

## Economic analysis of Moroccan sheep breeds' conservation

Lionboui H., Elame F., Ouhrouch A., Benjelloun B.

in

López-Francos A. (ed.), Jouven M. (ed.), Porqueddu C. (ed.), Ben Salem H. (ed.), Keli A. (ed.), Araba A. (ed.), Chentouf M. (ed.).  
Efficiency and resilience of forage resources and small ruminant production to cope with global challenges in Mediterranean areas

Zaragoza : CIHEAM

Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 125

2021

pages 661-664

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=00008083>

To cite this article / Pour citer cet article

Lionboui H., Elame F., Ouhrouch A., Benjelloun B. **Economic analysis of Moroccan sheep breeds' conservation.** In : López-Francos A. (ed.), Jouven M. (ed.), Porqueddu C. (ed.), Ben Salem H. (ed.), Keli A. (ed.), Araba A. (ed.), Chentouf M. (ed.). *Efficiency and resilience of forage resources and small ruminant production to cope with global challenges in Mediterranean areas.* Zaragoza : CIHEAM, 2021. p. 661-664 (Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 125)



<http://www.ciheam.org/>  
<http://om.ciheam.org/>

# Economic analysis of Moroccan sheep breeds' conservation

H. Lionboui<sup>1</sup>, F. Elame<sup>1</sup>, A. Ouhrouch<sup>1,2</sup> and B. Benjelloun<sup>1</sup>

<sup>1</sup>National Institute of Agronomic Research, Ennasr Avenue, Rabat (Morocco)

<sup>2</sup>Université Sultan Moulay Slimane, Beni Mellal (Morocco)

---

**Abstract.** As in many countries, animal production in Morocco has an important economic, social and nutritional role. However, the conservation of animal genetic resources is still carried out by in situ methods. In order to optimize the sustainable management of animal genetic resources, the economic assessment of animal genetic biodiversity is important. In this case study, we compared the economic value of the main animal breeds in Morocco. Animal breeds selected are prominent in the country, in particular, Beni Guil, Ouled Jellal, Sardi, Timahdit and Dman. Data collection of production costs and sale prices was carried out among farmers and organizations working in the sheep farming sector in Morocco. An economic weighting analysis was implemented in which the marginal profit of breeds was assessed. The economic importance of a character can be expressed by the marginal profit, which results from the increase of a unit of this character above the average of the studied breeds. In this approach, two economic values were computed. The financial market value of each breed is added to another value related to the private genomic polymorphism. The results showed that the price of the Dman breed would undergo the important increase that is around 3.3 MAD/kg considering that this breed has the largest number of exclusive variants and an important effective population size. Overall, this work may be of interest to policy makers in guiding development programs and projects to encourage breeds that have important adaptation values.

**Keywords.** Economic analysis – Sheep breeds – Private genomic polymorphism – Economic value – Morocco.

## **Analyse économique de la conservation des races ovines marocaines**

**Résumé.** Comme dans de nombreux pays, la production animale au Maroc joue un rôle économique, social et nutritionnel très important. Néanmoins, la conservation des ressources génétiques animales se fait toujours à travers des méthodes in situ. Afin d'optimiser la gestion durable des ressources génétiques animales, l'évaluation économique de la biodiversité génétique animale est vivement conseillée. Dans ce cas d'étude, nous avons comparé la valeur économique des principales races animales. Les races animales sélectionnées sont les races les plus dominantes du pays, en particulier les races Beni Guil, Ouled Jellal, Sardi, Timahdit et Dman. La collecte de données sur les coûts de production et les prix de vente a été réalisée auprès des agriculteurs et des organisations travaillant dans le secteur de l'élevage ovin au Maroc. Une analyse de pondération économique a été réalisée dans laquelle le bénéfice marginal des races a été évalué. L'importance économique d'un caractère peut s'exprimer par le profit marginal résultant de l'augmentation d'une unité de ce caractère au-dessus de la moyenne des races étudiées. Dans cette approche, deux valeurs économiques ont été calculées. La valeur marchande financière de chaque race, en plus d'une autre valeur liée au polymorphisme génomique privé de certaines races. Les résultats montrent que la race Dman a été concernée par la plus grande valeur économique d'adaptation 3,3 MAD/kg, sachant que cette race possède le plus grand nombre de variantes exclusives et une taille effective importante. Dans l'ensemble, ce travail pourrait intéresser les décideurs politiques pour orienter les programmes et projets de développement en vue d'encourager les races qui ont une valeur économique importante en matière d'adaptation.

**Mots-clés.** Analyse économique – Races ovines – Polymorphisme génomique privé – Valeur économique – Maroc.

---

## I – Introduction

Climate change is considered as the greatest future threat of animal production (WGI AR5, IPCC 2013). Livestock biodiversity is the most important safeguard against this threat, ensuring sustainability and resilience of production systems. The most important threats to biodiversity are related to the marginalization of traditional production systems and associated local breeds, mainly due to the expansion of intensive livestock production, often on a large scale and using a limited number of breeds (FAO, 2015). At the global level, erosion of animal genetic resources is rapidly occurring and genetic diversity is decreasing (Pizzi *et al.*, 2016). As a result, many countries are losing their genetic resources, essential for both food security and sustainable development. Thus, the economic assessment of genetic diversity indicators including inferences of the adaptive potential of local breeds seem to be crucial in this context of climate change and global erosion of biodiversity and pastoral/forage resources. Thus, the main objective of this research is to assess the economic value of five sheep breeds raised in Morocco while including market and other non-market values related to their genetic diversity.

## II – Materials and methods

### 1. Economic analysis

In order to preserve genetic diversity of livestock, IMAGE project “Innovative Management of Animal Genetic Resources” adopts a socio-economic approach to compare the economic importance of indigenous animal breeds. The breeds included are among the most important in Morocco, namely: Dman, Sardi, Beni Guill, Oulad Jellal and Timahdite.

For genetic resources, which have no market value, their economic assessment is done indirectly. In general, the value used is the wealth created by economic activities dependent on the existence of genetic resources (Lévêque and Glachant, 1992). The economic valuation allows assessing the biological diversity components for the purpose of its conservation and sustainable use.

An analysis of the economic weights was performed in which the marginal profit of the breeds was evaluated. The economic importance of a character is expressed by the marginal profit resulting from the increase of one unit of the character above the average of the studied breeds (Schlote, 1977). The marginal profit was calculated using the difference between marginal revenue and marginal cost.

### 2. Data collection

In this research, two indicators of genetic diversity were used to evaluate each breed, namely the number of exclusive variants at the genome level and the effective population size. Exclusive variants were estimated from global genomic variants using the perl vcf-compare module of vcftools (Danecek *et al.*, 2011). Current effective population sizes ( $N_e$ ) were inferred through the Pop-sizeABC algorithm (Boitard *et al.*, 2016). They were estimated at the level of each breed studied using the complete genome data of individuals (Benjelloun, 2015).

For data on sales prices and production costs used, data collection was carried out in 2018 among farmers and organizations working in the sheep farming sector in Beni Mellal-Khénifra, Sous Massa, Errachidia and the Eastern region of Morocco.

### III – Results and discussion

The economic analysis aims to compare the economic value of major animal breeds. Two economic values were calculated. The financial market value of each breed in addition to another value related to private genomic polymorphism that contributes to the individual variations of each breed. The latter is illustrated by the number of private mutations in their genomes and used as a proxy for “adaptation value” in the context of environmental changes.

The advantage of this approach lies in the fact of combining both market values, such as cost or price, and non-market values such as genomic variation. Results showed that high levels of genomic diversity characterize all the studied breeds. Similarly, their effective population sizes are very high in comparison with “industrial” breeds (Table 1).

**Table 1. Exclusive variants and Effective size of studied breeds**

| Breed        | Exclusive variants | Effective population size ( $N_e$ ) |
|--------------|--------------------|-------------------------------------|
| Dman         | 1,783,651          | 30,052                              |
| Sardi        | 1,621,728          | 28,296                              |
| OuledDjellal | 460,461            | 26,367                              |
| BeniGuil     | 341,296            | 32,223                              |
| Timahdite    | 934,212            | 43,781                              |

The profit calculation is based on an inventory of production costs and selling prices by breed. Costs include feeding costs, guarding, veterinary fees, and the value of lamb after weaning for each breed. Table 2 presents the average total cost estimates and the average selling price per breed reported per kilogram live weight.

**Table 2. Total cost and selling price by breed**

| Breed          | Production cost (MAD/kg) | Selling price (MAD/kg) |
|----------------|--------------------------|------------------------|
| Dman           | 31.8                     | 38                     |
| Sardi          | 45.1                     | 51                     |
| OuledDjellal   | 35.9                     | 43                     |
| BeniGuil       | 34.7                     | 41                     |
| Timahdite      | 34.1                     | 40                     |
| <b>Average</b> | 36.3                     | 42.6                   |

Once the marginal profit was estimated, we inferred the economic value of genetic characters by multiplying the marginal profit and the weight of each character. The results show that the price of Dman breed will be affected by the greatest increase, despite the fact that this breed remains the least profitable on the market. This recorded increase was 3.3 MAD/kg considering that this breed has the most important number of exclusive variants and a very important effective population size. Then, Sardi breed with a recommended increase of its selling price of 2.7 MAD/kg. It is marked by a high genetic diversity uniqueness as Dman breed (Table 1) and also a very high economic profitability. Timahdit was third in term of its economic value with an increase value of its selling price of 2.5 MAD/kg, followed by Oulad Jellal and Beni Guill breeds with recommended increases of 2 and 1.7 MAD/kg respectively (Table 3).

**Table 3. Calculation results of the economic value**

| Breed       | Variation in marginal profit | Economic weighting according to genetic character (MAD/kg) |                        | Economic value of genetic character (MAD) | Economic value (MAD/kg) |
|-------------|------------------------------|--|------------------------|---|-------------------------|
|             |                              | No. of exclusive variants                                  | Current effective size |   |                         |
| Dman        | 0.99                         | 2.14   | 1.16                   | 3.3                                       | 41.3                    |
| Sardi       | 0.93                         | 1.72   | 0.96                   | 2.7                                       | 53.7                    |
| OuledJellal | 1.13                         | 0.72   | 1.31                   | 2.0                                       | 45.0                    |
| BeniGuil    | 1.00                         | 0.42   | 1.27                   | 1.7                                       | 42.7                    |
| Timahdite   | 0.94                         | 1.01   | 1.52                   | 2.5                                       | 42.5                    |

## IV – Conclusions

This research focused on comparing the economic value of five major sheep breeds in Morocco, namely Beni Guil, Ouled Jellal, Dman, Sardi and Timahdit. To calculate this value, we combined both market values, such as raising costs and selling prices, and non-market values such as the adaptive potential represented by two indicators, namely, the number of exclusive variants and the effective population size. The results showed differences in the economic value of adaptation between these breeds. The Dman breed, which is not enough supported by animal development projects, has been affected by the greater economic value of genetic diversity, followed successively by Sardi, Tmahdit, Oulad Jellal and BeniGuill. These results would provide guidelines for development programs and projects in the country to encourage breeds that have high unique diversity.

## Acknowledgments

The authors gratefully acknowledge all the farmers who have agreed to contribute to this study, as well as the regional agricultural directorates of Béni-Mellal khénifra and Souss-Massa for their technical support. Research funded by “IMAGE” project.

## References

- Benjelloun B., 2015.** Diversité des génomes et adaptation locale des petits ruminants d'un pays méditerranéen: le Maroc. Thèse de Doctorat. Biodiversité, Ecologie, Environnement. Université Grenoble Alpes. Grenoble, France, 207 p. Available at: <https://www.theses.fr/2015GREAV011>
- Boitard S., Rodríguez W., Jay F., Mona S. and Austerlitz F., 2016.** Inferring population size history from large samples of genome-wide molecular data-an approximate Bayesian Computation approach. *PLOS Genetics* 12(3):e1005877 DOI: 10.1371/journal.pgen.1005877
- Danecek P., Auton A., Abecasis G., Albers C.A., Banks E. et al., 2011.** The variant call format and VCFtools. *Bioinformatics* 27: 2156-2158.
- FAO, 2015.** The second report on the state of the world's animal genetic resources for food and agriculture, edited by B.D. Scherf & D. Pilling. Rome.
- Leveque F. and Glachant M., 1992.** Diversité génétique : la gestion mondiale des ressources vivantes. *La Recherche* 23: 1 14-1 23.
- Pizzi F., Turri F., Gliozzi T. and Gandini G., 2016.** Implementation and cost analysis of a regional farm animal cryobank: an Italian case study, *Italian Journal of Animal Science*, 15:2, 207-210, DOI: 10.1080/1828051X.2016.1153406.
- Schlote W., 1977.** Choix et pondération économique des caractères en sélection animale (1). *Annales de génétique et de sélection animale*, INRA Editions, 9 (1), pp. 63-72.