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STUDY ON THE EVOLUTION OF GENETIC RESOURCES OF DOMESTIC ANIMALS IN ROMANIA

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Abstract

The paper proposes the identification of animal breeds at risk of abandonment and the analysis of animal genetic resources from the perspective of the evolution of total herds and genetic quality determination programs.
Data from the National Institute of Statistics show that in the period 2015-2022, Romania recorded a decline in the total livestock of cattle (-12.34%) and pigs (-32.44%) and slight increases in the total sheep and goats. On the other hand, the National Agency for Animal Husbandry indicates significant decreases in the number of breeding females, both in cattle (-14.7%) and pigs (-32.5%). Within the 4 species of animals analysed (cattle, sheep, goats and pigs), 14 breeds in danger of abandonment were identified, generally native breeds with lower production potential than that of improved breeds. For the identified animal breeds, genetic quality determination programs have been approved, which are implemented by animal breeders' associations accredited for the establishment and management of Genealogical Registries.
Maintaining the genetic diversity of local breeds in danger of abandonment can contribute to the diversification of existing populations, to restoring the vitality of selected lines, to increasing the productivity and disease resistance of animals.

Keywords: genetic resources, animal breeds, livestock, genetic quality

1. INTRODUCTION

Humanity benefits in a multitude of ways from the biodiversity in the surrounding environment. Although its value is difficult to quantify in monetary terms, biodiversity has a positive impact on the quality of life physically or as a source of education and inspiration [7].
Despite the recognition of the crucial role of biodiversity in maintaining human and planetary health, biodiversity is declining faster than at any time in human history [1].
In the last 50 years, globally, biodiversity has been severely compromised and altered, the global rate of species extinction is hundreds of times higher than the average rate of the last 10 million years. About a quarter of species in most groups of plants and animals are already threatened with extinction and about 1 million species are at risk of extinction in the coming decades [8,9].
Between 1970 and 2018, the estimated population size of mammals, birds, fish, amphibians and reptiles declined by an average of about 68% [5]. Biodiversity loss is seen in both agriculture and wildlife; many of the domesticated plant and animal species that were important food sources disappeared. Biodiversity is constantly being degraded, due to the way natural resources are exploited to support the production, consumption and trade of a globalized economy.
The human impact on animal biodiversity, leading to the extinction of some species or a decrease in the abundance of local species, is a less recognized form of global environmental change.
In a study on anthropogenic biodiversity loss, Dirzo R. et al., (2014 [2]) shows that out of 1500 species of terrestrial vertebrates studied, 322 species disappeared and the abundance of the populations of the remaining species decreased by 25%. For the invertebrate species studied, the results show that 67% of the monitored populations showed an average decrease in abundance of 45%.
Globally, the livestock sector occupies approximately 78% of agricultural land. The conversion of land for agriculture results in habitat destruction and loss of biodiversity because deforestation of natural ecosystems (such as forests) removes sources of shelter and food on which the survival of wild species depends [3]. In the "Red List" drawn up by the International Union for Conservation of Nature (IUCN), agriculture is identified as the main threat to 24,000 of the 28,000 species documented by the IUCN as being at risk of extinction. [6].
In all livestock systems, farm animal species play an essential role in maintaining food security and meeting the socio-economic needs of a significant part of the world's population.
Worldwide, about 40 species of animals have been domesticated for use in agriculture, food production. Five of these species (cattle, sheep, pigs, goats and chickens) are dominant both in terms of herd size and their geographical distribution. According to FAO data [4], cattle, sheep and chickens are widely found in all regions of the world while goats and pigs are less evenly distributed regionally. On the other hand, FAO data on the proportion of domesticated and farmed animal breeds at risk of extinction show that for 62% of local breeds the risk status remains unknown while 70% of local breeds with a known status are in danger of extinction (Figure no. 1).
Regionally, in 2023, the proportion of endangered local breeds was up to 82% in North America and Europe (FAO, 2023 [10]).

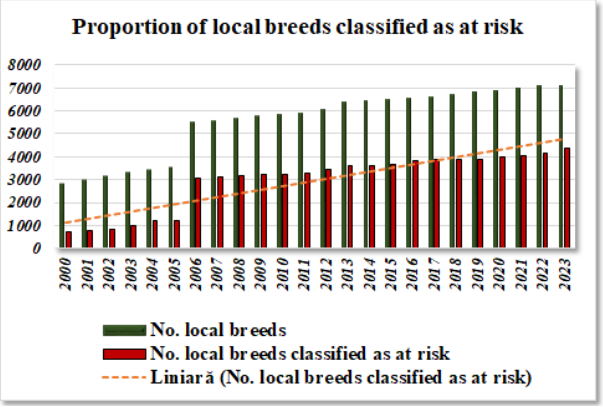


Figure no. 1: Status of local breeds globally, in the period 2000-2023
***Source*: FAO, [10]**

In the medium and long term, maintaining the biodiversity of farm animals is achieved by two methods: *in situ* conservation (live animals are maintained and used in the livestock production system) and *ex situ* conservation (storage of cryopreserved genetic material in gene banks). Regarding *ex situ* conservation, FAO data indicate a very small number of local breeds (287 out of 7,688 local breeds) and transboundary breeds (175 out of 1,115 transboundary breeds) for which there is sufficient conserved genetic material (FAO, 2023 [10]).

2. MATERIALS AND METHODS

The article proposes an analysis of the evolution of genetic resources in the animal breeding sector. The analysis is oriented towards the identification of animal breeds at risk of abandonment and the analysis of animal genetic resources from the perspective of the evolution of total herds under production control and genetic quality determination programs
For the documentation part, a series of scientific papers with relevant results in the field of biodiversity and special reports on the conservation of genetic resources were studied.
Data from the National Institute of Statistics (NIS), the National Agency for Animal Husbandry (NAAH), the Food and Agriculture Organization of the United Nations (FAO) and the European Environment Agency (EEA) were used for the analysis of genetic resources. The data on the evolution of the studied indicators (animal numbers, animal breeds, genetic quality determination programs) were systematized, processed, presented synthetically in tables and extensively interpreted in the paper.

3. RESULTS AND DISCUSSIONS

In Romania, the phenomenon of urban expansion, manifested after 1990, greatly expanded the built-up land, which led to the fragmentation of natural and semi-natural habitats and the reduction of biodiversity. According to NIS data, only in the period 2000-2014 the area occupied by constructions increased by 19.8%, the growth trend also manifesting itself in the following years and affecting agriculture as a whole.
Within agriculture, the livestock sector is one of the most difficult problems of today's agriculture, registering a decline in herds of the main animal species, both in the public and private sectors. If we analyse the NIS data, regarding the evolution of animal herds by species (table no. 1), we notice that, in the period 2015-2022, Romania recorded significant decreases in the total herds of cattle species (-12.34%) and pigs (- 32.44%), respectively slight increases in total flocks of sheep (+4.45%) and goats (+2.98%).

Table no. 1: The evolution of total livestock numbers in Romania, in the period 2015-2022

Effective (thousand head)	**2015**	**2020**	**2021**	**2022**	**Variation 2022/2015 (±%)**
Cattle Total of which:	2092	1875	1827	1834	**-12.34%**
Cows, buffaloes and heifers	1311	1231	1193	1194	**-8.93%**
Swine	4927	3785	3620	3329	**-32.44%**
Breeding sows	375	316	299	285	**-24.0%**
Sheep	9810	10282	10087	10247	**+4.45%**
Breeding shep	8330	8812	8765	8879	**+6.59%**
Goats	1440	1612	1493	1483	**+2.98%**
Breeding goats	1133	1291	1218	1215	**+7.23%**

***Source:* Author's calculations based on data from the National Institute of Statistics**

The decrease in the total herds of bovine and porcine species is also visible with regard to the mother herds. Thus, during the analysed period, the female herd of cattle (milk cows, breeding buffaloes and breeding heifers) decreased by 8.93%, while the female herd of pigs (sows) decreased by 24, 0% This affected the breeding sector in both species by decreasing the number of replacement heifers and sows.
On the other hand, if we analyse the data of the National Agency for Animal Husbandry (ANZ), the unit that coordinates the improvement, reproduction and conservation of animal genetic resources, we notice that in the bovine species the female herd suitable for reproduction decreased by 12.5%, in the period 2019-2023, against the background of the 14.7% decrease in the total breeding female population and the 13.5% decrease in the female population registered in production control (table no. 2).
In the *taurine species*, the decrease in total herds has affected the breeding sector. Thus, in the period 2019-2023, the total number of females under production control decreased by approximately 14%, the number of breeding females decreased by 15%, and the number of breeding female bulls by 12.4% (table no. 2).

Table no. 2: Evolution of the female herd registered in production control for the bovine species, in the period 2019-2023

Females (thousand head)	**2019**	**2020**	**2021**	**2022**	**2023**	**2023/2019 (±%)**
CATTLE						
Registered females	1451.9	1356.6	1355.0	1321.3	1255.8	**-13.5%**
Reproductive females	903.6	846.2	846.5	826.3	770.8	**-14.7%**
Females fit for reproduction	1057.1	991.6	1.004.2	984.6	926.0	**-12.4%**
COWS						
Registered females	1435.1	1339.4	1337.2	1302.6	1235.7	**-13.9%**
Reproductive females	893.0	835.5	835.3	815.1	759.0	**-15.0%**
Females fit for reproduction	1044.4	978.6	990.6	970.7	911.0	**-12.7%**
BUFFALO						
Registered females	16.8	16.3	16.7	17.8	18.7	**+11.0%**
Reproductive females	10.6	10.3	10.6	10.7	11.3	**+6.8%**
Females fit for reproduction	12.7	12.3	12.7	13.3	13.9	**+9.2%**

***Source*: Author's calculations based on data from the National Agency for Animal Husbandry**

In the *buffalo species*, since 2015, due to the increase in consumer demand for milk and buffalo milk products (especially in Transylvania), the total number of buffaloes has increased. In the period 2015-2022, the evolution of the total buffalo herds was a fluctuating one, being also influenced by the state subsidy for animals registered at Payments and Intervention Agency for Agriculture (164 euros/year/head of buffalo) and the subsidy for breeds in danger of abandonment (200 euros/ year/buffalo head).

According to NAAH data (table no. 2), in the period 2019-2023, in the buffalo species there were increases of 6.8% in the herd of females for reproduction, of 11% of the herd of females registered in production control and of 9, 2% of the breeding female population.

In Romania, the genetic improvement, conservation and reconstitution programs of some breeds are run by accredited/authorized associations, to which animal breeders have joined, under the coordination, control and verification of the National Agency for Animal Husbandry. NAAH is the approving authority for endangered species conservation programs and authorizes/accredits animal associations that establish and maintain farm animal herd registries for endangered local breeds.

Maintaining the genetic quality of livestock is based on genetic improvement and progeny testing of livestock. To this end, a number of programs are carried out under the authority of NAAH to determine the genetic quality of livestock and to establish and maintain herd registers.

According to NAAH data for the year 2023, in the taurine species, a number of 36 associations authorized to determine the genetic quality have run 19 genetic improvement programs for the Baltata with Black Romanian type Holstein Frize, Baltata Romanian Simmental type, Montbéliard, Brown, Aberdeen Angus, Charolais, Limousine, Aubrac, Galloway, Highland, Sura de Stepa – Hungarian Gray, Sellers and Jersey.

If we analyse the NAAH data on the evolution of bull breeding programs (table no. 3), in the period 2019-2023, we notice that starting from 2021, two new genetic breeding programs for the Salers and Jersey bull breeds have started. On the other hand, we observe a 59.6% increase in the number of bull breeders involved in genetic improvement programs (26,557 breeders in 2023 compared to 16,635 breeders in 2019) and a 22.3% increase in the number of tested animals (461,308 head in 2023 compared to 377,165 head in 2021).

Table no. 3: *The evolution of genetic quality determination programs in the taurine species in the period 2019-2023*

Specification	**2019**	**2020**	**2021**	**2022**	**2023**
IMPROVEMENT PROGRAMS					
Accredited societies for the determination of genetic quality	**37**	**40**	**37**	**37**	**36**
Total breeders participating in the running of the programs	**16,635**	**26,249**	**17,016**	**15,142**	**26,557**
Total improvement programs of which for breeds:	**13**	**13**	**17**	**19**	**19**
Baltata with Black Romanian type Holstein Frize	**2**	**2**	**2**	**2**	**2**
Baltata Romanian Simmental type	**2**	**2**	**3**	**5**	**5**
Montbéliard	**1**	**1**	**2**	**2**	**2**
Brown	**1**	**1**	**1**	**1**	**1**
Aberdeen Angus	**1**	**1**	**1**	**1**	**1**
Charolais	**1**	**1**	**1**	**1**	**1**
Limousine	**1**	**1**	**1**	**1**	**1**
Aubrac	**1**	**1**	**1**	**1**	**1**
Galloway	**1**	**1**	**1**	**1**	**1**
Highland	**1**	**1**	**1**	**1**	**1**
Sura de Stepa – Hungarian Gray	**1**	**1**	**1**	**1**	**1**
Sellers	-	-	**1**	**1**	**1**
Jersey	-	-	**1**	**1**	**1**
BREED CONSERVATION AND RECONSTITUTION PROGRAMS					
Societies accredited for the preparation and maintenance of the genealogical register	**9**	**9**	**10**	**10**	**10**
Sura de Stepa breed conservation program	**1**	**1**	**1**	**1**	**1**
Reconstitution program of the Pinzgau de Transilvania breed	**1**	**1**	**1**	**1**	**1**
Animals tested (heads)	**377,165**	**372,833**	**416,765**	**360,045**	**461,308**

***Source*: National Agency for Animal Husbandry**

For the *buffalo species*, NAAH approved a genetic improvement program for the Romanian Buffalo breed, a program implemented by the Association of Transylvanian Buffalo Breeders. NAAH data indicates for the year 2021, a herd of 5,968 tested animals and a number of 1,683 breeders participating in the program. The year 2022 saw an 82.9% increase in the herd of tested animals (10,917 heads in 2022 compared to 5,968 in 2021) and a 33.7% increase in the number of breeders

enrolled in the program (2,250 in 2022 compared to 1,683 in 2021).

In *sheep*, over the period 2019-2022, NAAH data shows an 8.7% decrease in the ewes registered in production control and a 9.5% decrease in the total ewes for breeding. In the case of *goats*, NAAH data, regarding the evolution of the total herd of goats under production control, show that while the total female herd registered in production control decreased by 24%, there was a 23.6% decrease in the female herd for reproduction and a 37.7% reduction in the breeding female population (table no. 4).

Table no. 4: The evolution of the female herd registered in the production control for sheep and goat species, in the period 2019-2023

Females (thousand head)	**2019**	**2020**	**2021**	**2022**	**2023**	**2023/2019 (±%)**
SHEEP						
Registered females	10080.0	9818.0	9584.5	9371.8	9200.3	**-8.7%**
Reproductive females	7492.4	7366.0	7228.4	6991.9	6784.0	**-9.5%**
Females fit for reproduction	8008.9	7816.7	7635.3	7384.7	7221.2	**-9.8%**
GOATS						
Registered females	1628.0	1544.6	1392.2	1339.2	1237.3	**-24.0%**
Reproductive females	1166.9	1105.8	1000.2	977.0	891.2	**-23.6%**
Females fit for reproduction	1269.3	1207.7	1088.6	1051.7	970.8	**-37.7%**

Source: **National Agency for Animal Husbandry**

In sheep, NAAH data shows an increase in the number of accredited associations for the preparation and maintenance of pedigree registers by breed, from 56 accredited associations (with 6,416 breeders) in 2019 to 62 accredited associations (with 10,077 breeders) in 2022. The 62 associations, authorized by NAAH to determine the genetic quality of the sheep stock, have run 20 breeding/conservation programs on a total stock of 2,977,189 sheep.

In the goat species, in 2022, 11 breeders' associations accredited to determine the genetic quality ran 6 improvement/conservation programs for a herd of 230,595 goats.

In the *pig species*, African swine fever has decimated pig herds and reduced the number of breeders. If we analyse the NAAH data, regarding the evolution of the herd of females for reproduction in the pig species, in the period 2019-2023, we observe a decrease in the female herd registered in production control by 37.6% (- 96,081 heads in the analysed period) and the total herd of females for reproduction by 35.2% (table no. 5).

NAAH data shows that, in 2022, genetic improvement programs in the pig species were carried out by 4 associations accredited for the preparation and maintenance of the genealogical register (in which 24 breeders participated) on a herd of 14,842 purebred pigs. Another 8 holdings carried out breeding programs with hybrid breeding pigs on a herd of 22,019 heads and one association carried out two conservation programs for native breeds, on a herd of 1,853 heads (21.35% lower than the one in 2021).

Table no. 5: The evolution of the female herd registered in the production control for the swine species, in the period 2019-2023

Females (thousand head)	**2019**	**2020**	**2021**	**2022**	**2023**	**2023/2019 (%)**
SWINE						
Registered females	255.3	234.1	219.4	168.7	159.2	**-37.6**
Reproductive females	178.8	181.5	163.8	126.0	115.9	**-35.2**
Females fit for reproduction	217.1	207.8	191.6	147.4	137.5	**36.6**

Source: **National Agency for Animal Husbandry**

With regard to native breeds of animals, 21 breeds of animals have been identified at the national level in different degrees of risk, namely: taurine species - Sura de Stepa; la bubaline – Romanian buffalo; sheep - Ratca, Merinos de Palas, Merinos de Cluj, Merinos de Transilvania, Merinos de Suseni, Oaia cap negru de Teleorman, Karakul de Botoșani, Țigaie Ruginie; for goats: Alba de Banat and Carpatina; for pigs: Bazna and Mangalița; for horses: Furioso North Star, Hutul, Gidran, Lipitan and Shagya Araba.

For some of these breeds, conservation programs are underway that aim to save the breeds, maintain a valuable genetic background and continuously increase the herd of purebred animals in order to avoid the danger of inbreeding.

In 2022, nationally, there were 11 associations accredited by NAAH to maintain genealogical registers for 16 animal breeds of bulls, buffaloes, sheep, goats and pigs. In the equine species, the genealogical registers for the 5 breeds identified as being at risk of abandonment are maintained by NAAH.

In 2019, NAAH approved the conservation program for the local Sura de Stepa bull breed, a breed at critical risk of extinction. The Sura de Stepa breed has played a particularly important biological role in the creation of improved taurine breeds in our country and constitutes a valuable biological material due to its adaptability, resistance and combinative capacity in crossing with other breeds. At the date of approval of the conservation program, the total herd of cows of known origin was 30 heads at the Cattle Breeding Research and Development Station - Dancu Iasi.

For the sheep species, conservation programs are ongoing for sheep breeds that are in danger of being abandoned, respectively: Ratca, Merinos de Palas, Merinos de Cluj, Merinos de Transilvania, Merinos de Suseni, Oaia Cap Negru de Teleorman, Karakul de Botosani and Tigaie Ruginie.

Regarding the conservation programs of the local breeds on the way to abandonment, the Alba de Banat and

Carpatina breeds were identified whose conservation programs are run by the National Association of Goat Breeders from Romania "Caprirom", an association authorized by NAAH for the establishment and keeping genealogical records for this species.

The emergence of support programs for pig breeders from the Bazna and Mangalita breeds has recently led to an increase in the total number of pigs from the two breeds, an estimate of the total livestock for the year 2021, being approximately 20,000 Mangalita pigs and 600 heads of Bazna pigs, mostly animals of no known ancestry. These livestock are arranged in 250-280 holdings with a number of 50-400 heads/farm. In the year 2022, the total herd of pigs from the Mangalita and Bazna Breeds was 1,853 pig heads in the conservation programs carried out by the Mangalita and Bazna Domestic Pig Breeders Association.

4. CONCLUSIONS

Local breeds of animals have a low production potential, which causes breeders' interest in a particular breed to decrease to the point of reducing the herd or even its disappearance.

In Romania, the decisions taken at the level of agriculture correlated with the economic pressure, led to the continuous reduction of the number of animal breeds used for production. This has had a negative influence on genetic diversity, the possibility of improving existing traits within breeds and developing new characteristics in response to consumer needs.

The decline of local breeds began in the 1970s, when many of the local breeds were no longer used in intensive breeding due to low yields. Thus, the import of animals from breeds with higher production performance than the existing ones was encouraged, a fact that led to the disappearance of some local breeds. Most of the time, the effects of policies and legislation governing the livestock sector are not favorable to the use of local breeds of animals.

The productivity, adaptability and resilience of agricultural ecosystems depend, among other things, on the availability of a rich genetic heritage of animal breeds.

Maintaining the genetic diversity of local breeds at risk of abandonment can contribute to diversifying existing populations, restoring the vitality of selected lines, increasing productivity and disease resistance of animals.

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