in Huesca mainly came from the European Union and the Spanish government which are actors outside the farming system. Stakeholders within the farming system thus have very little influence regarding these financial providers. In Huesca it seems that the system has been very reliant on financial aids. The participants scored the implementation of this strategy group as rather high (Figure 8). It is thus likely that this strategy has passed the optimal implementation rate and that the farmers are too reliant on aid. This means that this strategy is likely to have a negative contribution towards robustness.

7.3.2 Specific resilience attributes

The participants were also asked to score the relevancy of the resilience attributes (Cabell & Oelofse, 2012; Meuwissen et al., 2018) for their farming system. For this exercise there was a deviation from the methods described in the FoPIA- guidelines (D5.2 – Reidsma et al., 2018). Therefore, it is not possible to precisely assess the contribution of the attributes towards the resilience capacities and to identify trade-offs. It Is however possible to see that the participants found many of the attributes relevant for the resilience of the system. Especially the attribute of reasonable profitability is relevant for the system. Relevancy does not mean that it the current performance is good. It is even likely that the more relevant the participants find a certain attribute, the more they are missing the attribute within their system. However, it is not possible to prove such assumptions. The indicator that was scored as least relevant for the system was the exposedness to perturbations. During the workshop it became clear that the participants were strongly averse towards this attribute. In fact, they blamed the liberalisation and increased openness of the system often for the collapses they went through. Interestingly, the attribute of reasonable profitability is strongly connected to the conservation phase of a system and contributes mainly towards the robustness of a system. Cabell & Oelofse (2012) link exposedness to disturbances to the reorganisation phase and state that it mainly contributes towards adaptability. Furthermore, they state that in order for this attribute to achieve a positive effect

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the system already needs to be robust. It could be that the participants held the same opinion and did not think their system was robust enough to be exposed to disturbances. Another explanation could be that the participants mostly think through a sub-system (own farm) perspective when scoring the resilience attributes rather than seeing the benefits for the system as a whole. It could also be that conservation and high levels of robustness are just more desirable for the comfort of human beings.

7.3.3 General resilience

As explained before the methods applied within the Spanish case study deviated a bit from the guidelines. The FoPIA-SureFarm guidelines connect specific resilience attributes with the five general resilience principles (Resilience Alliance, 2010). By looking at the scores for the current performance of the specific resilience attributes something can be said about the general resilience principles. However, as the scores for current performance of the specific resilience attributes were not available, this link cannot be made. Instead, information from literature, interviews and other workshop outputs were used.

7.3.3.1 Diversity

Through the specific resilience attributes (functional diversity, response diversity and diverse policies). From the output from interviews and the workshop it becomes clear that the system is quite diverse. It is diverse when considering the farm types that can be found in the area. Many farms are mixed, and do not only rely on ovine production. Many of those mixed farms produce different livestock or crops next to their main practices. However, when looking at the diversity in responses towards challenges, it can be concluded that the system is lacking diversity. From the dynamics of indicators exercise, the majority of strategies focussed on either scale enlargement or modernization. It seems that the system has been decreasing its diversity in farm types over the last 20 years by specializing and intensifying their means of production. Furthermore, the functional diversity of the system is not high either. The system almost only focusses on the generation of income by producing food. A very important side – ecosystem service that the system delivers is the maintenance of pasture lands in the mountainous regions by grazing them. However, as the system changes towards new ways of producing, the practice of transhumance is more and more abandoned. Thus, the system is moving more towards the production of food and generating of income. This indicates that also on this aspect the system has been losing part of its diversity. The participants of the workshop scored the diversity of policies as very relevant for the system. This might indicate that currently there is a lack in diverse policies and policies that support the provision of public goods. It might also indicate that this is a very important attribute for the resilience of the system. From the discussions during the workshop and the output from the workshop it became clear that the farmers heavily relied on the financial support from outside the farming system. The whole system changed when something was changed within the CAP. This indicates that there is a lack of diverse policies. As Meuwissen et al., (2018) state that if this attribute is highly implemented it means that there is a safe and stable environment in the farming system wherein there is room for experimentation. The strong response of the system following the changes in the CAP payments, indicate that there was no safe and stable environment. Thus, it is likely that there is a strong lack of diversity within the policies.

7.3.3.2 Openness

The openness of the farming system is represented by the exposedness to perturbations and the infrastructure for innovation. At first, the exposedness to perturbation was scored as the least relevant attribute for the system by the participants. Interestingly, Cabell and Oloefse (2012) state that this attribute is important to make the system more resilient and more adaptable. However, they argue that a system only benefits when the perturbations are small and controllable. The system has been very protected for a long time until the payments decouplement in CAP in 2003. From that year onwards, it can be noted that several indictors went through a collapse (Dynamics of indicators exercise). It can thus be stated that the exposedness to perturbations was too abrupt and too strong in that case. From the workshop discussions and the causes of dynamics it seems however, that this attributes performance is improving. The participants repeatedly stated that the sector is now more open to fluctuations in prices due to the increased globalisation. The overall openness of the system seems to be improving towards a more resilient state.

7.3.3.3 System reserves

The specific resilience attributes “reasonably profitable”, “coupled with local and natural capital (production & legislation)”, “supports rural life” and “infrastructure for innovation” are contributing to the general resilience principle system reserves. Clearly, relying on the system reserves has been a very important strategy for this system to deal with shocks and pressures. Throughout the course of the years it was visible however that the system reserves became depleted. For example, a lack of social capital arose when the regions population decreased too much and there was a lack of skilled labour. Furthermore, access to pasture lands became lower. Also, farmers lack the capital to invest in more modern technologies.

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Since long, the participants argued, the system is not profitable anymore or at least much less than it used to be (Figure 11). However, they also made clear that it was mainly more profitable because of the subsidies they used to receive. Cabell & Oelofse (2012) argue that this means that the system is not reasonably profitable. The coupling with local and natural capital is very important for the system (Figure 19). This coupling has traditionally been very strong, as it is an extensive system. There used to be little inputs from outside the farming system. However, more recently, due to modernisation and intensification, farmers started to import more resources into the system. This thus leads to a decoupling of the system with the local natural capital. The attribute “supporting rural life” is currently going through a strong decrease. Many people left the countryside, and as an effect of that many of the available services are no longer available to people. People moved to the cities in search of a better quality of life. Also, there has been a long trend of ageing of the countryside. Lastly, the infrastructure for innovation within the area is not strongly present. The system lacks behind on modernisation and the application of innovative improvements. It can thus be concluded that the system is especially low on system reserves. It has been relying on its reserves for the last 20 years and this led in some cases to a collapse. Many farmers and other stakeholders were forced to exit the system. When looking at the indicators it can be seen that the dramatic decrease of many of them (Figure 7-16) came to an end during the last few years. It might be possible that the complete depletion of the system reserves, forced the system finally to reorganize and to change its course. This might indicate that the system is currently, albeit slowly, rebuilding its reserves.

7.3.3.4 Tightness of feedbacks

The current performance of tightness of feedbacks (socially self-organised and appropriately connected with actors outside the farming system). Within the system there is a lot of room for improvement regarding the social self-organisation. During the workshop it became clear that currently there are many new initiatives from stakeholders that improve the social organisation. As was described under the indicator dynamics, a strategy that is now often applied is (sale) associationism. Furthermore, the connection with actors outside the farming system is still very low. However, currently initiatives such as the PGI might improve those connections. It can be concluded that the tightness of feedbacks has been very low within the system, but due to the exiting of many stakeholders from the system and the depletion of reserves, the system was forced to reorganize and form new connections. It can thus be said that this general resilience attribute is improving for the system.

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7.3.3.5 Modularity

For the general resilience principle 'modularity' the following specific resilience attributes are important: spatial and temporal heterogeneity and optimal redundancy. The spatial and temporal heterogeneity was scored low in relevancy for the resilience of the system by the participants (Figure 19). Cabell and Oelofse (2012) see this attribute as a strong source for adaptation in the case of disturbances. As discussed earlier, there used to be high variety of farm types within the region. When looking at the farm typology, it can be noted that there is still a large difference in the number of heads per farm. Furthermore, many of the farmers have other agricultural side activities to ensure their incomes. Due to the disturbances in the economic profitability however, many farmers changed their strategy into specialisation and intensification (See chapter 5). It can be concluded that the spatial and temporal heterogeneity is quite high for this farming system but recently the system is moving towards a more homogeneous situation. The optimal redundancy of the system has been very high. This is often argued as to decrease the efficiency of the system (Cabell & Oelofse, 2012). In the last 20 years however, about 50% of all ovine farms disappeared from the region. It might thus be that through to the high levels of redundancy the system managed to survive. Along with the population decrease, the high number of exiting farms led to several problems in the region. During the workshop the participants spoke about problems with degrading pasture lands because there were not enough sheep to graze them anymore. This led to an increased risk for wild fires. Furthermore, the lack of services in the rural areas becomes an increasing issue. These examples indicate that the systems modularity has finally reached a point whereby it is harmful to the system when farmers exit. This strongly indicates that the modularity of the system is not optimal (Meuwissen et al., 2018). It can be concluded that the systems modularity decreased from very high to very low within 20 years. Recently the trend of exiting farmers has slowed down a bit. Also, it seems that stakeholders have become more active within associations and farmers' organizations. This coexistence of several comparable institutional organisations/mechanisms might further improve the modularity of the system.

7.3.4 Main processes

As farming systems are not static nor is their resilience, it is important to assess the way the system responds by looking at its dynamics. To provide a holistic multi-dimensional approach to the resilience of the farming system, the adaptive cycles concept was used (Holling et al., 2002). Within the FoPIA framework there are 4 main focal system distinguished (Resilience Alliance, 2010) in which a farming system can fare. Within the FoPIA framework these systems are referred to as main processes (Meuwissen et al., 2018). The four main processes are; agricultural production, farm demographics, governance and risk management.

7.3.4.1 Agricultural production

Agricultural production comprises all the activities that support the production of private and public goods at farms (Meuwissen et al., 2018). The general resilience principles that are embedded within this cycle are: openness, system reserves and modularity (Meuwissen et al., 2018). The farming system has been very production oriented over the assessed period. Even though the system encountered many challenges limiting the production. As the openness of the system increased, it started to deplete its reserves as a strategy. The system went from a conservation phase, towards a collapse and in more recent years into a reorganisation phase. About 50% of the farmers finally exited the system during the collapse, but the agricultural production did not decrease as much because the remaining farmers reorganized themselves into more intensified and more productive systems.

7.3.4.2 Farm demographics

Farm demographics are related to the number and characteristics of farms, and the provision and availability of labour(force) within the farming system. Meuwissen et al. (2018) link the general resilience attributes; diversity, tightness of feedbacks and modularity to this main process. As often discussed before, one of the most challenging problems of the area is the depopulation. Because of the exiting of many farmers from the system, the diversity and modularity have both decreased. The tightness of feedbacks, though currently improving, is still low. Currently it seems that the system for this process finds itself in the reorganisation phase.

7.3.4.3 Governance

The main process of governance comprises of the process of societal organisation through steering mechanisms to reach certain collective goals (Meuwissen et al., 2018). Meuwissen et al. (2018) link the following general resilience attributes to this process: diversity, openness and modularity. As discussed before the diversity and modularity of the system decreased. However, the openness of the system did strongly increase. The governance of the system seems to have been forced into a reorganisation phase due to the other collapsing main processes.

7.3.4.4 Risk management

Risk management is used to protect the system against shocks. By reorganizing resources and processes, total collapses can be prevented, or the system can return to the status quo

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(Meuwissen et al., 2018). Meuwissen et al. (2018) link the general resilience attributes openness, system reserves and modularity to this main process. This process proved not to be strong enough to prevent the other processes from falling into a collapse. However, just as in the case of governance this process was forced into reorganisation phase as the other processes collapsed. Stakeholders adapted new risk management strategies to cope with future perturbations (for example by grouping farms together into a larger farm).

Many of the strategies that were found for the dynamics of the indicators exercise. Many of them contributed stronger towards adaptability than robustness or transformability. This is likely due to the fact that the system finds itself largely in a reorganisation phase, in which adaptations need to be made. Robustness might be more linked to a conservation phase and transformability to a collapse. In literature it is argued that a pitfall for resilience is when all main processes find themselves in the same phase (Resilience Alliance, 2010). This is largely the case for this farming system. Most processes are in the reorganisation phase currently. From the general resilience principles, it can be seen that many of them have reached their lowest performance and slightly recovered in more recent years. As this trend is rather new, it is hard to conclude if the system reached its lowest point. As farming systems do not always follow all the phases of the adaptive cycles model (Van Apeldoorn et al., 2011). It might also be possible that the system will further collapse when new challenges present themselves.

7.3.4.1 Concluding remarks on robustness, adaptability and transformability of the farming system

When looking at the strategies that the participants found for dealing with the challenges it can be seen that the majority of those strategies contributes strongest towards adaptability. As was previously discussed, many of the main processes find themselves within the reorganisation phase. This might be the reason that the participants scored adaptability strongest. As their system is currently going through the process of adapting into an altered system. Furthermore, as the system reserves have become depleted, there are little resources available to enhance the robustness of the system. Lastly, some of the main processes went through a collapse. This might be the reason that the participants scored transformability quite high. As many farmers transformed their businesses from extensive ovine production into intensive porcine production systems. This means they partly exited the extensive ovine farming system and enhanced the collapse.

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7.4 Options to improve the resilience of the farming system

From the indicator dynamic exercise and the current performance of the indicators it can be seen that the farming system in Huesca was heavily affected by the challenges it encountered. Even though many of the farmers exited the system due to the unsustainable situation, the system was able to maintain a stable production, meaning that the production per farm strongly increased. It was concluded that the current system is a production-oriented system that is strongly dependent on natural resources.

The workshop participants were of opinion that almost all attributes were highly relevant for the systems resilience (Figure 19). This could indicate that the system needs a very broad approach towards resilience. However, a strong trend of modernisation and intensification has been noted, whereby the system is decoupling from local and natural capital by importing feed and nutrients to sustain a higher production. As discussed in the previous chapter, it is important to keep a close eye on the rate of intensification and scale enlargement. As when taken to extremes it would negatively affect the farming systems resilience. However, intensification and scale enlargement can also help the system to become more profitable (Hoekstra et al., 2018) and thus create a safer operating space in which higher levels of adaptability can be sustained (Meuwissen et al., 2018).

Furthermore, to improve the resilience it is important that actors within the system poses a diverse palette of strategies they can choose from when challenges occur. Currently, the systems diversity seems to be decreasing. Many of the farmers abandoned mixed farming and specialised into one practice. The raising costs of production were mentioned by the participants as the main cause for this trend. A solution to stop this trend might thus be to reduce the incentives for specialisation by providing inputs for a lower price. Some farmers mentioned that they grouped their farms into one holding "on paper", so they could buy feed and other products in larger quantities at much lower prices, but in fact they still operated as individual farms. The participants spoke about several other initiatives regarding social re-organisation as a response to shocks and pressures. To improve the resilience of the system policies should act as an incubator for such initiatives (Meuwissen et al., 2018).

Due to the decreasing population of the countryside there is a lack of social services, which decreases the quality of life. As the countryside is no longer attracting people, there is a lack of workforce. Which further affects the connectivity of the stakeholders and makes them more isolated. In order to prevent the countryside from further depopulation it is thus important that the rural life is supported (Meuwissen et al., 2018). Another aspect of the system in Huesca is that the systems traditional practices provided very important ecosystem services. Due to the increased intensification many farmers have abandoned the practice of transhumance which had far reaching consequences for the landscapes (Olea & Mateo-Tomás, 2009; Oteros-Rozas et al.,

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2014). This negatively affects the resilience of the farming system but also affects systems on a much larger scale.

The real costs of soil erosion, wildfires and loss of biodiversity are hard to estimate. However, it is likely that providing farmers with premiums and subsidies in exchange for the ecosystem services they deliver by sustaining their traditional practices will pay off in the long run.

At last, during the interviews before the workshop it became clear that there is a cultural aversion against bank loans in the area. This means that farmers do not want to be in dept. This cultural inhibition causes a very low rate of investment. Farmers are not able to innovate or modernise when the system goes through a period of low profitability. While in other farming systems, when the profitability is low a strategy often is to invest in modernisation or innovation. A way to improve the flexibility of the system is to improve the access to these loans. It might also be necessary to change the farmers perspectives about loaning.

7.5 Methodological challenges

The overall workshop progress was good and not many challenges occurred. As other FoPIA workshops in other case studies within this project were often regarded to as too long, the one in Spain was cropped into a slightly shorter version (the second part of the last activity was not performed). Therefore, there were no real problems of a loss of motivation or activeness. The participants gave a lot of input, and the moderator made sure that all sorts of stakeholders were able to speak. It was challenging to make sure that not only the opinions of the strongest debaters were leading the discussion, however, it was made sure by the FoPIA team that this was not the case. Something that proved to be challenging was the translation of the rather abstract definitions of the resilience capacities and resilience attributes towards more practical examples. An improvement for the future could thus be to come up with clear examples that strongly depict the presence of either robustness, adaptability or transformability whereby all case studies could present this without translation problems.

As discussed earlier, the workshop participants drew several dynamics of the indicators. When the development of the drawn curves is compared to the data from literature it can be found that participants do not always have a resembling idea of reality. They seemed to know the larger developments within the sector while not being aware of the more precise dynamics.

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8 Conclusion

The results and discussions in the FoPIA workshop reveal that the perception of the relevance of the provision of public goods of the extensive sheep farming, mainly those related with environment and keeping rural population, has been increasing over the last years. The farming system's actors consider that the relevance of the positive contribution of sector to the environment is almost the same than that of food production. Policies have not supported properly this essential function as this function has been gaining relevance.

The performance of the indicators of the system was very low. The system went through very difficult times over the last 20 years which has caused a shift in adapted strategies. The sector has encountered many challenges, and many farmers exited the system. The remaining farms are improving and reorganizing the system. Strategies such as increasing the size farm, investing in new technologies to improve farm management and animal handling, improving product quality, promotion and sales management are some examples of strategies performed by farmers in the region. Currently the system has moved towards a more intensified system whereby the share of traditional practices such as transhumance has strongly decreased.

The system shows to be mainly adaptable. The robustness of the system is rather low. The system has been relying on its reserves and modularity throughout the years but it became clear that those general resilience principles currently are very low performing and that new strategies are needed in order to sustain the current functions.

Main resilience attributes need to be highlighted in the sheep extensive sector: i) Reasonable profitability, that enables robustness (keep savings and low debts for hard times) and facilitates investment towards adaptability (new technologies to reduces costs and increase productivity; ii) Support rural life, to keep families and skilled labor force in rural areas; iii) Diverse polices that support farmers to deal with the low profitability and enhance the contribution of the sector to the environment and rural development; iv) Coupled with local and natural, to ensuring the availability in quantity and quality of pastures and biodiversity; and v) Socially self-organized-, an important attribute for intensive and skilled labor sectors. Shepherding requires farmers to be a lot of time the animals and to have the knowledge enough to do it in a proper way. An adequate knowledge transfer is key for the sector.

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Appendix A. Workshop memo

The workshop took place in a hotel in the city of Huesca. The workshop was held in a large conference room in the basement. The tables were set up in a ring, so everybody could see each other during the discussions. For the group exercises, other tables were set up. Upon arrival in the morning there was coffee and tea. The light within the room was fine, however, somewhat dark. The temperature was quite high during the beginning of the workshop but after it was requested to lower the temperature, it was fine. Furthermore, there were two coffee breaks and one large lunch at 16:00 after the workshop. The coffee and lunch were served in the lobby of the hotel. The service was really good, and the food was fine. The participants seem to enjoy the location and socialized a lot throughout the breaks. In the end everybody was positive about the place.

The workshop started around 9:00 after some coffee was served. The workshop ended around 16:00 and lunch was served afterwards. In between there were a few coffee breaks with a total break time (estimation) of 30 minutes.

Table 1. Stakeholder overview.

Organisation	Function	Stakeholder group
	Farmer	Farmers
ASAJA-Huesca	Farmers organisation	Farmers
	Farmer	Farmers
UAGA	Farmers organisation	Farmers
	Farmer	Farmers
	Farmer	Farmers
UAGA	Farmers' association	Farmers
ASAJA	Farmers' organization	Farmers
Plataforma del lobo y el oso	Farmers organisation	Farmers
Carnes Montfort	Distributor	Value chain
Servicio Provincial de Huesca	Veterinarian	Value chain
	Veterinarian	Value chain
Oviaragon-UPA-Grupo pastores-	Cooperative	Value chain
President of the Sanitary Defense Association (Sobrarbe)	Sanitary Defense Association (Veterinarians)	Value chain
	Veterinarian	Value chain
	University	Institutions
Servicio Provincial de Huesca	Public administration	Institutions
	Public administration	Institutions
	Public administration	Institutions
Servicio Provincial de Huesca	Public administration	Institutions
Universidad de Zaragoza	University	Institutions
Instituto Pirenáico de Ecología	University	Institutions
OCA de Barbastro	Public administration	Institutions
Servicio Provincial de Huesca	Public administration	Institutions

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Appendix B. details on ranking and rating the functions and indicators

Table A2. Mean and standard deviation of scores per function per stakeholder group and for all participants. 100 points needed to be divided to 8 function.10 highest values are bold.

	Farmer		Institution		Valuechain		All	
Function	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Foodproduction	**15**	7	**17**	7	**16**	4	**16**	6
Bio-basedresources	3	5	4	4	3	4	4	5
Economicviability	**30**	17	**23**	10	**29**	13	**27**	14
Qualityoflife	9	8	14	5	10	8	11	7
Natural resources	**15**	6	14	8	10	0	13	6
Biodiversity&habitat	11	7	11	8	9	5	10	7
Attractivenessofthearea	9	8	9	7	7	4	9	7
Animal health&welfare	9	5	9	6	**16**	4	10	6

Table A3. Importance of indicators per stakeholder group; original values and transformed values to include importance of the function and number of indicators per function. Transformed values allow for direct comparison between all indicators across all functions(n=24).

	Corrected values							
	Farmer		Institutions		Value chain		All	
Indicator	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Sheep census	15	4	18	4	15	4	16	4
Meat production	15	4	15	4	17	4	16	4
Wool production	2	2	4	2	3	1	3	2
Leather production	2	2	4	2	3	1	3	2
Gross margin	**41**	32	**32**	16	**37**	19	**37**	24
Price of lamb (€)	**26**	19	18	11	**28**	11	**24**	15
Feed costs	**23**	19	10	10	**23**	10	**18**	15
Number of ovine farms	11	2	17	6	8	6	12	5
Total labour (FTE)	6	2	11	6	8	6	8	5
% Pasture/Total UAA	13	6	18	4	10	4	14	6
Grazing area on arable land	13	6	10	4	10	4	12	5
Variety of breeds	12	5	7	6	10	3	10	5
Transhumance	9	5	11	7	8	3	10	5
Registered population rural areas	12	6	13	2	9	4	12	4
Sacrificed animals (PGI)	7	6	5	1	5	4	6	4
Spending on zoo-sanitary products	6	4	6	3	17	5	8	6
Violations of animal welfare rules	11	5	11	3	15	5	12	5

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	Original values							
Sheep census	49	14	53	12	46	11	50	13
Meat production	51	14	47	12	54	11	50	13
Wool production	53	26	49	15	50	14	51	18
Leather production	47	26	51	15	50	14	49	18
Gross margin	45	36	53	16	42	22	47	27
Price of lamb (€)	29	21	30	13	32	13	30	17
Feed costs	25	21	17	14	26	11	23	17
Number of ovine farms	66	10	61	21	50	22	61	17
Total labour (FTE)	34	10	39	21	50	22	39	17
% Pasture/Total UAA	48	14	64	15	52	19	55	17
Grazing area on arable land	52	14	36	15	48	19	45	17
Variety of breeds	55	25	39	25	54	18	50	24
Transhumance	45	25	61	25	46	18	50	24
Registered population rural areas	64	30	72	8	62	29	66	24
Sacrificed animals (PGI)	36	30	27	7	38	29	33	24
Spending on zoo-sanitary products	31	20	38	18	54	17	38	20
Violations of animal welfare rules	59	26	62	18	46	17	57	22

Table A4. Mean and standard deviation of scoring on performance of indicators per stakeholder group and for all participants. Indicators were scored from 1-5 where 1 = very low, 2 = low, 3 = medium, 4 = good, and 5 = perfect (n=24).

Corrected values	Farmer		Institutions		Value chain		All	
Indicator	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Sheep census	1.3	0.9	1.8	0	1.0	0.5	1.4	0.7
Meat production	2.3	1.1	1.9	0.4	1.2	1.0	1.9	1.0
Wool production	1.7	1.5	1.3	0.9	1.4	0.5	1.5	1.0
Leather production	2.3	1.8	1.4	0.9	1.6	0.5	1.8	1.2
Gross margin	1.7	0.9	1.6	0.5	1.6	0.7	1.7	0.8
Price of lamb (€)	2.1	1.1	1.8	0.8	1.8	0.7	1.9	0.9
Feed costs	1.9	1.3	1.9	1.3	2.2	0.8	2.0	1.1
Number of ovine farms	1.9	1.4	1.5	0.4	1.2	0.5	1.6	1.0
Total labour (FTE)	3.4	1.3	2.0	0.7	2.0	0.5	2.6	1.2
% Pasture/Total UAA	1.4	1.0	2.4	0.4	2.2	0.7	1.9	0.9
Grazing area on arable land	2.8	1.4	2.3	0	3.0	1.0	2.6	1.2
Variety of breeds	2.8	1.1	2.4	0.9	2.4	0.8	2.6	1.0
Transhumance	1.8	1.0	2.0	0	2.0	1.1	1.9	0.9
Registered population rural areas	1.5	1.0	1.3	0.5	1.4	0.5	1.4	0.7
Sacrificed animals (PGI)	2.3	1.1	2.6	1.0	3.0	0.7	2.6	0.9
Spending on zoo-sanitary products	3.6	1.2	2.9	0.5	2.4	0.8	3.1	1.0
Violations of animal welfare rules	2.2	1.1	3.3	0.9	2.6	0.7	2.7	1.0

Table A5. Mean and standard deviation of scoring on performance of functions per stakeholder group and for all participants. Derived from scoring of importance and performance of indicators (n=24).

Corrected values								
	Farmer		Institutions		Value chain		All	
Function	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Food production	1.8	0.9	1.8	0.7	1.1	0.2	1.7	0.7
Bio-based resources	2.0	1.7	1.4	0.5	1.5	0.9	1.6	1.0
Economic viability	1.9	0.9	1.7	0.7	1.8	0.8	1.8	0.8
Quality of life	2.6	1.1	1.7	0.3	1.5	0.4	2.0	0.9
Natural resources	1.8	1.0	2.2	0.9	1.5	0.6	1.9	0.9
Biodiversity & habitat	2.3	0.9	2.1	1.0	2.0	0.5	2.1	0.8
Attractiveness of the area	1.8	0.6	1.7	0.4	1.9	0.4	1.8	0.5
Animal health & welfare	2.8	0.8	3.1	0.7	2.5	0.7	2.8	0.7

Corrected values								
	Farmer		Institutions		Value chain		All	
Function	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Food production	1.8	0.9	1.8	0.7	1.1	0.2	1.7	0.7
Bio-based resources	2.0	1.7	1.4	0.5	1.5	0.9	1.6	1.0
Economic viability	1.9	0.9	1.7	0.7	1.8	0.8	1.8	0.8
Quality of life	2.6	1.1	1.7	0.3	1.5	0.4	2.0	0.9
Natural resources	1.8	1.0	2.2	0.9	1.5	0.6	1.9	0.9
Biodiversity & habitat	2.3	0.9	2.1	1.0	2.0	0.5	2.1	0.8
Attractiveness of the area	1.8	0.6	1.7	0.4	1.9	0.4	1.8	0.5
Animal health & welfare	2.8	0.8	3.1	0.7	2.5	0.7	2.8	0.7

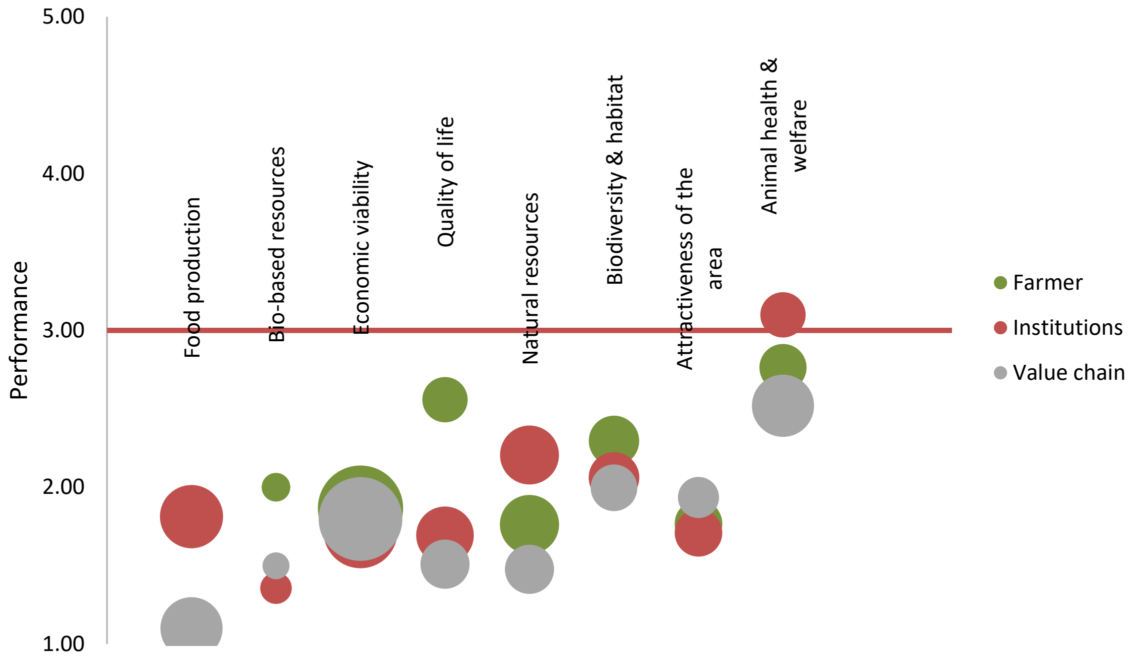
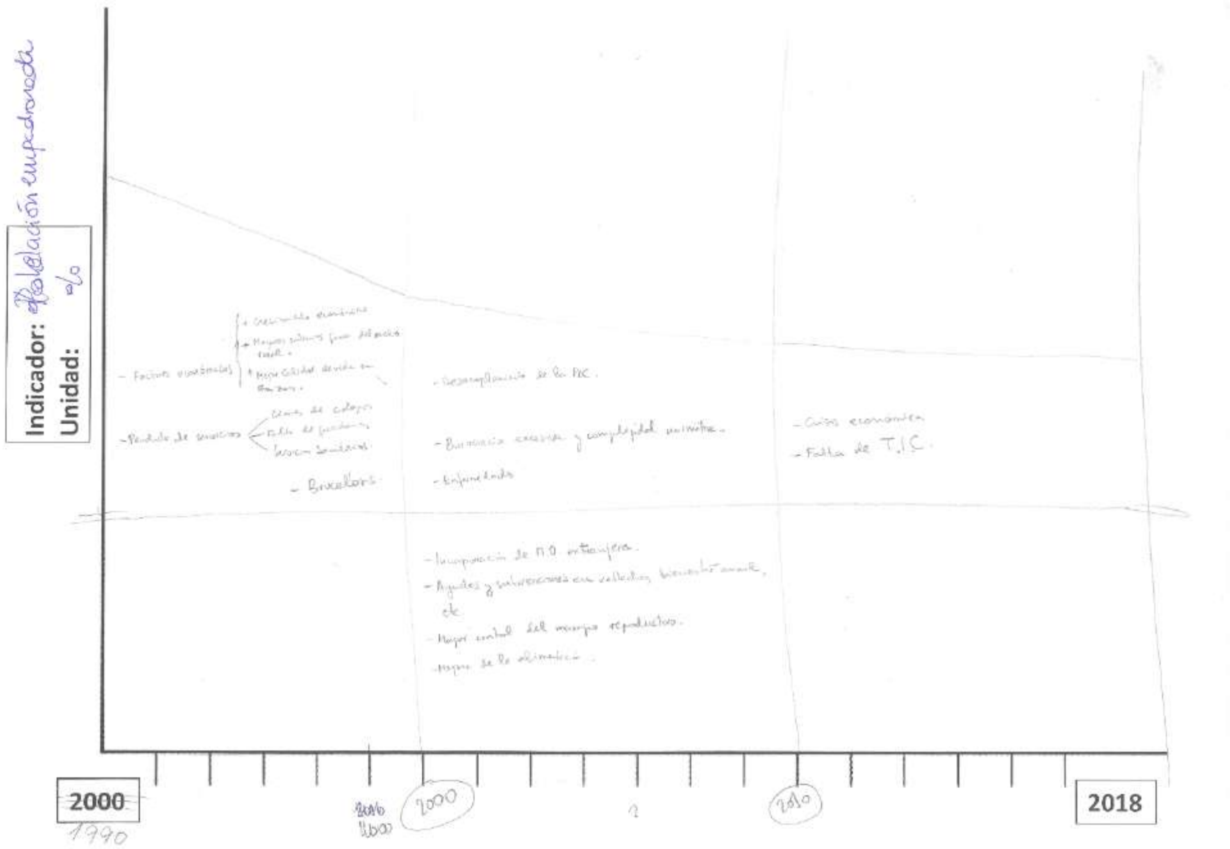


Figure A1. Bubble graph presenting averaged scores on performance of ***functions*** *(from 1 to 5), aggregated by stakeholder group, while also indicating their importance (size of the bubbles), relative to each other(n=24).*

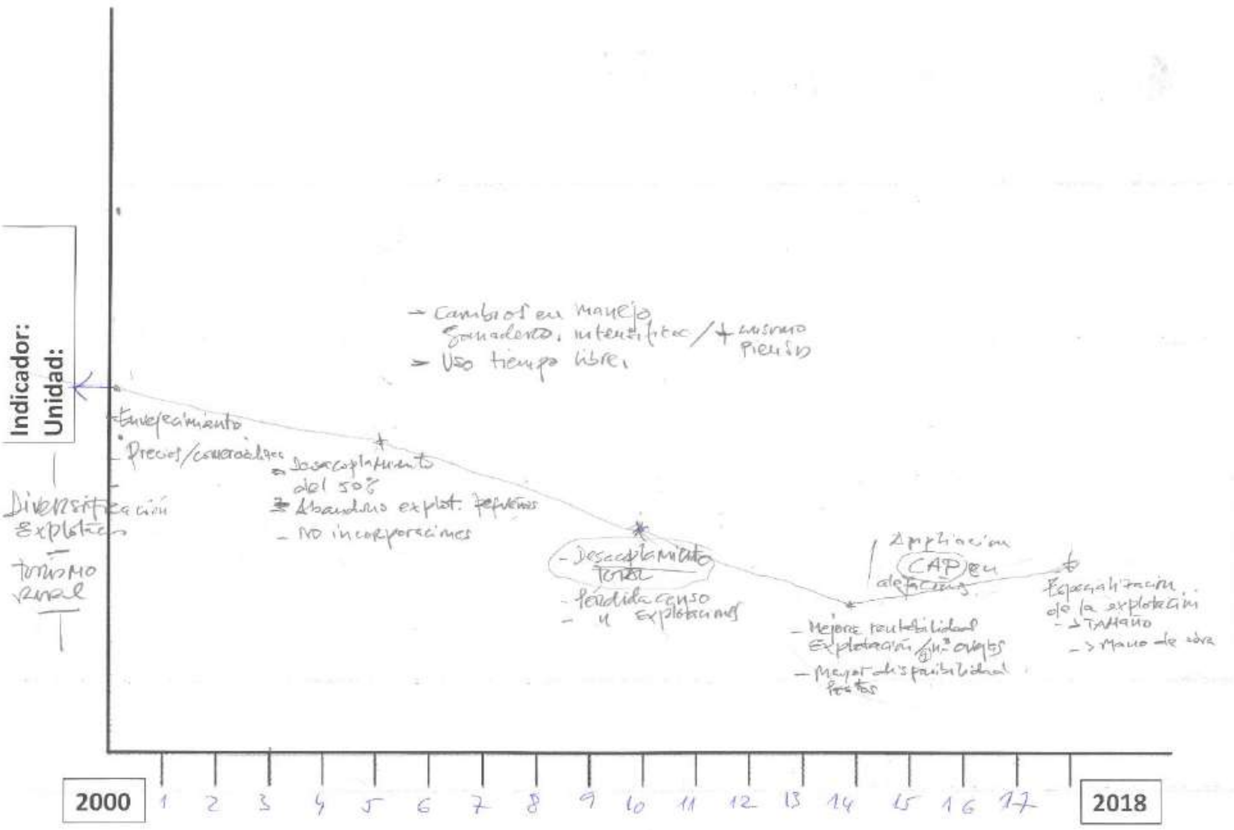
Appendix C. Dynamics of main indicators

Registered population rural areas



The participants drew a decreasing line, that had a stronger decrease in the beginning than towards the end (2018). In total the line is dissected into three periods. The development of the curve during the first one from 1990 towards 2000 is mainly influenced by economic factors and a lack of services. For the economic factors the group came up with the following examples; economic growth which caused better salaries outside of the countryside, better quality of life in other zones. For lack of services; closing of schools, lack of safety guards/police, lack of health services. For the decrease of the population in the rural areas during the second period (2000-2010), the participants found the following reasons; Decoupling of the CAP, Extensive bureaucracy and normative complexity, Diseases, Incorporation of foreign labour, Investment trough subsidies and aid, Improved reproduction techniques, Improved alimentation. During the last period (2010 – 2018) the registered population in the area became more stable according to the participants. The main reason they found for this stabilisation was the economic crisis.As there was less work available in the cities more people decided to stay in their regions. However, during this period a new challenge arose for this indicator; the lack of access to ICT applications within the rural areas.

% pasture/ total UAA



For this indicator the participants drew a simple decreasing line until 2014, when there was a slight increase in pastures. In the year 2000 the most important causes for the dynamics, according to this indicator group were ageing of the countryside, and the rise of costs. Around 2003/2004 the main causes for a decrease in pastures were the decoupling of 50% of the CAP and the abandoning of the smaller farms, during the same time there were very little incorporations of farms into other farmers. Around 2010 the main causes were; the complete decoupling of the CAP, the steep decrease in the sheep census and the number of farms. From 2014 onwards, the decreasing trend was changed into an increasing one, according to the participants. The main causes they found for this change were the increased profitability of the farms and per sheep. Also, because of the large number of exiting farmers there was a larger availability of pastures. At last, from 2017 onwards, the participants found that farmers became increasingly specialized in ovine farming increased their sizes and increasingly contracted external labour.

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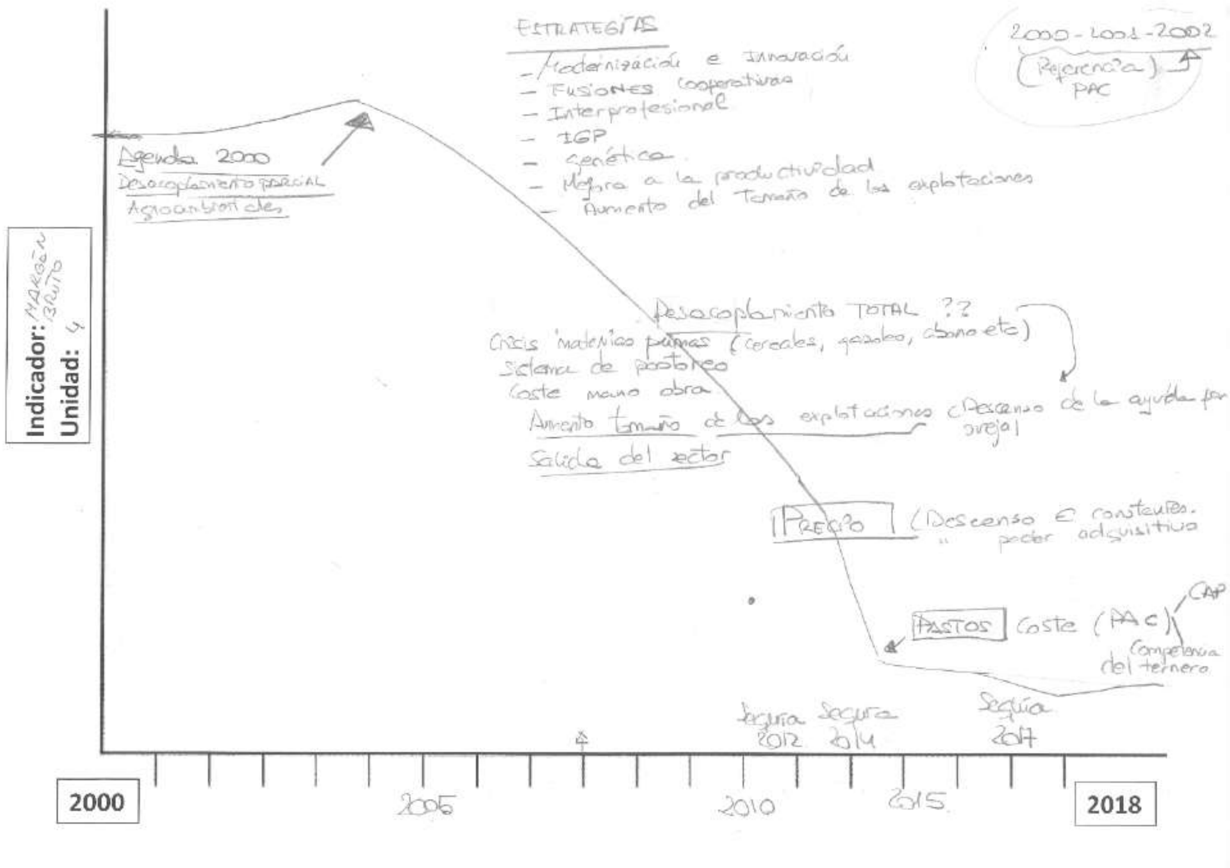
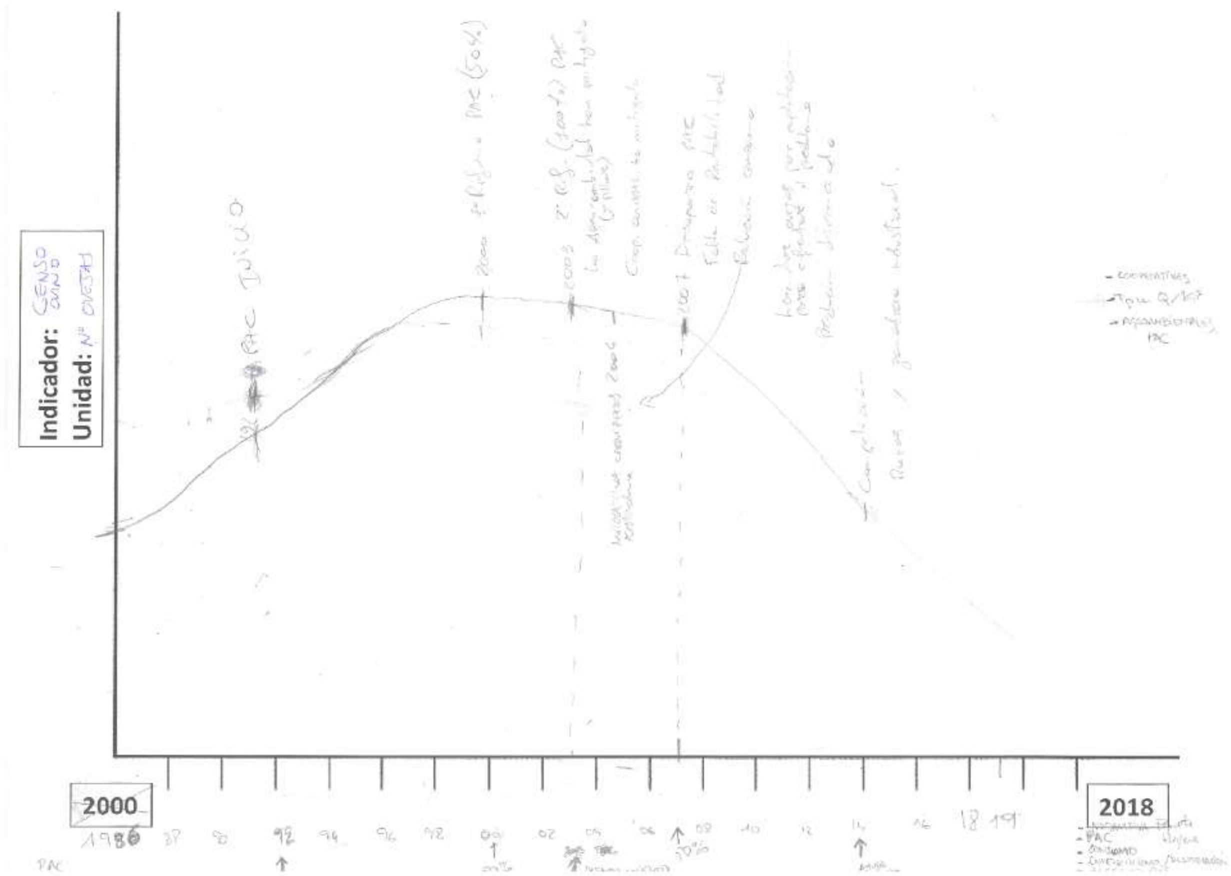
Gross margin



The gross margin group was of opinion that overall there has been a strong decrease in the profitability of the system. Until 2004 there was a slight increase however. Another slight increase can be found in the last years (2017 – 2018). The first large change to the system was caused by the agenda 2000 announcement (Partial decoupling of CAP). Under the new CAP the farm profitability decreased strongly. Furthermore, when the CAP was completely decoupled (around 2010) the decrease in profitability became even stronger. During this period other challenges arose, like the increasing costs of labour. Also, in the years 2012, 2014 and 2017 the region suffered droughts. In the year 2014 the price of meat further decreased, which led to lower profitability. In 2015, the access to pastures improved due to the large number of exiting farmers, this increased the profitability a bit as the costs of feed decreased. Later however, an increased competition with calf meat forms a new challenge for the system.

Sheep census



The participants of the sheep census group drew a parabolic curve that ends lower than it started. They decided during a discussion that the graph had to start in 1986 instead of 2000 to give a better image of the way the sector developed. From 1986 until 2000 the sheep census strongly increased. The participants wrote that this was mainly caused by the CAP payments. When in 2000 the CAP was partly decoupled, the growth of sheep census stopped. When in 2003 the CAP was fully decoupled and partly replaced by the agro-ambiental measures, the sheep census started to gradually decline. In 2004 the system encountered another challenge, when the new EU hygiene rules for food of animal origin were established. When in 2007 also the payments for agro-ambiental measures were changed, the sheep census collapsed. At that time the profitability of the system was to low for many farmers. Furthermore, there was a decline in the popularity of sheep meat, which made it harder to sell. Also, the economic crises strongly affected the farmers in the region. In more recent years, ovine farmers have to increasingly compete with more industrialised farmers over access to pastures.

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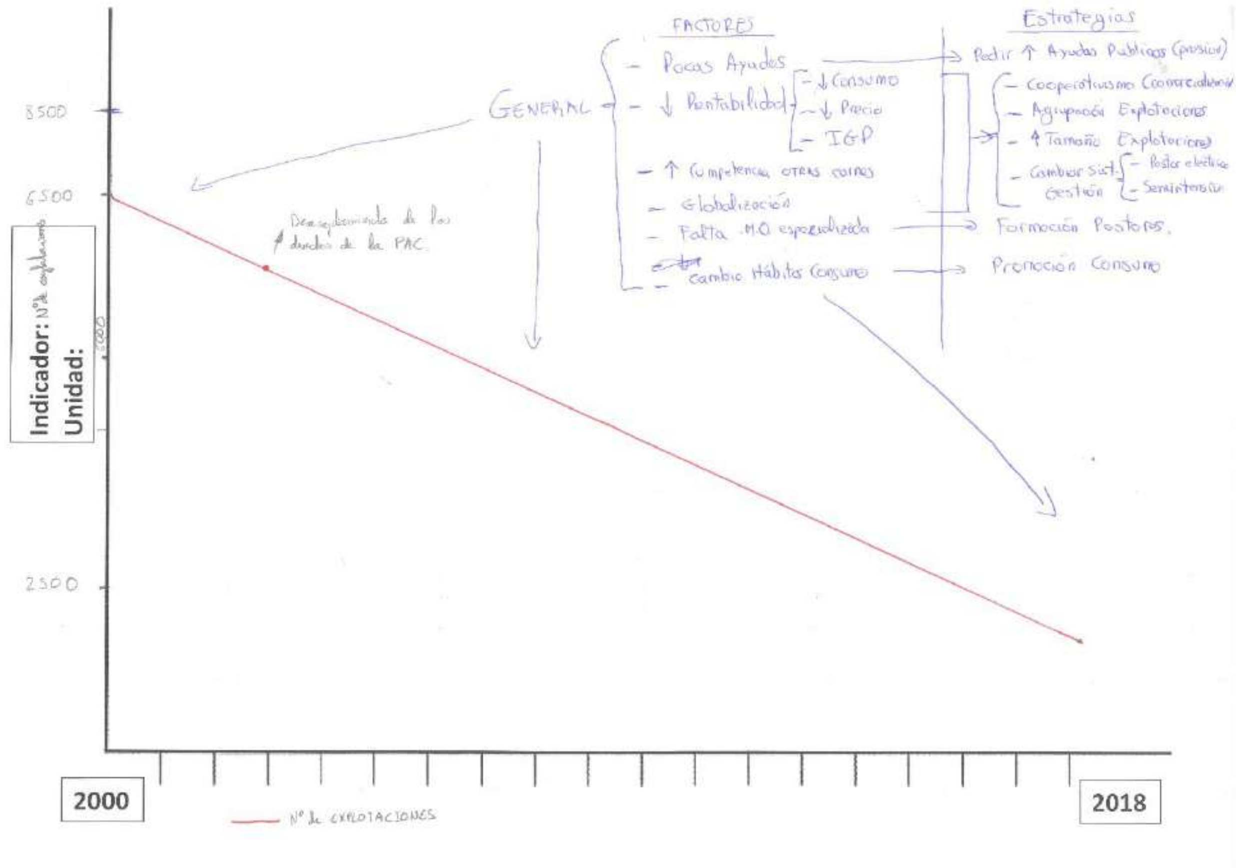
Number of ovine farms



For the number of ovine farms, the participants drew a straight and steeply decreasing line. They gave several reasons that caused the dynamics of this indicator. As general factors causing the decrease they found; Little financial help, decreasing profitability of the system, Increased competition with other meats, Globalization of the sector, Lack of skilled labour, Changing consumption patterns (Decreased consumption of ovine meat). Furthermore, they found the following strategies; Putting pressure on the authorities in order to receive more public financial aid, establishing commercial cooperatives in order to cope with the decreasing popularity of the sheep meat. Grouping of farms into larger farms, so when buying resources prices become lower. Increasing the size of the farms. Changed management methods into more intensive ones (for example electric fence instead of herding). Educating new pastors in order to cope with the lack of skilled labour. Promoting the consumption of sheep meat.

Appendix D. details on scoring strategies and resilience attributes

Table A6. Mean (and standard deviation) of implementation scores of strategies and their potential contribution to robustness, adaptability and transformability.

		Potential contribution to resilience capacities							
		Implementation		Robustness		Adaptability		Transformability	
Selected indicator	Strategy	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Registered population rural areas	Contract foreign labour	4.2	0.4	2.6	0.5	0.4	0.9	0.0	0.7
	Modernisation of farms	3.8	1.1	1.8	1.3	2.8	0.4	2.2	0.4
	Improve management and nutrition	4.4	0.9	2.6	0.5	2.4	0.9	2.4	0.5
% Pasture/Total UAA	Diversification	3.4	1.1	1.7	1.3	2.0	0.6	1.4	1.4
	Increase herd size of farms	3.6	1.3	1.8	1.0	2.0	0.8	2.6	0.5
	Increase area of pasture	4.0	1.4	0.8	2.5	1.5	0.6	1.0	1.8
	Specialisation of farms	3.0	0.0	1.8	0.4	2.0	0.0	0.6	1.1
Gross margin	Modernisation and innovation	3.0	1.0	2.2	0.4	2.4	0.5	1.4	1.3
	interprofessional cooperatives	3.5	1.0	2.1	0.8	2.5	0.5	0.0	0.0
	PGI	4.2	0.8	1.5	1.3	2.6	0.5	0.0	0.0
	Improve genetics	3.0	1.2	2.5	1.0	2.6	0.5	0.0	0.0
	Dimensions of farms	2.8	1.3	2.0	0.0	2.4	0.5	0.0	0.0
Sheep census	Increase herd size of farms	3.4	0.9	2.3	0.5	2.6	0.5	0.0	0.0
	Start of CAP	4.0	0.0	2.3	0.5	2.2	0.4	0.0	0.0
	Agro-environmental measures	3.2	1.1	1.7	1.2	1.9	0.9	0.8	1.2
	Product differentiation	4.0	0.0	1.4	1.1	2.0	0.8	0.8	1.1
	Variety of breeds	5.0	0.0	2.6	0.9	1.4	0.9	1.0	1.0
	Industrialised farming	3.0	0.0	2.2	0.8	2.0	1.4	0.6	1.9
Number of ovine farms	More public support	2.0	0.0	1.8	1.3	2.0	0.7	0.6	1.5
	Marketing associations	2.0	0.0	1.4	0.9	2.2	0.8	1.0	1.2
	Grouping of farms	3.0	0.0	0.6	1.1	1.8	1.1	0.8	0.8
	Size of farms	2.7	1.1	1.0	1.3	0.8	1.2	0.4	1.5
	Management systems	3.3	0.5	1.3	1.0	1.0	1.2	1.0	2.4
	Promotion of consumption	3.3	1.0	1.3	1.0	1.0	0.8	0.5	1.0
	Pasture formation	2.3	1.0	1.0	0.0	0.8	0.5	1.0	1.4

Figure A2. Bar graph presenting total positive and negative points allocated to a strategy's contribution to robustness, adaptability and transformability (n=24).

Table A7. Mean and standard deviation of relevancy scores of resilience attributes. Per stakeholder group and for all participants (n=24).

	Extent into which attribute applies in FS							
	Farmer		Institutions		Valuechain		All	
Resilienceattribute	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
ReasonablyProfitable	4.6	1.3	4.4	0.5	5.0	0.0	4.6	0.9
FunctionalDiversity	3.4	0.9	3.2	0.7	3.8	1.1	3.4	0.8
Response Diversity	3.0	1.0	3.2	0.8	3.6	1.1	3.2	1.0
Exposedtodisturbance	2.7	1.2	3.3	1.2	3.2	1.5	3.0	1.3
Spatial and temporal heterogeneity (farm types)	3.9	1.1	3.3	1.0	2.6	0.9	3.4	1.1
Supports rural life	3.8	1.5	3.8	1.4	3.8	1.1	3.8	1.3
Infrastructureforinnovation	3.3	0.7	3.7	0.5	3.8	1.3	3.6	0.8
Diversepolicies	3.8	1.9	4.2	1.1	3.6	1.3	3.9	1.4
Coupled with local and natural capital	3.6	0.7	3.6	0.9	4.0	0.7	3.7	0.8
Sociallyself-organized	3.6	0.9	3.3	1.1	3.8	0.8	3.5	0.9
Appropriately connected with actors outside	3.4	1.4	2.8	1.3	3.2	1.3	3.1	1.3

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