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Factors influencing sheep farmer attitudes towards breeding tools across Mediterranean breeds

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Abstract. One of the key challenges for the success of sheep breeding programmes is to achieve a wide farmer engagement, which in many cases, especially in sheep breeds, is far from being fully reached. Understanding farmer attitudes and its driving factors give key insights for designing extension activities aiming to increase farmers' uptake of breeding tools. However, farmer attitudes towards breeding tools have only been studied in very few occasions. Here we investigated the attitude of Spanish and Greek sheep farmers towards breeding tools and the main factors affecting it. A farmer survey that includes a scale to measure farmers' attitudes was designed. The survey included additional information on farm and farmer profiles. Data were analysed using multivariate statistical methods. Two hundred fifteen farmers from Greece and Spain completed the survey. We found large heterogeneity in farmers' attitudes not only across countries and breeds but also within them. Although there were farmers with a clear positive attitude towards genetic and genomic breeding (n=58) and farmers with a very positive attitude towards traditional selection (n=58), the majority had a balanced attitude towards genetic and genomic breeding and traditional phenotypic selection (n=82). In both counties, farmers of business-oriented intensive farms (contrary to family or family business farms) tended to have the highest positive attitude towards genetic and genomic breeding compared to traditional selection. This study indicates the need of tailoring extension programs to demonstrate farmers the usefulness of genetic and genomic breeding tools to improve animal performance.

Keywords. Sheep genetic & genomic - Breeding tools - Farmer attitudes - Mediterranean - Local breeds.

Facteurs influençant les attitudes des éleveurs ovins vers des outils de sélection dans les races méditerranéennes

Résumé. L'un des défis principaux pour le succès des programmes d'amélioration ovine est de parvenir à un fort engagement des éleveurs, ce qui bien souvent, en particulier pour les races ovines, est loin d'être le cas. La compréhension des attitudes des éleveurs et de leurs facteurs déterminants nous donnent une perception fondamentale pour mettre au point des activités de vulgarisation visant à augmenter la maîtrise des outils d'amélioration par les éleveurs. Toutefois, les attitudes des éleveurs envers les outils d'amélioration n'ont été que rarement étudiées. Ici nous examinons l'attitude des éleveurs espagnols et grecs concernant les outils d'amélioration ainsi que les facteurs qui l'influencent. Une enquête sur les éleveurs a été concue, incluant une échelle pour mesurer leurs attitudes. L'enquête comprenait une information additionnelle sur la ferme et les profils des éleveurs. Les données ont été analysées en utilisant des méthodes statistiques multivariées. Un total de 215 éleveurs grecs et espagnols ont rempli l'enguête. Nous avons trouvé une large hétérogénéité pour les attitudes des éleveurs, non seulement entre pays et races mais aussi entre eux. Bien que certains éleveurs avaient une attitude nettement positive concernant l'amélioration génétique et génomique (n=58) et certains autres très positive concernant la sélection traditionnelle (n=58), la majorité montraient une attitude mitigée envers l'amélioration génétique et génomique et la sélection phénotypique traditionnelle (n=82). Dans les deux pays, les éleveurs possédant des exploitations intensives de type entreprise (contrairement aux exploitations familiales ou exploitations de type entreprise mais familiales) tendaient à avoir l'attitude la plus positive concernant l'amélioration génétique et génomique en comparaison à la sélection traditionnelle. Cette étude indique le besoin de concevoir sur mesure les programnes de vulgarisation pour montrer aux éleveurs l'utilité des outils d'amélioration génétique et génomique afin d'augmenter les performances animales.

Mots-clés. Génétique et génomique ovine – Outils d'amélioration – Attitudes des éleveurs – Méditerranée – races locales.

I – Introduction

The success of breeding programmes relies on farmers' engagement. This may seem self-evident, however in many cases, especially in sheep local breeds raised under extensive systems, farmer use of breeding tools and participation in breeding programmes is usually far from optimum levels. As a result, the genetic gain achieved within breeds is limited. Nevertheless, research in the field of animal breeding has focused on the development of methods and techniques to evaluate the genetic potential of animals ignoring the effect of social factors on farmer breeding decision-making process. In recent years, farmers' views about genetic improvement, their trait preferences, and the link between these and implementation of breeding programmes are attracting the attention of academics. Understanding farmer attitudes and specifically the factors influencing them may give key insights for designing extension activities aiming to increase farmers' uptake of breeding tools and participation in existing programmes. However, to our knowledge, farmer attitudes towards breeding tools have scarcely been studied. The objective of our study was to explore the attitude of Greek and Spanish sheep farmers towards breeding tools and to identify its main drivers.

II – Methods

We designed a farmer survey that included a scale to measure farmers' attitudes towards breeding tools. The scale consisted of a set of attitudinal statements that allow for the determination of farmer attitudes. Farmer denoted their level of agreement with these statements using a 6-item Likert scale (Likert, 1932). The survey requested additional data on farm size, farming system characteristics, ownership structure, use of reproductive and breeding technologies, farmer age, education and family profile. The set of statements that form the attitudinal scale were developed and tested in a previous study implemented with more than 600 beef and sheep farmers of local and international breeds in Australia, New Zealand and Spain (Martin-Collado et al., 2021). The latter study used standard methodologies for the development of attitudinal scales (e.g. Dunlap et al., 2000) and found two independent attitudinal dimensions; one related to farmer attitudes towards traditional selection and another one toward genetic and genomic breeding. In the present study, we used those two dimensions ("Att. toward traditional selection" and "Att. toward G&G breeding") to derive an attitudinal gradient variable ("Att. gradient Traditional-G&G") as the subtraction of the second to the first; therefore, the more positive the value of "Att. gradient Traditional-G&G" the more positive the attitude toward traditional selection compared to genetic/ genomic breeding, and vice versa. The relationship between the attitudinal statements included in the survey, the attitudinal dimensions and the attitudinal gradient are shown in Table 1. The survey was conducted in Greece and Spain between the end of 2019 and the beginning of 2019. A total of 215 farmers were surveyed; after guality check of data, 198 surveys were analysed; 86 in Greece and 112 in Spain covering seven (Assaf, n=7; Chios, 13; Crossbreed, 36; Frizarta, 3; Kefalonias, 1; Lacaune, 24; Lesvos, 2) and four (Assaf, 29; Churra, 11; Latxa, 32; Manchega, 40) breeds respectively. We grouped farmers according to "Att. gradient Traditional-G&G" using k-means cluster analysis. Then, linear discriminant analysis was used to explore how country, breed, farm and farmer profile relate to attitudes based on its power to help discriminating among farmer attitudinal groups. The discriminating power of the variables was evaluated by estimating probabilities of misclassification of farmers among attitudinal groups (Lachenbruch et al., 1979).

Attitudinal statement	Att. toward traditional selection	Att. toward G &G breeding	Att. gradient Traditional G&G
Using breeding values to select rams/ewes improves the performance of sheep better and faster than other ways of selecting	-0.4	0.4	-0.4
The use of genomic and DNA/gene information to select rams/ewes will improve the performance of sheep better and faster than any other method	-0.2	0.8	-0.6
It is important that opportunities for selection of sheep with genomic and DNA/gene information are fully utilized	-0.2	0.8	-0.6
It is important that opportunities for selection of sheep with new genetic developments are fully utilized	-0.2	0.7	-0.6
The appearance of a ram/ewe is sufficient for telling its performance	0.8	-0.6	0.7
The appearance of progeny fully indicates how good the ram/ewe is	0.8	-0.1	0.6

Table 1. Correlation between attitudinal statements, attitudinal dimensions and attitudinal gradient

III - Results

The distribution of farmer attitudes towards traditional selection and genetic/genomic breeding was very heterogeneous across and within breeds and countries (Fig. 1). The cluster analysis revealed three groups of farmers according to their attitude: (i) "Pro-Traditional selection" farmers (n=58; average "Att. gradient Traditional–G&G"=1.76), (ii) "Balance Traditional-Genetic and Genomic" farmers (82; -0.19), and (iii) "Pro-Genetic and Genomic breeding" farmers (58; -1.77).

We developed three discriminant models to distinguish among attitudinal groups (i) in both countries, (ii) in Greece, and (iii) in Spain. In addition, we also discriminate between "Pro-traditional selection" and "Pro-Genetic and Genomic breeding" farmers ignoring observations from the intermediate group.



Fig. 1. Distribution of farmers' attitudes towards traditional selection (positive values) versus genetic/ genomic breeding (negative values) across breeds and countries.

We found that in the analysis considering both countries (all data), the minimum misclassification rate was 0.41. The latter indicates that 59% of farmers can be correctly assigned to their attitudinal group. Such rate was achieved considering Breed, Production system (intensive, vs extensive/semiextensive) and Pedigree recording (whether farmers record pedigree or no) in the model. Discrimination between just "Pro-Traditional selection" and "Pro-Genetic and Genomic breeding" farmer groups was easier; there was a misclassification rate of 0.19 with a model including Breed, the Production system and the Farm property regime (business, family business or family farm). In Greece, farmer age influenced farmer attitudes; the best fitted model included Production system, Breed, Age, and Performance recording data to produce a misclassification rate of 0.37. In Spain education level was related to farmer attitude; the best model produced a misclassification rate of 0.36 including Production system, Breed, Education level and Performance recording data. Table 2 shows the value of the driving factors of farmer attitudes across farmer groups.

		Attitudinal farmer group		
Farming system and farmer factors		Balance Pro-traditional selection	Traditional G&G	Pro-G&G
¹ Production system	Intensive	22.4	28	56.9
	Extensive/semi-extensive	77.6	72	43.1
¹ Farm property regime	Business	0.0	6.1	17.2
	Family business	34.5	41.5	50.0
	Family farming	65.5	52.4	32.8
Pedigree recording (% of farmers)		34.5	50.0	84.5
Performace data recording (% of farmers)		46.6	56.1	91.4
^{1,2} Education level (Spain)	Basic	48.0	36.6	39.1
	Intermediate	12.0	17.1	8.7
	University	40.0	46.3	52.2
² Age (Greece)		44.2 ± 11.6	40.5 ± 9.7	40.2 ± 8.6

Table 2. Factors related to farmer attitudes towards breeding

¹ Perc. of farmers of each attitudinal group that falls in each category of production system, property regime and education level.

² Education level is on related to farmer attitudes in Spain and age only in Greece.

IV – Discussion

The present study shows that sheep farmer attitudes towards breeding tools are very heterogeneous. Three farmer groups were identified and all of them were present in both countries and in all breeds; farmers that had a "pro-traditional selection" attitude, farmers that had a clear "pro-genetic and genomic breeding" attitude and farmers who had a similar attitude towards both breeding paradigms. The latter was the largest group representing those farmers who think both approaches help their selection decisions.

Overall, our results indicated farming system and business orientation, age and education level as the major factors influencing farmers' attitude towards genetic/genomic breeding tools. Farmers of intensive business-oriented systems had a more positive attitude towards genetic and genomic breeding. Farmers of this group usually collect information that is formally analysed and translated into genetic and economic tools. On the other hand, farmers with an attitude pro-traditional selection tend to record neither pedigree nor performance data, maybe reflecting that their decision making is generally based on opinions not backed by formal data analysis. It should be noted however, that under extensive farming conditions controlled mating and artificial insemination are challenging making genetic/genomic selection difficult to implement (Mrode *et al.*, 2018).

We found that attitudes were influenced by education level and age. However, a different pattern was revealed depending on the country. In Spain, the higher the farmer education level, the more positive attitude towards genetic and genomic tools. In Greece age was a driver of farmer attitudes; younger farmers were more positive towards genetic/genomic breeding. Such results are consistent with findings from previous studies which showed age to be a key determinant of Greek farmers' attitude towards innovation (Andreopoulou *et al.*, 2014, Kountios *et al.*, 2018). Considering the above, age and education could possibly be characterized as co-dependent drivers of farmers' attitude. Certainly, the lack of access of older people to training programs about genetic/genomic breeding tools should be taken into account. This insight could be used towards designing appropriate extension activities tailored to the specific needs of different farming systems and farmers.

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