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

Documenting animal genetic resources in the Mediterranean: interaction and cooperation in the region

**C. Ligda[1,*], D. Tsiokos[2], G. Hadjipavlou[3], M. Djemali[4],
M. Fadili[5], E. Charvolin-Lemaire[6] and E. Sturaro[7]**

[1]Hellenic Agricultural Organization, VRI, P.O. Box 60 272, 57 001 Thessaloniki (Greece)
[2]Hellenic Agricultural Organization, RIAS, P.O. Box 58 100, 57 001 Pella (Greece)
[3]Agricultural Research Institute, P.O. Box 22016, 1516 Lefkosia (Cyprus)
[4]INAT – University of Carthage, Animal Genetic and Feed Resources Research, 43,
Av. Charles Nicole, 1082, Tunis (Tunisia)
[5]INRA Morocco, 25 Avenue Ennasr, BP 415 RP Raba (Morocco)
[6]INRAE UMR GABI 1313, Domaine de Vilvert, Bat 211, 78352 Jouy en Josas (France)
[7]University of Padova, DAFNAE, Via dell'Università 16, 35020, Legnaro (PD) (Italy)
*e-mail: chligda@otenet.gr

Abstract. This study aims to present the status of animal genetic resources documentation in the Mediterranean region through specific country examples. For this purpose, data from six countries (France, Italy, Greece, Cyprus, Morocco and Tunisia) were exported from the Domestic Animal Diversity Information System (DAD-IS) and analyzed. The key figures refer to the number of breeds registered, breeds per risk status, population trends, degree of data completeness, etc. According to the analyzed data, the rate of completeness of population figures varied between 20% to 100%. The SDG 2.5.2 indicator in the countries was widely diverse. In addition, complementary data were collected through a questionnaire to understand the organizational structure and the relevant policies in each country. Previous work carried out in the frame of the European Regional Focal Point on farm animal genetic resources (ERFP) has been used and extended to Mediterranean countries not previously included in that survey. Means to stimulate data recording and promote the use of the DAD-IS system, as well as enhance the communication and interaction are also discussed, aiming to increase data availability and improve data flow between institutional, national, regional and international databases. This ongoing work reflects the primary aims and activities of the ERFP Working Group (WG) on Documentation and Information and the European Federation for Animal Science (EAAP) Mediterranean WG.

Keywords. DAD-IS – Animal Genetic Resources – Documentation – Conservation.

Documenter les ressources zoogénétiques en Méditerranée: interaction et coopération dans la région

Résumé. Cette étude présente l'état de la documentation des ressources zoogénétiques dans la région méditerranéenne au travers d'exemples choisis dans différents pays. Les données de six pays (France, Italie, Grèce, Chypre, Maroc et Tunisie) ont été analysées à partir du système d'information sur la diversité des animaux domestiques (DAD-IS). Les chiffres clés concernent le nombre de races enregistrées, leur statut de risque, les tendances de la population, le degré d'exhaustivité des données, etc. Selon les données analysées, le taux d'exhaustivité des chiffres de population variait entre 20% et 100%. L'indicateur ODD 2.5.2 dans les pays était très diversifié. En outre, des données complémentaires ont été collectées au moyen d'un questionnaire pour comprendre la structure organisationnelle et les politiques pertinentes dans chaque pays. Les travaux antérieurs réalisés dans le cadre du point focal régional européen sur les ressources zoogénétiques (ERFP) ont été étendus aux pays méditerranéens non inclus auparavant dans cette enquête. Les moyens de stimuler l'enregistrement des données et de promouvoir l'utilisation du système DAD-IS, ainsi que d'améliorer la communication et l'interaction sont également examinés. L'objectif étant d'accroître la disponibilité des données et d'améliorer le flux entre les bases de données institutionnelles, nationales, régionales et internationales. Ce travail reflète les principaux objectifs et activités du Groupe de travail Documentation et Information de l'ERFP et du Groupe de Travail Méditerranée de l'EAAP.

Mots-clés. DAD-IS – Ressources Génétiques des Animaux – Documentation – Information.

Options Méditerranéennes, *A, no. 129, 2022 – Addressing the challenges
of agro-pastoral farming systems to strengthen their resilience*

49

I – Introduction

The Mediterranean region is one of the world's richest in terms of livestock breed diversity, profiting from its proximity to the Middle East, the site of their original domestication. The region is characterized by mountain chains and sea straits where diverse breeds linked to the territory are raised in diverse production systems. This mosaic, in conjunction with the various transformation and marketing channels available, leads to a wide variety of products that reflect the natural and typical image of the region. This richness is a natural resource that can be used to ensure the sustainability of the farming systems and livelihoods in the rural areas. This richness can be also used to respond to new challenges mainly due to climate change (Boyazoglu, 2002; Boyazoglu & Morand–Fehr, 2001; Rancourt *et al.*, 2006; Hadjipavlou *et al.*, 2021).

In this context, the efficient management of animal genetic resources (AnGR) remains a challenging task that requires deep knowledge of the populations, as well as sufficient monitoring systems. Efficient management ensures that actions and targeted measures are taken early enough to prevent irreversible losses of genetic variability and enables the development of appropriate strategies for the sustainable use of livestock genetic resources.

Many local breeds that are not currently highly valued in the global commercial livestock production, have characteristics that make them potentially valuable in the growing market of niche products or in the provision of public goods, including ecosystem and cultural services (FAO, 2014a; Ligda and Casabianca, 2014). There is a need to benefit more from the advantageous characteristics of locally adapted breeds, particularly in line with challenges associated with climate change and the ongoing need for livestock that are suitable for use by small-scale producers and in low-input production systems. Characterization is expected to provide information on present and potential uses of livestock genetic resources that can be used to make decisions concerning their conservation and management. However, there are still knowledge gaps on the breed characteristics, underlying the need to improve the characterization of breeds (FAO, 2015; Hoffman, 2010; Tixier-Boichard, 2014).

Conservation actions are set up, based partly on the risk status of a breed, usually assessed by population data (population size and rate of change of population size), while genetic data and demographic parameters (such as level of crossbreeding, geographical concentration) can also be taken into account. Moreover, socio-economic and cultural aspects are also considered as important factors of the sustainability of local breeds (Gandini *et al.*, 2004). Multicriteria approaches have been developed in some European countries that take into account the diverse factors that impact the future of genetic resources (Verrier *et al.*, 2015)

The risk status of farm animal breeds is monitored at country level. Relevant information is gathered through characterization, surveying, and monitoring activities by breeders and other actors. Different information systems exist in the countries including databases of herd books and other specific AnGR-related databases. Data for monitoring the status and trends of AnGR globally are drawn from the Domestic Animal Diversity Information System developed by FAO (DAD-IS; http://www.fao.org/dad-is/en/). DAD-IS is the front-end of a global network of information systems developed and maintained by FAO. This Global Databank enables National Coordinators to enter breed-specific data, required to estimate risk status trends reports. Based on these data and additional information from Country Reports, FAO publishes the State of the World Reports (FAO, 2015). In the European region, the European Farm Animal Biodiversity Information System (EFABIS; http://www.fao.org/dad-is/regional-national-nodes/efabis/en/) operates as the regional node for the exchange of national data on animal genetic resources, provided by the European National Coordinators. Countries have the possibility to set up their own national information systems within EFABIS (national node).

The continuous efforts to update DAD-IS and promote the use of the Information System by FAO and European Regional Focal Point (ERFP), for the European region, have resulted to an increase

of data recorded, however the level of completeness of the system varies across countries (FAO, 2015; FAO, 2018). In general, the fields related with the demographic parameters are the most complete and updated regularly, but there is still room for improvement, while more gaps are observed in the data fields concerning cryo-conservation, and characterization of breeds. The identified gaps, either related with the monitoring of population data, regular recording and flow of data or with the breed characterization and documentation, require the enhanced cooperation between researchers, breeders and public administration.

The importance of livestock breeds diversity in the Mediterranean region and their historical evolution, leads to the need to assess the status and trends of livestock diversity in this geographical area that links two regions (Europe and Africa) as a whole, contributing to the enhanced cooperation in the region. This is a preliminary study that aims to present the status of AnGR documentation in the Mediterranean region, by analysing specific country datasets from DAD-IS and to provide insights to the current picture. The work aims to promote the improvement of DAD-IS data completeness and quality and its use for better monitoring and management of AnGR. The discussion considers also the links between recorded data and the actual situation, the activities carried out and their effect on the status of local farm animal genetic resources. The work was initiated through the activities of the ERFP WG Documentation and Information and the EAAP Mediterranean WG aiming to stimulate interaction and cooperation in the Mediterranean region in aspects related with the documentation of AnGR.

II – Material and methods

For this study, the cases of France, Italy, Greece, Cyprus, Morocco and Tunisia were examined. The work was based on the data recorded in the DAD-IS (http://www.fao.org/dad-is/en), the global Information System of FAO that is used for monitoring the status and trends of AnGR. The data on breed population sizes and conservation programmes are used to monitor Indicators 2.5.1 and 2.5.2 of the Sustainable Development Goals (SDG), according to the following definitions (FAO, 2018).

SDG indicator 2.5.1: Number of plant and animal genetic resources for food and agriculture secured in either medium- or long-term conservation facilities;

SDG indicator 2.5.2: Proportion of local breeds, classified as being at risk, not-at risk or unknown level of risk of extinction.

The following data of the six countries were extracted from DAD-IS on 05.11.2020.

   i) Population data of registered breeds for all the years included in the database. Each year in the database included breed population figures, number of herds, information on Artificial Insemination (AI) use and *in situ* conservation programs, as well as the population trend.

   ii) Data concerning the storage of animal genetic resources secured in conservation facilities (data used for SDG indicator 2.5.1).

IBM SPSS Statistics package version 25 (IBM SPSS, 2017) was used to produce the statistical figures and tables. Microsoft Access version 2019 (MS Access, 2019) was used to produce new tables by merging extracted tables, linking information on risk status and conservation measures.

The analysis provided summary statistics results on the number of breeds registered per species at country level and as a total, the number of updates (per year, species, country), breed distribution per risk status, population trends, degree of data completeness, and *in situ* conservation programs per risk status. Risk status per breed per country for all the years of data in the database was estimated based on the recorded population data.

In addition, complementary data were collected through a questionnaire, developed previously (2016) and sent by ERFP (WG Documentation and Information) to the National Coordinators, with the aim

to understand the organizational structure in each country. The questionnaire inclincludes informa-
tion on the the following: criteria and methodology used to estimate endangerment status, bodies in-
volved in the process (ERFP, 2017). Furthermore, new tools that could be implemented in the sys-
tem providing an overall picture of the socio-economic environment of the breeds are discussed.

III – Results and discussion

The number of breeds registered per species in the six countries reflects the wide diversity of sheep
breeds (175 breeds with population data) in the region, followed by cattle (108 breeds), horses (102
breeds) and goats (75 breeds). The countries have differential contributions to this regional diversity,
as shown in Table 1. The variation is mainly due to the country size and importance of the rele-
vant sectors, but it also gives indications on the historical role of Breed Societies and evolution of
herd books in the countries. It might also reveal some differentiation between countries concern-
ing breed recognition strategies and relevant interest from breeders.

Table 1. Number of breeds with population data in the countries

	Cyprus	France	Greece	Italy	Morocco	Tunisia	Total
Buffalo			1	1			2
Cattle	2	46	11	35	11	3	108
Sheep	6	61	23	71	8	6	175
Goats	5	17	2	45	5	1	75
Horses	2	55	7	30	1	7	102
Ass	1	7		8			16
Pigs		36	1	12			49
Rabbit	1	18		46	1		66
Chicken	2	51		18	1	3	75
Goose		7		2			9
Duck	2	6		2			10
Turkey	1	3		4	1		9

Figure 1 depicts the population data updates per year since 2000, provides a clear picture of the
fluctuation across the years. In general, the number of updates is less than what would be expected
based on the total number of breeds registered. This wide variation indicates the possible links of
the data update frequency with other events (i.e., the process of preparation of the FAO State of
the World Reports, regional Workshops, etc.) that may generate attention on this process tem-
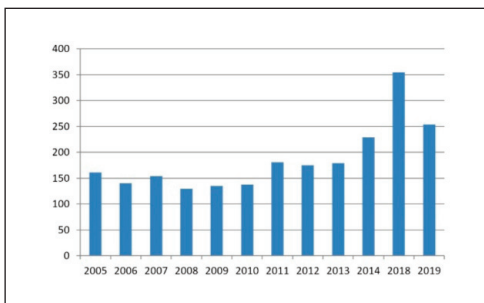porarily, which is not maintained afterwards at a regular basis.

Fig. 1. Number of updates per year in all six countries.

There is variation between the countries, on the percentage of data completeness across breeds that is estimated having as year of reference the year of last update; this ranges from around 20% in Cyprus and Tunisia to 100% in Italy (Figure 2).
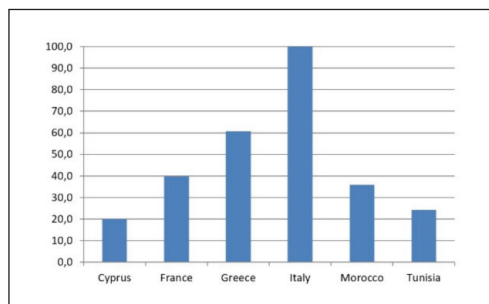

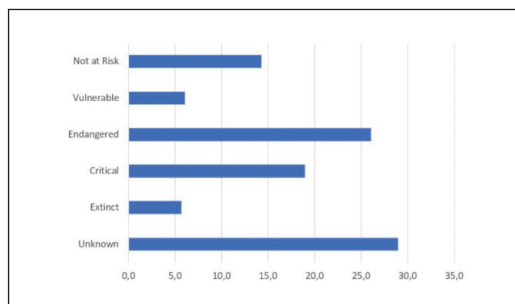Fig. 2. Percentage of data completeness in the six countries.

Fig. 3. Distribution of breeds per risk status category.

Examining the distribution of breeds per risk status category, only 14% are in the non-risk category, while 29% of the recorded breeds are still under unknown status (Figure 3). This underlines the need to continue the efforts to improve reporting on AnGR. However, it is important to note that for the 84% of the breeds under the three risk categories (critical, endangered, and vulnerable), *in situ* conservation actions are implemented (Table 2).

Table 2. Number of breeds under *in situ* conservation measures per risk status category

	No response	No	Yes
Critical	18	2	110
Critical maintained	1		19
Cryo conserved only	1		
Endangered	12	18	136
Vulnerable	3	8	37
Endangered maintained	2	3	35
Not at risk	7	25	81
Unknown	206	16	7

The SDG 2.5.1. indicator provides an overview of the local breeds secured in GeneBanks for long term conservation. From the recorded data on DAD-IS, it is shown that for 62% of the breeds, no information is recorded, while 30% of the breeds has no material stored in a GeneBank (Figure 4). Looking at the information at country level, one can make the hypothesis that this picture may deviate from the actual situation of the *ex situ* conservation activities in the countries, but it may also reflect the reluctance of countries to store such information on DAD-IS. This can be explained by several reasons, such as gaps of cooperation within/between institutes having GeneBank facilities and collections, lack of coordination and still, to some extent, lack of awareness on these indicators.

The SDG 2.5.2. indicator is a complex indicator which is difficult to interpret and utilize when lacking information. Considering that in some countries still a high number of breeds is under unknown status, which has a direct impact on the estimation of the SDG 2.5.2 indicator, we do not include these breeds within the estimated figure. The percentage of local breeds at risk within local breeds with known breed status, ranges from 10% to 90%, however this should not be examined as a static
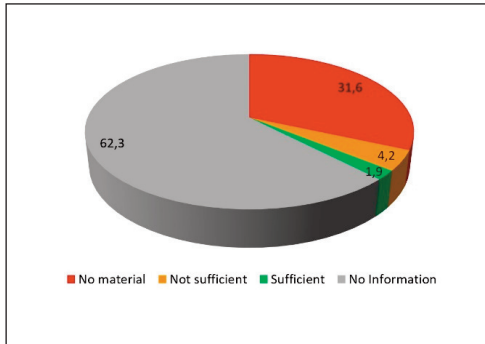
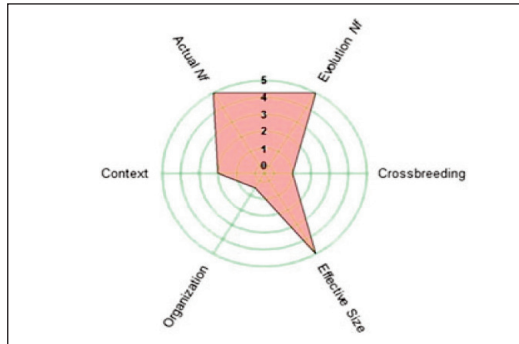Fig. 4. **SDG 2.5.1 indicator in the six countries of the Mediterranean region.**

Fig. 5. **Example of the multicriteria approach: Radar chart for Boulonnais horse breed (France), from Verrier *et al*. (2015).**

number, but through its evolution in time. For this purpose, reliable data and frequent updates are necessary. The SDG 2.5.2 indicator in the countries examined is widely diverse, potentially indicating the extent to which DAD-IS was used for breed population data monitoring in each country.

From the information collected through the ERFP WG questionnaire, the Ministries of Agriculture (Rural Development and /or Environment, according to the country) have the coordination of the monitoring and documentation in all countries. Different roles and responsibilities are given to the regional departments according to the country's administrative organization. The policies and measures in the European countries of the Mediterranean region follow the relevant EU regulations, and specific measures are implemented through the Rural Development Plans (Ligda and Zjalic, 2011; FAO, 2015). Risk status is estimated by demographic criteria, while additional criteria following multicriteria approaches, are taken into account in some countries (ERFP, 2017); an example of the multicriteria approach is presented in Figure 5, from Verrier *et al*. (2015).

Relevant policies in Tunisia and Morocco, are under the responsibility of the Ministry of Agriculture and follow the FAO Global Strategy. National Focal Points (NFPs) are established in all countries. The FAO Sub-Regional Office for North Africa established in 1996 provides support to the five Maghreb countries: Algeria, Libya, Morocco, Mauritania and Tunisia, in particular through the provision of advice on general policies and the strengthening of institutional capacities and human resources. The need to develop joint projects, organize training workshops for farmers; improving collaboration in ex situ conservation by capitalizing on work already done; strengthening labelling measures; improve monitoring of AnGR; and creating a regional GeneBank were underlined by the participants of the Regional FAO Workshop in Rabat (FAO, 2014b).

Breeder associations participate in the management of AnGR, while Research and Technical Institutes are involved at a different level. The impact and role of the various stakeholders depends on the set structure in each country (e.g. Existence of National Committee for the management of AnGR). Several studies have emphasized the role of diverse stakeholder participation, including livestock keepers and breeders, in the management of AnGR (Lauvie *et al*., 2011; Leroy *et al*, 2017). Stakeholder participation refers to taking part in policy- level activities, but also in specific animal-level activities. One of the main findings of the study of Leroy *et al*. (2017) on the role of stakeholders in the management of AnGR was that the involvement of a particular stakeholder group was highly depended on the historical background and ideas behind the development policies and donor involvement.

In respect to the discussion on the improvement of DAD-IS utilisation, the outcomes of ERFP WG Documentation & Information on the approach aiming to elucidate the additional factors that shape the general environment (physical and socio-economic environment) might be of interest for the

whole region. Such information could be specifically of interest for breeds that are just above the demographic thresholds and could prove very informative to National Coordinators, policy makers, and regional administration, as it can provide straightforward overview visualization of a breed's status at different dimensions (socio-economic and cultural aspects). Other stakeholders as Breeder Associations or scientists can be also interested in this kind of information. The descriptors proposed refer to breed viability (market recognition, breed profitability, continuity of activity, subsidies dependency), existence of breeder organization and assessment of breeding / conservation program, Genebank status, Cooperation level, and Cultural value (ERFP, 2017).

IV – Conclusions

In general, this first analysis shows the richness of information provided by DAD-IS, which could be utilized by various users according to their specific interests and needs. Furthermore, a wide variation in updating DAD-IS is observed, between the years as well as between countries, but also within species and breeds within a country. The variation within a country reflects the changes in policies and priorities in the country, and the differences in the level of organization in each sector (e.g., the development level of Breeders' Societies etc.). The wide variation between countries corresponds to the differences in the policies, priorities and capacities between countries. The comparison between countries is only meaningful for identifying the organizational and other relevant structures that provide a positive environment for the efficient management of AnGR and data documentation, taking into consideration the specific situation in each country or region.

The presented figures show that there are still gaps in AnGR documentation. The first category of gaps relates to the lack of sufficient structure(s) for population monitoring and data flow organization, and the second one with knowledge gaps on the breed characterization. The two types of gaps require different approaches. All cases have a common need to raise awareness on the importance of updating the relevant fields and to establish links within the country (breeder associations, Institutes, etc.) that will ensure that all possible information is included. Lack of data or inaccurate data lead to imprecise interpretations of the global (and national) reports and indicators and therefore these cannot be used for developing relevant recommendations or action plans, or when these are used, this should be done with caution. Effective management of AnGR requires efficient monitoring that will lead to implementing the objectives of sustainable breeding programs and will ensure the conservation of AnGR for a viable future.

Having this in mind, means to stimulate data recording that will permit the efficient use of the DAD-IS system are discussed, such as developing specific tools to analyze groups of breeds of specific interest for certain areas. These analysis tools will potentially improve data collection strengthening of local capacities. Enhancing the communication and interaction between various stakeholders working in the field will increase data availability and improve data flow from institutional to national, to regional and international databases. In this context, the work developed by the ERFP WG Documentation and Information and the current activities aiming to enhance the exchange with National Coordinators from the countries of North Africa, will contribute to defining the existing drawbacks especially on aspects related with the necessary organizational structures to facilitate the involvement of livestock keepers and breeders. By identifying the weak points at country level and establishing a network, adapted to each country needs, an efficient data flow process will be facilitated that will improve the quality, accuracy and thus the use of the Information System. The gaps on breed characterization can be overcome through better and coordinated communication between researchers, public authorities, and breeder associations.

Would the establishment of a sub-regional focal point for the Maghreb countries help in this direction? The positive experience from the European Regional Focal point indicates that this could be a potential route to follow. The experience cannot be copied, but it would need to be designed

and adapted to the political, social and economic environment of the countries. Above all, networking and building stronger links across the two sides of the Mediterranean region is crucial. Joint regional activities would also be very efficient tools in this effort, not limited to but also including improved research cooperation and exchange programs that would capitalize on the positive experience and results of the ARIMNET and ARIMNET2 ERANET projects and the relevant current and future PRIMA Calls.

References

Boyazoglu, J. and Morand-Fehr, P., 2001. Mediterranean Dairy Sheep and Goat Products and their Quality: A Critical Review. In: *Small Ruminant Research*, 40(1), p. 1-11.

Boyazoglu, J. and Hatziminaoglou Y., 2002. Livestock genetic resources and production systems: A Mediterranean overview. A Mediterranean overview. In: *Arch. Latinoam. Prod. Anim.,* 2002. 10(1). p. 62-67.

ERFP, 2017. Socio economic and environmental parameters and their applicability into a tool to evaluate risks and trends. Project report (edited C. Ligda and E. Sturaro).

FAO, 2014a. Characterization and value addition to local breeds and their products in the Near East and North Africa – Regional Workshop, Rabat, Morocco, 19-21 November 2012. Animal Production and Health Report No. 3. Rome.

FAO, 2014b. Ecosystem services provided by livestock species and breeds, with special consideration to the contributions of small-scale livestock keepers and pastoralist. Background Study Paper 66. FAO Commission on Genetic Resources for Food and Agriculture Assessments, Rome, Italy.

FAO, 2015. *The second report on the state of the world's animal genetic resources for food and agriculture.* In FAO Commission on Genetic Resources for Food and Agriculture Assessments (ed. BD Scherf and D Pilling), 562 p. FAO, Rome, Italy.

FAO, 2018. *Status and Trends of Animal Genetic Resources*. CGRFA/WG-AnGR-10/18/Inf.3. FAO, Rome, Italy.

Gandini, G.C., Ollivier, L., Danell, B., Distl, O., Georgoudis, A., Groeneveld, E., Martyniuk, E., van Arendonk, J.A.M. and Woolliams, J.A., 2004. Criteria to assess the degree of endangerment of livestock breeds in Europe. In: *Livestock Prod. Sci.*, 91(1-2), p 173-182.

Hoffman, I., 2010. Climate change and the characterization, breeding and conservation of animal genetic resources. In: *Animal Genetics,* 41: s1, p. 32-46.

Hadjipavlou, G., Tzouramani, I. and Ligda, C., 2021. Impact of Diverse Technical and Economic Factors on Sustainable Farmer Market Choices: The Case of Cyprus Sheep and Goat Milk Channel Choice. In: *Journal of Innovation Economics & Management*, 1(1), p. 57-78.

Leroy, G., Baumung R., Notter D., Verrier E., Wurzinger M. and Scherf B., 2017. Stakeholders and the management of animal genetic resources across the world. In: *Livestock Science*, 198, p. 120-128.

Lauvie, A., Audiot, A., Couix, N.F., Casabianca, H., Brives., E. and Verrier, E., 2011. Diversity of rare breed management programs: Between conservation and development. In: *Livest. Sci.,* 140 (1-3), p. 161-170.

Ligda, C. and Zjalic, M., 2011. Conservation of animal genetic resources in Europe: overview of the policies, activities, funding and expected benefits of conservation activities. In: *Anim. Genet. Res.*, 49, p. 75-86.

Ligda, C. and F. Casabianca, 2014. Adding value to local breeds: challenges, strategies and key factors. In: *Animal Genetic Resources Information*, 53, p. 107-116.

MS Access, 2019. Available at: https://office.microsoft.com/access.

Rancourt, D.M., Fois, N., Lavin, M.P., Tchakerian, E. and Vallerand, F., 2006. Mediterranean Sheep and Goats Production: An Uncertain Future. In: *Small Ruminant Research*, 62, p. 167-179.

SPPS, 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Tixier-Boichard, 2014. Status and Gaps in characterization of Animal Genetic Resources. 10th WGGALP, Vancouver, Canada.

Verrier, E., Audiot, A., Bertrand, C., Chapuis, H., Charvolin, E., Danchin-Burge, C. and Sabbagh, M., 2015. Assessing the risk status of livestock breeds: a multi0indicator method applied to 178 French local breeds belonging to ten species. In: *Animal Genetic Resources Information,* 57, p. 105-118.