SMARTER

SMAll RuminanTs breeding for Efficiency and Resilience

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Productive, resilient or efficient? The ideal animal for small ruminant breeders: a five-country case study

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About the SMARTER research project

SMARTER will develop and deploy innovative strategies to improve Resilience and Efficiency (R&E) related traits in sheep and goats. SMARTER will find these strategies by: i) generating and validating novel R&E related traits at a phenotypic and genetic level ii) improving and developing new genome-based solutions and tools relevant for the data structure and size of small ruminant populations, iii) establishing new breeding and selection strategies for various breeds and environments that consider R&E traits.

SMARTER with help from stakeholders chose several key R&E traits including feed efficiency, health (resistance to disease, survival) and welfare. Experimental populations will be used to identify and dissect new predictors of these R&E traits and the trade-off between animal ability to overcome external challenges. SMARTER will estimate the underlying genetic and genomic variability governing these R&E related traits. This variability will be related to performance in different environments including genotype-by-environment interactions (conventional, agro-ecological and organic systems) in commercial populations. The outcome will be accurate genomic predictions for R&E traits in different environments across different breeds and populations. SMARTER will also create a new cooperative European and international initiative that will use genomic selection across countries. This initiative will make selection for R&E traits faster and more efficient. SMARTER will also characterize the phenotype and genome of traditional and underutilized breeds. Finally, SMARTER will propose new breeding strategies that utilise R&E traits and trade-offs and balance economic, social and environmental challenges.

The overall impact of the multi-actor SMARTER project will be ready-to-use effective and efficient tools to make small ruminant production resilient through improved profitability and efficiency.

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1 Abstract

This paper on the non-market valuation of genetic traits in animal breeding presents the first international study of small ruminant breeders' preferences for an 'ideal' animal. We surveyed 612 breeders, 15 breeds in 5 countries and estimated the importance given by breeders to different genetic traits related to animal production, resilience and efficiency (R&E). Data were collected for 8 traits using the stated preference survey method and the 1000minds online tool. Data was made available here: https://zenodo.org/record/8279610 . The results show differences in preferences between traits, with the highest average preference across all breeds for product quantity and the lowest for longevity compared with the other 6 traits (product quality, mastitis or footrot resistance, gastro-intestinal parasite resistance, mortality at weaning, prolificacy and functional longevity). We present the preferences collected in each breed and, for the survey of French Romane breeders, we produce a typology of preference profiles. The two preference profiles identified focus on either reproductive performance or animal health. Our results contribute to a better understanding of breeders' expectations regarding the characteristics of the animals in their herds, and are particularly relevant when it comes to defining breed selection objectives in line with the needs of the end users: the breeders.

2 Productive, resilient or efficient? The ideal animal for small ruminant breeders: a five-country case study

2.1 Summary

The study aims at better understanding the diversity of breeders’ preferences with respect to the relative importance of traits related to animal resilience, health and efficiency (SMARTER H2020 project). Data were obtained through preference surveys based on choice experiment that were administered to small ruminants’ breeders in 5 countries and for 15 breeds (n=612) with the decision-making software 1000minds.

We present preferences in each breed for the following eight traits: product quality, resistance to mastitis or to footrot, gastro-intestinal parasite resistance, mortality at weaning, prolificacy, functional longevity. Results highlight differences in preferences between the proposed traits with a higher degree of importance for R&E traits, as well as production traits. For example, longevity ranked highly for Assaf (average rank = 2nd), Alpine (1st), Manech Tête Rousse (3rd) and to some extent Saanen (4th). Longevity was the top ranked trait on average, by wool breeders. Feed efficiency also ranked highly for Chios (2nd), Frizarta (2nd), Lacaune (3rd), and Assaf (3rd). Mastitis was also ranked highly (e.g., average rank = 1st for Manech Tête Rousse sheep and 2nd for Saanen goats), while milk was ranked highly by most dairy breeds (average rank = 1st for Assaf, Chios, Frizarta, and average rank = 2nd for Lacaune; in Greece. Average rank = 1st for Saanen and average rank = 2nd for Alpine; in Italy).

The second part of the paper present a deeper analysis of farmers' preferences in the case of French Romane breeders (meat-oriented production). We detail the two preference profiles identified in Romane through cluster analysis and characterize them. Our results may contribute to inform small ruminants industries' experts, especially on the revision of breeding objectives for more resilient and efficient animals.

2.2 Introduction

In the global context of an agro-ecological transition of agricultural and food systems and the development of "one health" approaches, players in the livestock sector are looking for concrete proposals to reduce the impact of their production on ecosystems while increasing their resilience in the face of hazards (health, climate and economic). Genetic selection is an important tool to be mobilised on farms to help animals and farms evolve towards these new objectives.

This article presents the first international study of small ruminant breeders' preferences for an 'ideal' animal and builds on E. Janodet master's thesis (Janodet, 2020). We surveyed 612 breeders in 5 countries and 15 breeds and estimated the importance given by breeders to different genetic traits related to animal production, resilience and efficiency.

This is the first international study of its kind. Previous work has focused on estimating farmers' preferences for a type of production and for a country: dairy sheep in Greece (Ragkos and Abas, 2014), dairy cattle in Denmark (Slagboom et al., 2016), dairy cattle in Australia (Martin-Collado et al., 2015) and beef sheep in Ireland (Byrne et al., 2012).

2.3 MATERIALS AND METHODS

2.3.1 DATA COLLECTION

We collected the preferences of study participants using the stated preference survey method by modelling hypothetical choices. This is one of the choice experimentation methods classically used in economics (Bouscasse, 2017; Brahic and Terreaux, 2009; Pearce et al., 2006).

Choice experimentation methods make it possible to quantify the preferences of an individual or a group for different situations, products or goods, whether real or fictitious. This is the group of methods most commonly used to model the choices of individuals or groups (Bouscasse, 2017).

The stated preference survey using hypothetical choice modelling consists of proposing two fictitious scenarios to the respondent (called an alternative). For example, the alternatives could be two herds, herd A and herd B. Each scenario proposes a different combination of two characteristics (called attributes), with a value from a previously defined panel (called levels). The farmer then has to choose which scenario he feels corresponds best to the ideal animal or herd for his/ her farm. In concrete terms, the farmer will choose between herd A and herd B on the basis of information on two characteristics. For example, do they prefer flock A with ewes at 350L milk/lactation (most desirable level of the attribute 'milk production') and 15% mortality at weaning (least desirable level of the attribute 'mortality at weaning') or flock B with ewes at 200L milk/lactation (least desirable level of the attribute 'milk production') and 5% mortality at weaning (most desirable level of the attribute 'mortality at weaning')? An example is provided in Figure 1.

Several alternatives, mixing the attributes and their levels, are thus successively suggested to the farmer, and will make it possible to estimate the weight of the various attributes in the decisions of each respondent and therefore their preferences.

This method is particularly suited to our study because:

- it allows the inclusion of any attributes, whether or not they are present in the selection objectives, and whether or not they have a direct impact on the profit margins of the farms,
- it avoids the qualitative bias associated with rating the desirability of a situation on a scale of 1 to 10 (unlike contingent rating and rating by pairs),
- it is closer to a real choice situation than when the contingent ranking method is used.

2.3.2 BREEDERS SURVEYED

The surveys were carried out in 5 countries (see Table 1) among sheep (milk and meat) and goat (milk) farmers, covering a total of 15 breeds and targeting 25 to 50 surveys depending on the breed.

Country	Partner Organisations	Completed Surveys	Breeds
Uruguay	Instituto Nacional de Investigacion Agropecuaria (INIA-UY)	86	Merino, Corriedale
Greece	Aristotle University of Thessaloniki (AUTH) FIZARTA SHEEP COOPERATIVE	280	Assaf, Lacaune, Frizarta, Chios
France	IDELE INRAE	88	Manech tête rousse, Causse-du-lot, Romane, Lacaune
Italy	Associazione Regionale Allevatori Della Lombardia (ARAL)	66	Alpine, Saanen
Spain	Centreo De Selection y mejora Genetica de Ovino Y Caprino de Castilla Y Leon (OVIGEN)	92	Assaf, Churra, Castellana

Table 1 List of breeds surveyed, corresponding countries and partner organisations.

The surveys were distributed in each country by the breed selection organisations and the technical partners associated with each breed. They were distributed to a variety of breeders in each breed: breeders, multipliers and users of the selection scheme.

They lasted between 30 minutes and 1 hour.

2.3.3 CONSTRUCTION OF THE SURVEY PROTOCOL

The various partners in the study (see Table 1) co-constructed the method by choosing and validating the format and medium of the survey (survey of stated preferences, carried out online, by each breeder individually), as well as the genetic traits studied (these will be the attributes of our survey).

We designed and deployed a pilot survey for the Manech tête rousse breed (n=33 respondents) in spring 2020. Each partner then adapted the questionnaire to their own situation (1) translating the survey into the target language and (2) setting the attribute units and attribute levels for the preference survey section (see 2.3.4.2 “Attributes” and "Levels").

2.3.4 SURVEY QUESTIONNAIRE

In the introduction to the questionnaire, respondents are asked to give their consent to the collection and processing of data from the survey. To this end, a text describes the objectives of the survey, the organisation carrying out the survey, the partners receiving the data, the conditions for storing the data and the rights of respondents with regard to the protection of personal data.

The survey questionnaire itself consists of two parts: a socio-demographic section and a stated preference survey which are described below.

2.3.4.1 Socio-demographic section

This section aims to describe the situation of the farmer and the farm. It consists of closed-ended quantitative or qualitative questions (with a Likert scale) on the breeder's profile, breeding system, herd composition and management, and knowledge of selection tools.

For this socio-demographic section, we used Survey Gizmo software (Alchemer since October 2020) to collect the breeders' answers online. Once the questions have been answered, the breeder is automatically redirected to the second part.

2.3.4.2 *Stated preference survey section*

The second part is the stated preference survey. It aims to identify the ranking in order of importance that the farmer gives to several genetic traits for production, resilience and health and animal efficiency. During this part, the farmer makes several successive choices: he chooses between two combinations of genetic traits and their associated values until his preferences emerge.

For this section, we used the 1000minds software as a data collection tool. This software enables online surveys of stated preferences to be constructed and carried out. 1000minds uses the PAPRIKA method (for Potentially All Pair-wise Rankings of all Possible Alternatives) to construct the alternatives proposed to respondents and minimise the number of questions asked as the respondent progresses through the survey (Al-Isma'ili et al., 2016; Hansen and Ombler, 2008). PAPRIKA also calculates the weights associated with each characteristic once the survey has been completed.

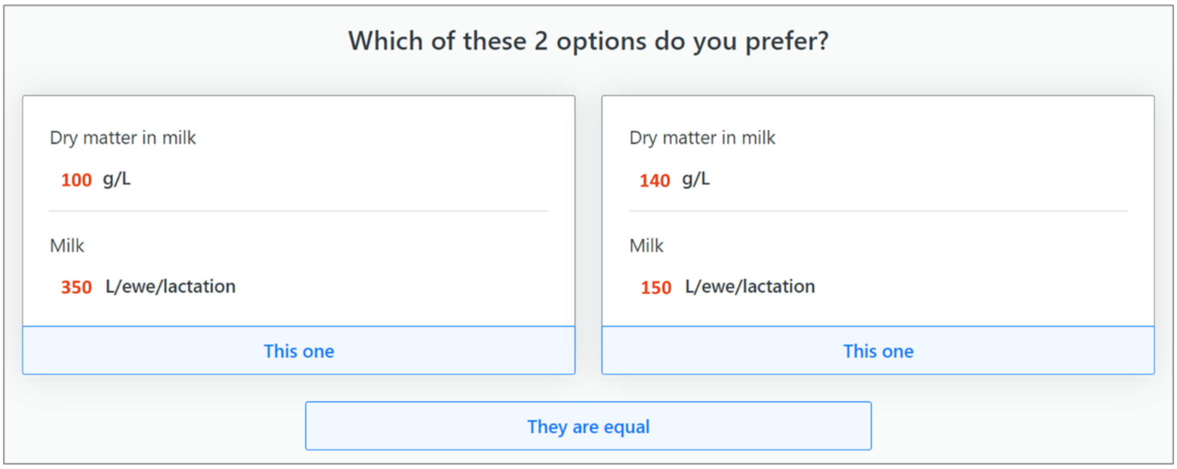


Figure 1 : Example of a choice offered to respondents.

The software's output data are the utility values given by each respondent to each attribute, calculated using the PAPRIKA method. The attribute with the highest utility value is the attribute that is preferred to the others, and vice versa for the attribute with the lowest utility value. Attributes are ranked from most preferred to least preferred in descending order of utility values.

Selected levels and attributes

Attributes

The stated preference survey concerns 8 attributes (i.e. genetic traits) with 3 levels each. This allows a survey time of around 20 minutes for this part of the questionnaire. This choice, which is the result of a compromise between completion time and the number of attributes studied, was decided collectively by the SMARTER project collaborators, based on tests of completion times for 4 versions of the survey with different numbers of attributes and levels (6 to 8 attributes and 2 to 4 levels).

The 8 attributes are (see Table 2, in the case of the Manech tête rousse):

- 2 attributes linked to the animal's production: quantity and quality of animal product (milk, meat, wool)

- 2 attributes linked to the animal's health: resistance to mastitis or footrot and gastro-intestinal parasite resistance

- 4 attributes linked to the animal's efficiency: feed efficiency, prolificacy, functional longevity and mortality at weaning.

These attributes are common to all breeds participating in the study.

Levels

The levels were defined by combining a review of the literature, focus groups with breeders and exchanges with the project partners and other collaborators (in the case of the French breeds: Institut de l'Elevage (IDELE), Centre Départemental de l'Elevage Ovin, Races de France, fellow researchers). The participation of breeders and industry players in the construction of the levels made it possible to identify levels that were realistic and in line with the realities on the ground, and expressed in a unit that spoke to breeders (e.g. '% of animals with symptoms' instead of '% of animals infested' for the attribute resistance to parasitism).

The levels are specific to each breed. For each breed, the partners have established the relevant levels for the breed in question using the methods mentioned in the previous paragraph. For milk production, for example, a Lacaune ewe does not have the same production as a Manech Tête Rousse ewe: the levels for these two breeds will therefore be different. Similarly, the overall attribute of product quantity will not be the same for the Lacaune milk breed (quantity of milk) or Merinos breed (quantity of wool), resulting in different levels.

2.3.5 DATA ANALYSIS

2.3.5.1 Classification of characteristics according to respondents' preferences

The individual utility values given by each respondent and each attribute were averaged according to 3 modalities:

- Breed

Individual utility values are averaged by breed.

- Breed groups

Breed utility values are averaged by breed group. We have calculated the averages for dairy breeds (all dairy breeds, sheep and goats), dairy sheep breeds (dairy ewe breeds only) and dairy goat breeds.

- Breeders

Individual utility values are averaged. This allows individual responses to be explicitly considered. We have produced Breeder averages for dairy breeders (all dairy breeds) and wool breeders (Merinos, Corriedale).

The utility values were then translated into preference rankings (1=most preferred, 8=least preferred).

We compared the average rank between breeds and between groups of breeds, considering only breeds for which the number of respondents was greater than or equal to 25.

2.3.5.2 Categorization of preference profiles

We produced a categorization of preference profiles for the traits studied in order to identify whether groups of breeders sharing similar preferences could be distinguished. The data collected were analysed using R software (version 4.0.3).

This was carried out by Principal Component Analysis (PCA) on the individual utility values of the sample of interest, followed by hierarchical ascending classification (HAC). The HAC was carried out on the first n dimensions of the PCA to obtain a minimum of 80% of the total variability of the sample. The number of groups was chosen by comparing the inertia between and within groups for different numbers of groups. We chose the number of groups that minimised intra-group inertia and maximised inter-group inertia.

We will only present here the results of the typology for the Romane breed (n=38).

2.3.6 RESULTS

The results for the Spanish breeds will not be analysed here because, the survey focused on 6 and 7 characteristics instead of 8 (no 'Resistance to parasitism' for the 3 breeds, and no 'Feed efficiency' for the Churra). This difference in survey design means that there is a high risk of confusion to compare results from the Spanish breeds to the ones from the other breeds.

2.3.6.1 Descriptive analysis of preferences

2.3.6.1.1 All breeds

Differences were observed in the ranking of the various traits studied according to individual (not shown), breed (Table 2, e.g. Assaf versus Lacaune), production type (wool versus dairy, Table 3), and species x country (dairy goat in Italy versus dairy sheep in Greece and France, Table 4).

The Product Quantity trait is preferred by dairy breeders (rank 1, cf. Table 3) whereas it is ranked 7th or 8th out of 8 by wool breeders. Conversely, the longevity trait is preferred by wool breeders whereas it is ranked 8th by dairy breeders.

In milk production, sheep and goats rank feed efficiency differently: this aptitude is perceived as more important (rank 2) in dairy sheep than in dairy goats (rank 7) (Table 4).

2.3.6.1.2 Dairy sheep breeds

For dairy sheep (Table 2), milk quantity is preferred (rank 1 or 2) in all breeds except in Manech tête rousse (rank 6). In Manech tête rousse, mastitis resistance and milk quality are the preferred traits.

Depending on the breed, longevity may be prioritised in the 1st traits (Alpine, Assaf, and Manech tête rousse, respectively rank 1, 2, 3) or at the end of the list (Chios and Lacaune in Greece and Frizarta, respectively 8, 8 and 7).

		Median Rank	Mean Rank	Stand. Dev.	Aver. Rank	Median	Mean	Stand. Dev.	Aver. Rank
		Dairy Sheep							
Greece		***Assaf***	n=70			***Chios***	n=112		
	Milk	2.0	2.3	1.2	**1**	1.0	1.6	0.9	**1**
	Dry matter in milk	4.5	4.5	1.0	**5**	4.0	4.5	1.2	**7**
	Parasitism	8.0	7.4	0.9	**8**	8.0	7.2	1.0	**3**
	Mastitis	4.0	4.3	1.2	**4**	5.0	5.1	1.1	**5**
	Feed efficiency	2.0	2.7	1.1	**3**	2.0	2.5	0.9	**2**
	Longevity	2.0	2.5	1.3	**2**	3.0	3.4	1.3	**8**
	Prolificacy	6.0	5.7	0.9	**6**	6.0	5.5	1.2	**6**
	Mortality at weaning	7.0	6.6	0.7	**7**	6.5	6.2	1.0	**4**
		Frizarta	n=28			***Lacaune***	n=70		
	Milk	1.0	1.2	0.4	**1**	1.0	2.0	1.2	**2**
	Dry matter in milk	4.0	4.1	1.0	**6**	4.3	4.7	1.4	**5**
	Parasitism	8.0	7.1	1.2	**8**	8.0	6.8	1.5	**6**
	Mastitis	5.0	4.8	0.9	**5**	5.0	4.7	1.2	**4**
	Feed efficiency	2.0	2.1	0.5	**2**	2.0	2.7	1.2	**3**
	Longevity	3.8	4.1	1.2	**7**	3.0	3.8	1.7	**8**
	Prolificacy	6.5	6.1	0.8	**4**	7.0	6.4	1.0	**1**
	Mortality at weaning	6.5	6.5	0.7	**3**	5.0	4.9	1.6	**7**
France		***Manech tête rousse*** n=33				***Lacaune***	n=5		
	Milk	6.0	5.3	1.9	**6**	5.5	5.4	1.7	**8**
	Dry matter in milk	3.0	3.3	1.8	**2**	2.0	2.5	1.2	**1**
	Parasitism	4.0	4.1	1.4	**5**	4.5	5.0	2.0	**4**
	Mastitis	2.0	3.1	1.7	**1**	4.5	5.1	1.9	**5**
	Feed efficiency	6.0	5.7	1.7	**7**	5.5	4.6	1.5	**3**
	Longevity	3.0	3.8	1.7	**3**	4.5	5.2	1.8	**6**
	Prolificacy	7.0	6.8	1.1	**8**	5.5	5.3	1.2	**7**
	Mortality at weaning	4.0	3.8	1.6	**4**	1.0	2.9	2.3	**2**
		Dairy Goat							
Italy		***Alpine***	n=41			***Saanen***	n=25		

	Milk	3.0	3.6	2.0	**2**	2.0	2.6	1.6	**1**
	Dry matter in milk	5.0	5.0	1.6	**7**	4.0	4.3	1.6	**3**
	Parasitism	4.0	4.5	1.7	**5**	5.0	4.8	1.9	**5**
	Mastitis	4.0	4.0	1.7	**3**	3.0	3.4	1.7	**2**
	Feed efficiency	5.0	4.8	2.2	**6**	4.0	4.9	2.3	**7**
	Longevity	3.0	3.5	1.7	**1**	4.5	4.4	1.6	**4**
	Prolificacy	8.0	6.5	1.6	**8**	7.5	6.8	1.2	**8**
	Mortality at weaning	4.0	4.1	1.7	**4**	5.0	4.8	1.3	**6**

Table 2 Order of preference of traits by breed, in dairy sheep and goat production.

	Order of preference for wool breeders[1] (n=86)	Order of preference for dairy breeders[1] (n=384)	Order of reference for dairy breeds[1] (n=8) (if N per breed >=25)
The highest ranked	Longevity	Product Quantity	Product Quantity
	Prolificacy	Efficiency 2	Health 1
	Product Quality	Health 1	Efficiency 2
	Health 1	Prolificacy	Prolificacy
	Efficiency 2	Efficiency 1	Product Quality
	Efficiency 1	Health 2	Efficiency 1
	Product Quantity	Product Quality	Health 2
The lowest ranked	Health 2	Longevity	Longevity

[1] Efficiency1 (Mortality and weaning); Efficiency2 (feed efficiency); Health1 (Mastitis); Health2 (Parasite resistance)

Table 3 Character rankings according to their order of preference averaged for all wool breeders (n= 86 individuals), all dairy breeders (goats and sheep) (n= 384 individuals) and averaged by breed, all dairy breeds (goats and sheep) (n= 8 breeds).

	Order of preference for dairy sheep breeds[1] (n=5) (if if N per breed >=25)	Order of preference for dairy goat breeds[1] (n=2) (if if N per breed >=25)
The highest ranked	Product Quantity	Product Quantity
	Efficiency 2	Health 1
	Health 1	Prolificacy
	Product Quality	Product Quality
	Prolificacy	Health 2
	Efficiency 1	Efficiency 1
	Longevity	Efficiency 2
The lowest ranked	Health 2	Longevity

[1] Efficiency1 (Mortality and weaning); Efficiency2 (feed efficiency); Health1 (Mastitis); Health2 (Parasite resistance)

Table 4 Ranking of traits according to their order of preference by breeders averaged by breed all breeds dairy sheep (n= 5 breeds) and all breeds dairy goats (n= 2 breeds)

2.3.6.2 *In-depth analysis: Romane breed case study, French breeders*

2.3.6.2.1 Descriptive analysis

On average, the most important traits for the French Romane breed farmers surveyed (n=38) were product quality (EUROP carcass classification criterion) and resistance to footrot (Table2, Figure 2). The least important traits for them were feed efficiency and product quantity (quantity of meat produced on the farm). Product quality was considered at least 20% more important than the other criteria (up to 80% more important than meat quantity) (Table 5).

Breeders' rankings of traits are fairly variable (standard deviation from 2 to 2.5 depending on the trait for Romane, and from 0.7 to 2 for dairy sheep breeds). All the traits, with the exception of the quantity of product, were cited as both the most important and the least important (Figure 2).

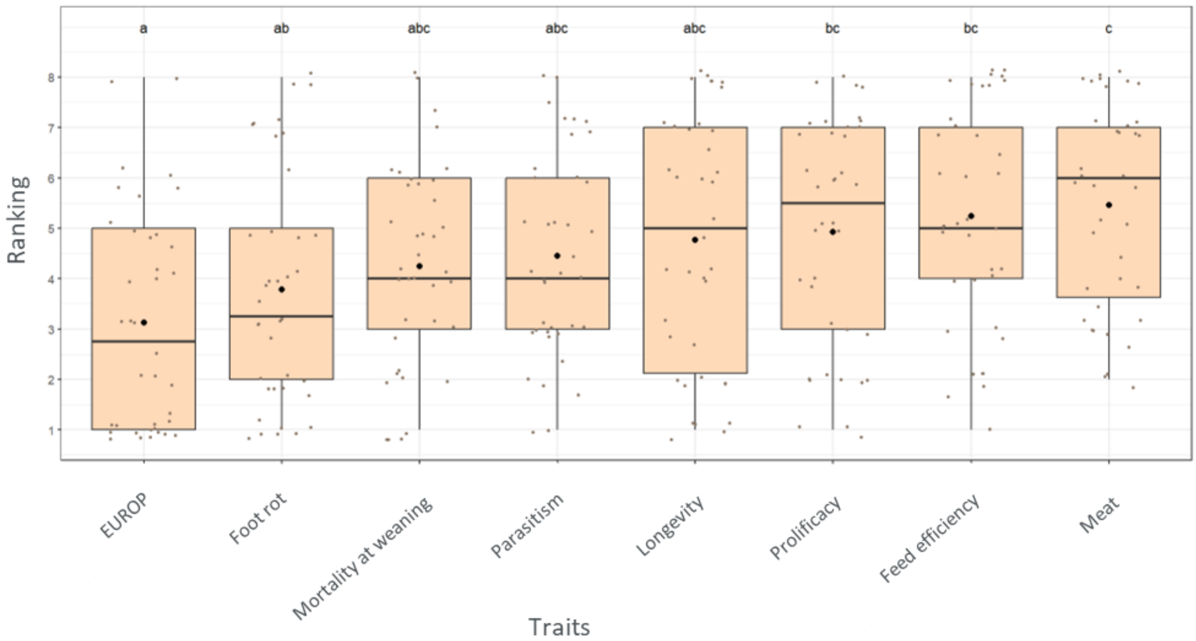


Figure 2 Genetic traits ranked in order of preference (1=most important) among the French Romane breeders surveyed (N= 38). The box and whisker plots represent the mean (black dot), median (solid lines), first and third quartiles (contained in the boxes) and dispersion (line) for each trait studied. The distribution of rankings by trait is represented by the scatterplot. The letters a, b and c indicate the differences between characteristics according to the Kruskal-Wallis test of variance ($P < 0.05$).

		EUROP 16.5%	Foot rot 14.3%	Parasitism 13.4%	Mortality at weaning 12.9%	Longevity 11.9%	Prolificacy 11.2%	Feed efficiency 10.6%	Meat 9.3%
EUROP	16.5%		**1.2**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.8**
Foot rot	14.3%	0.9		**1.1**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
Parasitism	13.4%	0.8	0.9		**1.0**	**1.1**	**1.2**	**1.3**	**1.4**
Mortality at weaning	12.9%	0.8	0.9	1.0		**1.1**	**1.2**	**1.2**	**1.4**
Longevity	11.9%	0.7	0.8	0.9	0.9		**1.1**	**1.1**	**1.3**
Prolificacy	11.2%	0.7	0.8	0.8	0.9	0.9		**1.1**	**1.2**
Feed efficiency	10.6%	0.6	0.7	0.8	0.8	0.9	0.9		**1.1**
Meat	9.3%	0.6	0.7	0.7	0.7	0.8	0.8	0.9	

Table 5 Table of relative importance of the traits studied for french Romane breeders. Example of interpretation: on average, the EUROP trait is 1.2 times more important than the Footrot resistance trait.

2.3.6.2.2 Preference profiles

We identified two preference profiles among the Romane farmers surveyed. According to the criteria presented in the materials and methods section, we retained the first 5 axes of the PCA (85% of the variability) and chose to form 2 groups.

Profile A groups 18 breeders who give priority to reproductive performance (mortality at weaning and prolificacy). Profile B groups together 20 breeders who give particular priority to traits linked to animal health (footrot resistance and parasite resistance). Details of the ranking of traits by profile are given in Figure 3 and summarised in Figure 4.

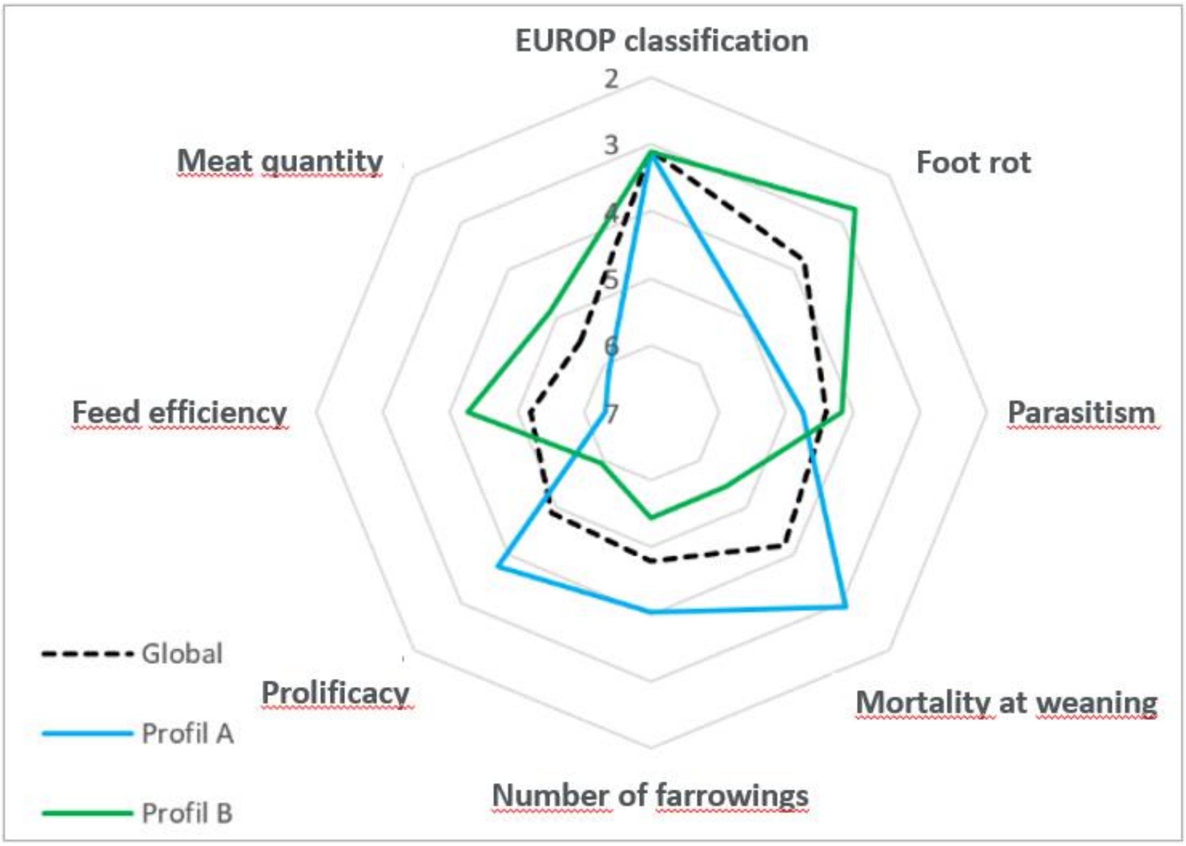
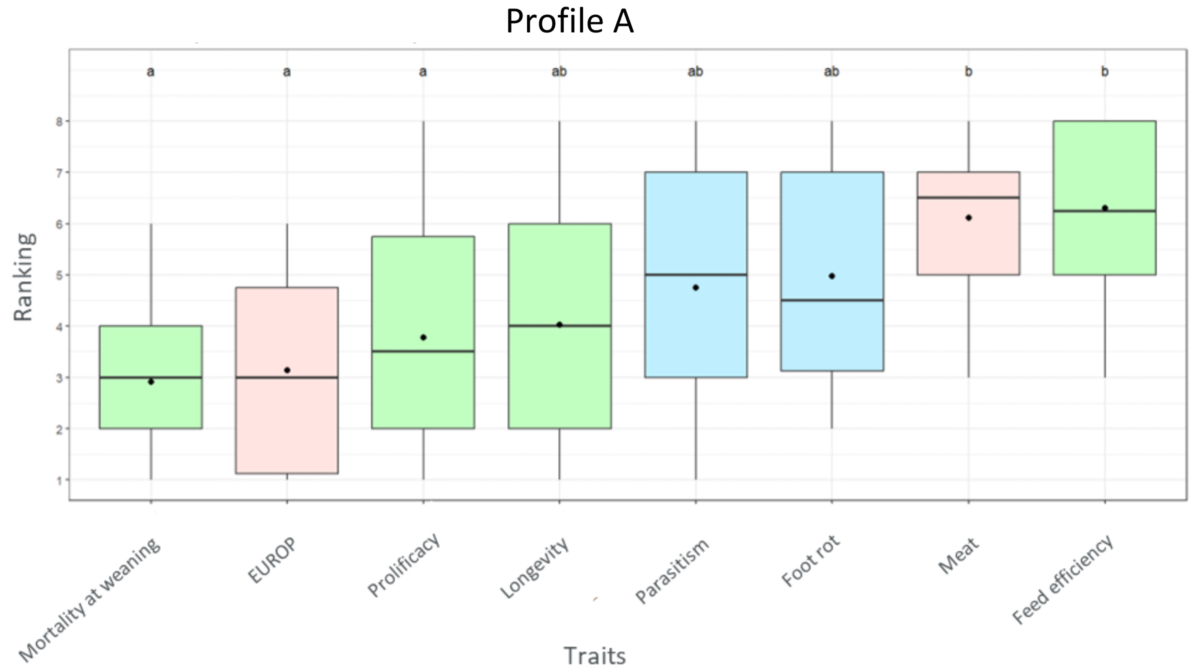


Figure 3 Average ranking of traits by all Romane breeders (dotted line) and by profile (green and blue) (n=38)



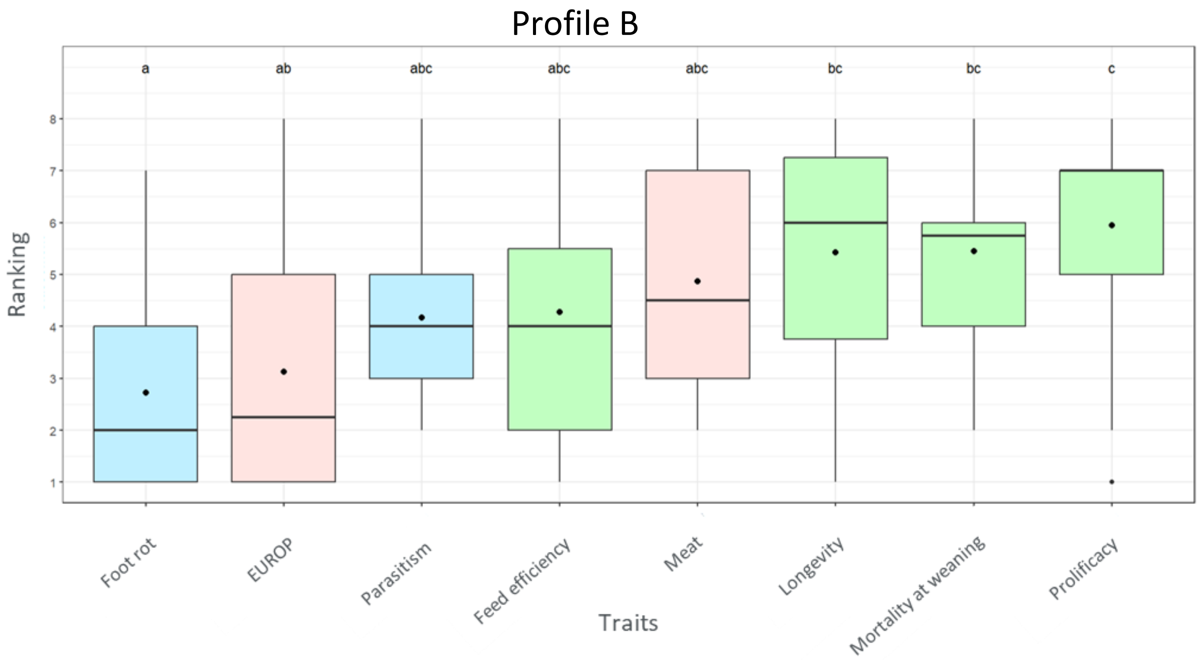


Figure 4 Genetic traits ranked according to their order of preference (1=most important) for Profile A and Profile B of French Romane breeders surveyed. Blue: resilience traits; Pink: production traits, Green: efficiency traits. The box and whisker plots represent the mean (black dot), median (solid lines), first and third quartiles (contained in the boxes) and dispersion (line) of each trait studied. The letters a, b and c indicate the differences between characters according to the Kruskal-Wallis test of variance ($P < 0.05$).

2.3.7 DISCUSSION

Results and method

Choice modelling methods such as the one we have used make it possible to identify and quantify the preferences of individuals and thus classify them. However, they do not give the underlying reasons for such preferences (Bouscasse, 2017). Farmers are influenced by the context in which they find themselves (economic, social, technical situation) at the time of the survey. A study carried out in Greece in 2014 among dairy ewe farmers made this observation. No traits linked to milk composition are included in selection programmes in Greece. This is probably a reason why it is often under-considered in the preferences of the breeders surveyed, all of whom placed low importance on this trait (Ragkos and Abas, 2014). A similar trend can be seen in our surveys, with milk quality ranked 5, 6 or 7 for dairy sheep surveys in Greece.

Nevertheless, it is still possible to formulate hypotheses based on our knowledge of the technical and socio-economic context in which the respondents find themselves and on the characteristics of the breed. For example, we observe that the attribute 'milk production' is not prioritised among the preferred attributes of the Manech tête rousse breeders, whereas it is for the other dairy breeds. These differences could be due to the particularities of the Manech tête rousse dairy industry in the Pyrénées-Atlantiques (the area of the breeders surveyed). In this area, dairy sheep farms deliver milk or process it into cheese. Remuneration for milk is fairly high and depends heavily on the quality of the milk, with a goal to produce Ossau Irraty or similar cheeses. On average, farms in this area have a high stocking rate. The breeds selection scheme has effectively improved milk production over the last few decades. In this respect, we can assume that farmers are not prioritising milk production with strong female producers (cf. satisfactory remuneration for milk, payment scale based on milk quality, notable progress in milk production, etc.) but are rather looking to reduce production costs (priority on longevity, resistance to mastitis and mortality at weaning). Only an in-depth qualitative survey would make it possible to test these hypotheses and explain the differences in prioritisation identified.

The major difficulty encountered in carrying out this study was the data collection. Contacting people and sending out the survey by e-mail does not encourage commitment, especially in professions where office work is not at the heart of the activity. In addition, the survey is long and tedious, which can lead respondents to abandon the survey (91 drop-outs) or lead to a drop-in concentration and motivation, skewing actual preferences (Nielsen and Amer, 2007; Tano et al., 2003). This is why we chose 8 attributes and 3 levels to limit the survey to 40 minutes, with the preference survey lasting 20 minutes. For several breeds, we conducted the surveys by telephone for a better response rate and to limit survey-related fatigue.

Contributions to genetic selection

In genetic selection, the weights associated with the traits included in the selection objectives are determined using several methods: the weight to be given to each trait, the genetic correlations between traits, the genetic parameters of the traits and the profit associated with the weight of each trait. Another way of doing this is to define the weightings according to expert opinion, based on the idea one can have of the hierarchy and the relative importance of the traits in relation to each other. This method is widely used in France (as is the case for INRAE). By quantifying the preferences of a group of breeders, our method makes it possible to incorporate breeders' opinions into the definition of selection criteria for a breed at a low cost. This would consider their skills and expertise, as well as the fact that it is they who create, disseminate and use genetic progress. Designing selection objectives in this way, taking explicit account of farmers' preferences, is in line with the logic of the agro-ecological transition of livestock farming, where producers are involved in the decisions that will have an impact on them (Wezel et al., 2009).

2.3.8 CONCLUSION

This survey is the first international, multi-breed, multi-production study to quantify and classify the preferences of ruminant breeders for an ideal animal. In-depth analysis of the data enables preference profiles to be identified, corresponding to a set of preferences shared by a group of breeders. Data was made available here : https://zenodo.org/record/8279610 .

This type of survey can be used as a basis for establishing breed selection objectives, for example. It is conceivable either to take the average preferences for the breed, or to design several selection objectives to meet the expectations of breeders belonging to the different preference profiles. Considering the opinions of breeders, and more generally of the players in the industry, is all the more interesting given that with the development of genomics, which makes it possible to increase the speed of genetic gain, selection is opening up to the integration of new traits.

3 Deviations or delays

Because of delay in data collection (caused by COVID) the analysis was done lately. While analysing the data, we decide to drat the results in the form of a conference paper rather than a journal article. Indeed, we target the 3R conference (3R: Rencontres Recherches Ruminants, Paris). The 3R conference is held every two years, and the next one will be held in December 2024. We will submit it as soon as the call for papers opens; which is usually in March.

The results of the study were presented at the EAAP conference in Lyon, August 26th - September 1st 2023, Session71, Theatre12 under the title “Resilient, healthy or efficient. The ideal animal according to breeders od small ruminants in Europe", by E. Janodet and M. Sautier.

We therefore acknowledge that the deliverable may be published after the deadline we requested (March 2024).

4 Additional data on stakeholders' preferences

The approach used to survey the breeders (internet surveys) did not work in full. We employed an intern who

- contacted the breeders by telephone
- designed a survey for collecting the preferences of the stakeholders of the small ruminant industry
- distributed and advertised the stakeholder survey.

It allowed to reach a Total choice survey numbers very close to DoA with N=661 surveys, ie. 85% of expected (N=775).

The stakeholders surveyed were: participants to the SMARTER summer course, researchers, extension services agents and students in agricultural and animal science. A total of 49 additional surveys were therefore gathered.

Stakeholders results showed different preferences compared to breeders as shown in Figure 5. The resilience traits (1) "Mortality at weaning" and "Resistance to parasitism" are the highest ranked for Researchers and extension agents and for Summer School Participants, and (2) "Resistance to mastitis" and "Mortality at weaning" are the highest ranked for Undergraduates in agriculture and animal science. For breeders, the highest ranked traits are the Production traits "Quantity of Milk" and "Feed efficiency".

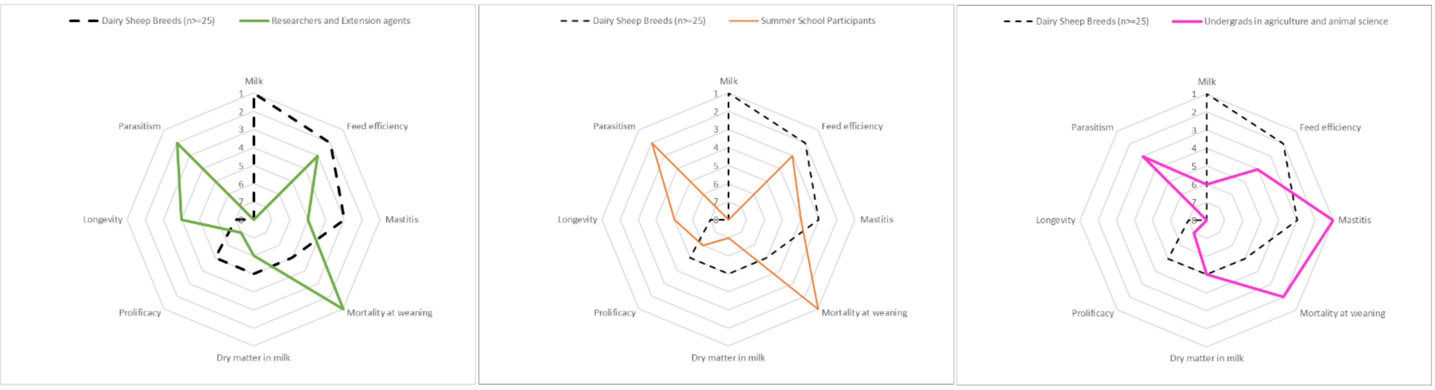


Figure 5 Ranking of traits by dairy sheep breeds (n≥25) (dotted) compared to average ranking by Researchers and extension agents (green), Participants to SMARTER Summer School (orange), and students in agricultural and animal science (pink).

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