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## EVALUATION OF THE SUSTAINABILITY OF DAIRY GOAT SYSTEMS IN TUSCANY

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**Abstract:** *The sustainability of animal production systems should be understood as a complex concept, multidisciplinary, dynamic and temporal, and has been recommended by FAO to detect the most relevant properties and the tendency of changes of these systems. Studies have emphasized the reduction in the number of sustainability indicators and the importance of using other indicators rather than technical and economic ones. Another important point is to integrate these indicators into a single index, which is capable of reflecting the evolution of the system and its sustainability.*

*The production of goat milk in Tuscany is based on the use of natural pastures and has been stimulated by the value of cheese, however, there is no tradition of production as in other European countries and these systems have been developed and deployed to other marginally productive systems and agrotourism.*

*The objective of this study is to evaluate some aspects of sustainable production of goat milk in Tuscany, taking into account indicators such as: socioeconomic, animal welfare, human development, participation in cooperatives, the presence or no certification, and conservation of natural resources and environmental conservation in order to integrate all of them into a global sustainability index (Sg).*

**Keywords:** *dairy goat systems, goat milk, Tuscany region.*

### Introduction

The animal production systems have to be sustainable for continue functioning for future generations and, therefore, should be accessed for that. Sustainability is a complex subject, temporal and comprises a multi-dimensional approach which depends heavily on the researcher maturity and understanding. Its assessment should be based on a matrix of sustainability attributes as productivity, stability, resilience, reliability, adaptability and equality and indicators related to productive, economic, social, cultural, institutional, political and ecological aspects.



They should be used to detect most relevant proprieties in the animal production systems and their tendency to change (Massera et al., 2009; Nahed-Toral J. et al. 2006, Peacock and Sherman, 2010). However, these indicators should be analyzed in an integrated way for the calculation of a single sustainability index what can facilitates the use of complex information by non-experts (Castoldi and Bechini, 2010).

### Materials and methods

Population and population growth are major determinants of the demand for food and livestock products. However, there is an increasing of the consumers' conscience about the importance of health aspects, environmental issues and ethical issues and the European programs recognize the importance of livestock to reach such demands.

Regarding to heath aspects related to the consumers, they are focusing not only on the traditional nutritive value of the food but also on the increase of some nutrients and on nutraceutics properties.

Tsiplakou et al. (2010) have shown that organic milk production system of goat and sheep have a higher nutritional value than conventional systems and Silanikove et al. (2010) emphasized the importance of milk goat for use as a nutritional source for infants and children and as a medicinal food.

In relation to environmental issues, goats have been blamed, wrongly, as a responsible for devastating areas considered non-degraded and responsible for overgrazing, soil degradation and deforestation. Overgrazing cause changes in the structure of vegetation associated with decreased coverage of shrubs and herbaceous species increased (Arevalo et al., 2011). However, many studies show that livestock can improve soil, vegetation and biodiversity of fauna and flora. And the trampling can stimulate grass tillering, improve seed germination and break-up hard soil crusts when animals are properly managed (Steinfeld et al., 2006). Goats managed extensively with a correct stocking rate, have been seen as architects of the vegetation producing heterogeneity and the establishment of natural vegetation mosaics, therefore, could help increase the diversity of habitats (Malta, J. et al., 2010). In terms of ethical issues, a major one is for the better animal welfare.

The Tuscany region has a tradition based primarily on sheep cheeses (Tuscany pecorino) with DOP, with a strong consumer market. However, goat production systems in Tuscany have been stimulated by the use of natural pastures and for increasing typical production and value (as a gourmet food), the preservation of the native germplasm, for its social and environmental role, by protecting rural land and promoting biodiversity.



Most recently, a zootechnical overview has been performed on the Italian native goat population named "Garfagnina" which is registered on the Tuscan regional repertory of genetic resources at a risk of extinction (Martini, M. et al. 2010). The most of garfagnina flocks are located in the hills and mountains of the northwestern Tuscan Apennine area, generally managed by family farm and regarding to feeding systems, are semi-extensive and represent one of the main sources of income for the majority of breeders (Corrias, F. et al., 2012).

## Results and discussion

In the world there are about 750 million goats due to their ability to provide high quality food under diverse climatic conditions and resilience to extreme and capricious environments (Silanikove et al. 2010). The majority of goats in the world are kept in extensive and semi-intensive systems in many cases using management techniques that have not changed much for many generations. The goats can be seen on marginal rangelands that cannot be cultivated or used for other agricultural purposes. Intensive systems can also be found in Europe and United States (Peacock and Sherman, 2010).

The goat extensive production systems depend mostly on the rainfall for adequate forage, these flocks are generally low producing in terms of milk and offspring but well adapted to the climatic conditions and relatively tolerant of local diseases (Degen, A.A. 2006).

In Tuscany, the most of dairy goat production systems are semi-extensive, out of winter when they are housed; the animals are in the pasture during day-time and receive concentrate at the barn. There is a great variation in production performance among breeds (Haenlein, G., 2007) and feeding systems, and therefore an enormous potential of genetic improvement because of the relatively high heritability of this traits.

The study of the sustainability of the goat production systems in Tuscany can help to elucidate the main strength and weakness of these systems in order to support government for specific policies. The research was taken place at the Tuscany region, central Italy, between parallels 43° and 11 ° N and meridians 25 and 11 W, which has an area of approximately 22,993 Km<sup>2</sup>.

Hills make up nearly two-thirds (66.5%) of the region's total area, and mountains of which the highest are the Apennines, a further 25%. Plains occupy 8.4% of the total area, mostly around the valley of the River Arno. The climate is fairly mild in the coastal areas, and is harsher and rainy in the interior, with considerable fluctuations in temperature between winter and summer, giving the region a soil-building active freeze-thaw cycle.

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## Conclusions

30 farms were selected related to dairy goat systems: 14 traditional production systems, 13 organic farms, 2 biodynamic production system and 01 social system. The information was obtained through collection of primary data from a structured questionnaire with direct interviews with the producers. The interview questionnaire included 100 questions relative to a general description of farm characteristics and overall management practices, and included information about: farm location and land use, flock size and structure, feeding management, reproduction and breeding strategies, labor force, production, health, economic, strength and weakness points of the farm, presence or absence of certification and succession of the farm.

Based on Castoldi and Bechini (2010) the indicators should describe a large variety of sustainability aspects and its values are first converted into a sustainability score ( $S_i$ ; 0–1) applying continuous non-linear sustainability functions that use thresholds defining what is sustainable, unsustainable, or Intermediate. They obtained 15 values of  $S_i$  per each field, which they aggregated into  $S_g$  using indicator-specific weights provided by different stakeholders. This procedure permits not only the single indicators evaluation, but also to combine indicators for an assessment of systems at field level.

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