

Livestock genetic resources and production systems: A Mediterranean overview

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ABSTRACT: The Mediterranean Region is one of the oldest and historically one of the most prosperous cradles of agriculture. Throughout the centuries, cycles of prosperity and rural decline have been linked to the economic situation of society. From an agricultural point of view, the eco-environmental concept is flanked to that of the single geopolitical one, which includes major social economic factors; on this basis it would be possible to define the zone around the Mediterranean Sea as a *relatively homogenous*. This zone corresponds to a rich and complex historic and cultural system in which agriculture has always been carried out in difficult natural conditions: irregular seasons and rainfall, soil erosion, and pronounced reliefs, as an association of certain traditional dryland plants like the olive tree, the vine and the palm with cereals and dry pulses. The cow and sow have always been the main animal resources of Central and Northern Europe, as the ewe and goat have been of the Mediterranean, traditionally raised for the production of milk which was then transformed into typical local products. Even today, in this zone, products from small ruminants are more appreciated than the derivatives of obtained cow's milk. In particular, products from multiple purpose breeds of the small ruminant species present, are largely characteristic of the animal types that have accompanied man during the last 100 centuries. These breeds supplied food (milk and meat), clothes (wool and leather) and fertilizer from dung. The existence of sheep and goats in ancient European and civilizations of the Near East, was already evident in the third millennium BC when animal images began to appear in paintings, incisions, scriptures and artistic representations. Improvement of agricultural and livestock production methods can best be obtained through the balanced utilization of traditional systems and more advanced technologies, without underestimating the possible damage and immediate impact which application of the very modern plant and animal techniques could rapidly have on the quality of the environment. The evolution of traditional extensive systems towards more intensive ones, should not be introduced by force nor by too much planning; in many cases this violates the principle and role of the traditional raising of livestock which has survived for centuries with satisfactory results.

Key words: Animal genetic resources, local cheese, Mediterranean livestock, small ruminants

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Recursos genéticos ganaderos y sistemas de producción: Una visión mediterránea

RESUMEN: La región mediterránea es una de las más antiguas e históricamente una de las cunas más prósperas en agricultura. A través de los siglos, el declive rural y de prosperidad se ha debido principalmente a la situación económica de la sociedad. Desde el punto de vista de la agricultura, el concepto de ecología ambiental viene asociado al de geopolítica, que incluye los principales factores socio-económicos. Partiendo de esta base se podría definir la región que rodea el Mar Mediterráneo como una zona relativamente homogénea. Esta zona corresponde a un sistema histórico y cultural a la vez complejo y rico en el que la agricultura se ha realizado desde siempre en condiciones naturales difíciles: estaciones y lluvias irregulares, erosión de los suelos, relieves pronunciados, y una asociación entre ciertos cultivos tradicionales de secano como el olivo, la vid y la palma con cereales y leguminosas. La vaca y el cerdo han sido desde siempre el recurso animal más importante para el centro y norte de Europa, mientras que la oveja y la cabra lo han sido para el Mediterráneo, tradicionalmente criadas por su producción de leche que luego se transformaba en productos típicos locales. Incluso hoy en día en esta zona los productos provenientes de estos pequeños rumiantes se aprecian mucho más que aquellos derivados de la leche de vaca. En par-

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ticular, los productos derivados de razas a doble propósito que pertenecen a estas especies actuales de pequeños rumiantes, son ampliamente característicos del tipo de animales que han acompañado al hombre en los últimos 100 siglos. Estas razas han proporcionado al hombre alimento, leche y carne, vestidos, lana y cuero, así como fertilizantes y abono para la tierra. La existencia de ovejas y cabras en las civilizaciones medievales Europeas y del Próximo Oriente era evidente ya en el tercer milenio AC., cuando las imágenes de animales empezaron a aparecer en las pinturas, incisiones, escritos y representaciones artísticas. La mejora en la agricultura y en los métodos de producción animal han sido posibles sólo a través de una utilización combinada de sistemas tradicionales y tecnología de vanguardia, sin desestimar los daños posibles y el impacto inmediato que la aplicación de técnicas ultra modernas pueden tener a breve distancia sobre la calidad del ambiente. La evolución de los sistemas tradicionales extensivos hacia sistemas intensivos no puede ser introducida ni a la fuerza ni con demasiada planificación; en muchos casos se llega a violar el principio y el papel alcanzados por la agricultura tradicional, que ha sobrevivido a través de los siglos dando resultados satisfactorios.

Palabras clave: Recursos genéticos animales, sistemas de producción, ambiente mediterráneo, ganadería mediterránea, quesos locales

Introduction

Viewed on the world globe, the Mediterranean appears like a small cut on the earth's surface, from the Straights of Gibraltar to the Arabic peninsula. The geological breaks and the earth's movements have created, over thousands of centuries, a series of chains of mountains and autonomous marine basins, a multitude of islands and a vast number of peninsulas. The result is a sort of "Mediterranean entity", constituted by a mosaic of human and ecological populations and strata both in the maritime and mountainous zones; these directly influence agriculture and livestock husbandry (Boyazoglu and Flamant, 1991). At the natural crossroad of three continents, the Mediterranean has played a permanent role in the development of florid civilizations, in the expansion of maritime empires and in the diffusion of three of the major religions of the world. In the Mediterranean basin, the environment is not exactly advantageous for the development of modern practical agriculture, in fact, irregularity of annual precipitations is a large factor against high productivity. The coastal zone principally offers poor grazing, rocky ground and climatic situations that are too dry, too hot or too cold. Arable land is scarce and often in the internal plains, the ground is too subtle, in many cases, the plough can only scratch the surface. Many of the zones of the interior are characterized by vast continental altiplains with an altitude of approximately 1 000 m which have two dry seasons, one in winter and one in summer and evolve towards desert conditions in the Near East and North Africa (Boyazoglu and Flamant, 1990). The arid and semi-arid conditions which characterize the southern part of the Mediterranean basin have created extremely difficult conditions inland in spite of which human and animal populations have succeeded and flourished. Therefore, the constitution of genetic types of animals with special anatomic and physiological properties, has allowed the optimum adaptation to the eco-systems and the development of special husbandry systems based on nomadic and migratory pastoralism, in an effort to cover the animals' nutritional needs (Morand-Fehr and Boyazoglu, 1999). Throughout the cen-

turies animal agriculture has therefore developed, based on small ruminants which due to their small size, have individual nutritional needs which are easier to satisfy in comparison to cattle; having also shorter gestation and lactation periods (Flamant, 1992). Notwithstanding the adverse environmental conditions, many of the earliest successes of rural civilizations in the world occurred in this region. The variance of culture, climate, vegetation, land-use, socio-economic reality and food habits, have modelled the agricultural production systems in general and the livestock farming systems in particular. From the first periods of domestication, ruminants have traditionally populated the mountainous and hilly zones, in harmony with the environment and socio-cultural habitat. Since the Second World War, external interference has unfortunately had, as in many other parts of the world, a rather negative influence on the rural society development in this region (Boyazoglu and Flamant, 1990).

The basic unifying factor in the region is without doubt, the climate common to the different ecological subregions, landscapes and scenarios, styles of life and traditions. The Mediterranean climate favours cereal cultivation, both wheat and barley, for which the traditional growing practice is based on rotation between one year of cultivation and one of fallow (Jones, 1992).

In modern times, the elimination of malaria from the coastal plains and the attraction to the North Europeans of the sea and sun, have stimulated the large development of tourism. There has also been the direct or indirect involvement, from both the State and private industry in livestock selection and production systems. It is interesting that in recent years, in opposition to the intensification of production, one sees a strong return to rural quality, diversification and acknowledgement of the value of natural, traditional, local products and a growing demand for them (Matassino *et al.*, 1991).

Livestock Farming Systems

The difference between the systems and society of the old pastoral world, based on 10 000 years of activity and the

new animal agriculture structures, is still visible. Pastoralism in the Mediterranean has always been considered a way of life structured on tradition and human needs and on the existence of the natural animal and plant resources.

Nomadism and transhumance at various levels still constitute the systems of husbandry dominating the grazeland traditions of the African and Asian zones in the basin. Naturally, where conditions permit, livestock systems co-exist with plant production. In the European part of the basin, nomadism almost became extinct in the 19th Century. Transhumance is still present, but is in continuous decline. Indicatively, the population of the sheep transhuming in Greece has declined from 30 percent in 1955 to 6 percent in 2000. The cause could be principally explained by the changes which came about in the social tissue in this region and less from the changes of production methods. A result of this evolution has been the elimination of the *tseligato*, a sort of cooperative of sheep and goat breeders developed in the Balkans in the 18th and 19th centuries which became an example of optimum human organization for the management of flocks, founded on the respect and protection of the environment. The repercussions of these changes in the livestock production systems have contributed to the destruction of the fragile Mediterranean ecosystems due to the unbalanced use of grazings and pasturelands (overloading or deficit use) with the result of an increase in fires, erosion and degradation of the surface area.

On the African side, agriculture is traditionally based on mixed systems of animal and plant production. The exclusive animal raising systems dominate the area where rainfall is so scarce that it does not allow any form of cultivation. The nomadic breeding or transhuming management of ruminants is the main characteristic of the areas with a total annual rainfall of 200 to 600 mm; in zones with less than 200 mm of rain per year (desert conditions), nomadic husbandry systems of camels dominate. In these regions, man and animals make use of the traditional knowledge regarding climatic and ecological changes with the intention of securing a sufficient daily quantity of water and grazing; this type of system is on the decrease due to the progressive passing of nomadic populations to types of agriculture and husbandry of a sedentary nature or towards various other economic activities (El Aich and Benyoussef, 2000).

In many cases the decrease in the movement of flocks during recent years has been accompanied by a degradation of pastureland due to the appropriation of the land for cultivation of forage crops; moving towards intensification and mechanization. An interesting case on the proportional reduction of the pasture quality has recently been observed in China following privatization; accompanied also by the reduction in the movement of animals (Hatziminaoglou and Boyazoglu, 2001).

The potential use/reuse of the marginal rural zones must evidently take into consideration the increase and diversification of the needs of all populations of the basin. Today, this also includes sport, tourism, recreation, hunting, fish-

ing, summer residences and naturally the need to evaluate and sustain the consumption of natural local and traditional "typical" products. This last point is of major importance for the Mediterranean livestock sector with reference to the specificity and uniqueness of these products and the centre of their origin and quality; an inheritance which has been denied systematically and continuously by all those who wanted to equalize and minimize the historic inheritance of local production even usurping in many cases the use of the denominations of origin (Boyazoglu and Morand-Fehr, 2001).

State-of-the-Art of Local Animal Production

In the Mediterranean area during the period of domestication, a large quantity of genetic variability accumulated. Traditional populations, breeds and selected lines are now in different stages of the evolution process conducted by breeders. Beginning with the industrial development (1900), the economic and social situation has greatly changed, the demand for animal protein is increasing with an intensification and specialization of both the plant and animal sectors, thanks to the scientific and technical acquisitions (conservation of products, production techniques, milking, pastoralism and expansion of the cheese industry) which permit the increase in animal production through the use of genetically improved material, more productive and technically better managed. In fact, with the advances in quantitative genetics, it was possible to take advantage of artificial insemination developments, the principle of the genetic indexes which are now more easily attainable through better computing technology and advances in biotechnology applied in reproduction (Nardone and Gibon, 1998).

Data referring to production in many cases, also progeny, are now available for many of these populations. Demographic instruments, genetic polymorphism and the quantitative genetic concept are used to describe the variability within and between populations. The *in vivo* conservation and the management of local genotypes has been applied here more conscientiously than anywhere else without waiting for the suggestions provided from international organizations nor the globalizing of the development of biotechnology research. The methods finally used (Rochambeau, 1998) to conserve and use the local genetic resources were firstly identification, then registration, management, study and evaluation.

The most impressive change in regional livestock began just after the Second World War when the cattle that mainly populated the mountain and hilly areas of the Mediterranean, in harmony with the environment, were gradually replaced by the Black and White milk cows originating from North America. These are now kept under intensive free stabulation conditions mostly around the cities. Greece is a classical example of the change of the composition of the

local cow population. About 45 years ago (1955), the national cattle herd consisted of 85 percent of small, well-adapted local cows, which were mainly used in the low mountain and hilly areas and only 15 percent were of the so called crossbred types through improvement of exotic animals or pure-breds. Since 1975 crossbreeding with specialized genetic material (above all through artificial insemination) created a population of 15 percent pure-bred Black and White cows and an uncontrollable mass of crossbred animals equal to 70 percent which can only be farmed under intensive conditions of management and feeding; the local population is therefore reduced to no more than 150 000 animals (Zervas and Boyazoglu, 1979). In the same way, the buffalo population living in the humid zone of the north of the country decreased during the same period from 100 000 buffalo cows to only 800 head (Georgoudis and Boyazoglu, personal communication, 2001).

This series of changes is happening in the south and east of the Mediterranean where the introduction of highly sophisticated genetic material (milk cows) implies an increase in the nutritional needs which cannot be satisfied by the traditional extensive farming conditions, with the consequential import of feedstuffs, often genetically modified, from other continents.

While the genetic composition of the cattle population has changed dramatically, that of small ruminants has hardly been modified. The raising in rather small flocks (for milk and meat, but also wool and leather) still plays a very important role in the use of the low potential marginal areas and uncultivated lands and can be defined as the traditional activity of the rural society of the Mediterranean. Practically all goats and 60 percent of the sheep are totally or partially milked and about 90 percent of the milk is transformed into good quality products which have a connotation of production origin denomination and regional or "natural" local quality (e.g. Roquefort, Pecorino Romano, Pecorino Sardo, Feta, Idiazabal, Manchego, Serra da Estrela, etc.). Regarding mutton and lamb, different Mediterranean countries traditionally produce milk lambs (Greece, Italy, Morocco, Portugal and Tunisia) with an average carcass weight of 10-14 kg; in other countries mutton is preferred (Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Libya) and heavier lambs. In some cases both forms of production exist (France and Spain). A good example of European appellation of origin meat is the Sardinian lamb. With reference to goat meat, this has always been much appreciated by Mediterranean populations, particularly that of young kids (Hatziminaglou and Boyazoglu, 2001).

A characteristic trait of the meat sheep of the Middle East is the presence of a fat tail, for which there is a strong local demand. Wool, principally derived from the fat tail and long-wool breeds, is the basis of the local carpet industry; the leather industry, has not yet been sufficiently developed.

Conservation of the Animal Genetic Resources and their Use in Europe

In Europe and in particular the Mediterranean region, radical changes in the structure of human population caused an early awareness of the possible erosion of the animal genetic resources (1970); since the beginning, this was linked to the conservation of the breeds in danger (Zervas and Boyazoglu, 1979). This lead, then fully coincided, with the increase of attention worldwide to the question of animal genetic resources (AGR) and their conservation; evidently later than in the plant sector (Ollivier, 1998a). More recently, the first concrete international action in the field of AGR took place in Europe; it was the concorded activity that began in 1980 when the European Association of Animal Production (EAAP) instituted a working group on AGR (Maijala *et al.* 1984). On a global level, 1980 was also a starting point, namely, the first consultation of experts on AGR was held in Rome (FAO, 1981).

One of the first activities of the EAAP Working Group was to organize regular enquiries and studies on cattle, sheep, goat, equine and swine breeds or populations in different European countries. Very soon it was clear that there was a need to computerize the collected data. This was therefore discussed during the annual meeting of EAAP held in Budapest in 1986 then in Lisbon in 1987. The Veterinary University of Hanover (Germany) was chosen in February 1988 as the central operations unit and an agreement was made between FAO and EAAP to create a Global Databank for AGR in developed and developing countries, to be situated in Hanover. Following this agreement, a joint working group FAO/EAAP formulated a questionnaire to collect data on five main livestock species, which afterwards was made available in four languages (English, French, German and Spanish).

In 1991 it was decided that Hanover would transfer their global function to FAO (AGAP) and would no longer collect the data from non-European countries. The non-European data were transferred from Hanover to FAO, Rome and the global databank was completed in the following years. In 1993 the European data were also transferred from Hanover to Rome in view of the preparation, by FAO, of a World Watch List for the diversity of domestic animals (Loftus and Scherf, 1993). In the same year, EAAP published a keybook on "Genetic Diversity of European Breeds of Livestock Interest" (Simon and Buchenauer, 1993), in which information is given on 877 breeds. At the end of 1994, when the transfer from Hanover to Rome was completed, information had been collected for a total of more than one thousand breeds, belonging to nine species and 53 countries (Ollivier, 1998b).

Since 1994 the two databanks of Hanover and Rome have worked separately but complementary; the first one collecting additional information of specific importance to Europe's livestock industry. Since 1995 the updating periods were put under the responsibility of national focal

points (NFP) and presented in each country within the FAO Global Programme for Management of Animal Genetic Resources, with the support of EAAP for the designation of NFPs in European countries (EAAP/FAO NFP). The national coordinators (NC) meet annually on the occasion of the annual meeting of EAAP (the seventh meeting was held in Budapest in 2001). The information collected in the two databanks was made available in 1996 on the relevant web-sites.

In 1996 the President of EAAP, Alessandro Nardone, suggested that a proposal be put forward to the European Union in connection with the regulation of genetic resources in agriculture (regulation 1467/94) to unify the European databank (EAAP/AGDB) and the information system created by FAO (Domestic Animal Diversity-Information System or DAD-IS). The project was approved and sustained in 1997 for 18 months. At their first meeting, the European national coordinators agreed upon a protocol to unify updates of the databank and for the annual transfer of data to FAO DAD-IS. A European regional focal point was developed in (ERFP) that addresses the specific needs of the region, including regional rural sustainable development within the FAO global system.

The development of the Regional Focal Point for Europe (at the Genetic Resource Office, Paris) coordinated by the National Focal Points (Martyniuck and Planchenault, 1998) and the annual meetings of the European National Focal Points (EAAP/FAO; seven already held, on the margin of the annual meetings of EAAP) are the logical evolution of this process.

Animal resources: an integral factor of the production system

To conclude, the mosaic environment of the Mediterranean has permitted an important expression of animal genetic diversity manifested by a large number of breeds, proportionally greater than those found on a world scale. Nardone (1996) for example, noted that 97 Mediterranean cattle breeds represent 12 percent of the total of the world breeds, while the 38 million cows of the Mediterranean basin represent no more than three percent of the world population of cows. Within the animal population bred in the Mediterranean region, one can find breeds that could be part of humanity's patrimony for their original genetic composition, especially with regard to small ruminants that have dominated livestock systems of the Mediterranean for various millennia (Boyazoglu and Flamant, 1990). Interest in fibre production, fundamentally characterized these small ruminants; two breeds emerged here which are now diffused worldwide: the Merino sheep of Spain and the Angora goat of Turkey. Moreover, specific breeds have been found in isolated situations that have been traditionally selected for their prolificacy with levels well above the average, like the Greek island breeds (e.g. Chios and Kyme) and those of certain Saharan oases (D'mane sheep in Morocco

and Zaraibi goats in Egypt). Amongst the milk sheep breeds, the Lacaune must be mentioned, intimately connected with Roquefort cheese production; the development of the selection programme for this breed during the last four decades (1958-1998) constitutes today a reference at world level (Astruc and Barillet, 1999). We should also mention the Sarda, Churra, Serra of Estrala breeds and some of the Awassi lines.

Biological diversity is the main measure of genetic evolution and the importance of the local genetic resources is to be underlined for the "typical" local products which are of major economic importance (local quality products of animal origin), linked in particular, to the "regional specialties" (Matassino and Moioli, 1996). Genetic resources are thus essential for the qualitative characteristics of animal products and biodiversity can be fundamental to resolving complex problems of human diets (Matassino, 1991, 1992a and 1992b).

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