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Food and Agriculture Organization  
of the United Nations

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European Regional Conference on Goats  
7–13 April 2014

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# ORGANIZATION AND SHIFTS IN THE GENETIC SELECTION AND BREEDING OF GOATS TO ADDRESS CURRENT ENVIRONMENTAL ISSUES IN LIVESTOCK ACTIVITIES

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## Abstract

A major part of the world's ecosystem resources (water, soils, forests, biodiversity) has been highly degraded by current agrofood systems. In addition, an important social crisis caused by low incomes, rural emigration, the loss of rural employment and indebtedness is concomitant to the environmental crisis. Within this context, the international community and institutions have signed an agreement to define a common strategy for tackling the challenges that humankind has to face. The dominant paradigm is still the classical one of progress and intensification, but for several years there has been a movement for redefining and diversifying agricultural systems towards an environmental transition. The external negative effects of livestock as an important cause of the emission of carbon dioxide (CO<sub>2</sub>) and environmental damage have recently increased. The future of livestock sectors, as well as other agrofood systems, has, therefore, to be questioned to find ways of decreasing these negative externalities and developing more sustainable systems.

Among the different types of livestock, the general opinion is that goats would be well adapted to limiting these negative externalities through their ability to valorize rangelands, shrubs and by-products. This paper discusses this proposal through a general analysis of goat production systems and a review of the situation of goat breeds and

genetic selection for all goat products – meat, milk or fibre – throughout the world. Possible strategies regarding the reorientation of production systems to face the socio-environmental issues are discussed, along with their potential application in Europe.

**Key words:** goat breeding, agro-ecological transition, goat breeding, local breeds, livestock policy

## Introduction

The livestock sector is highly affected by the systemic crisis that has been facing the world for several decades. This urgent situation involves environmental, energy, social, financial and political issues, and, so far, the only responses to these difficulties proposed by public and economic powers have focused on finding ways to restore growth. Growth would create more wealth, jobs, happiness and prosperity, but – as underlined by Jackson (2009) – an economy based on perpetual expansion in a world with limited resources is ecologically unsustainable, socially problematic and economically unstable.

The objective of this paper is to explore ways of facing, and possible solutions to, these challenges to the goat sector – a very specific subsector in the world of livestock. It focuses on genetic selection and breeding issues and their relations with environmental factors. These discussions are elaborated at the global level with special attention to the development of possible strategies for goat farming in Central and Eastern Europe.

## Materials and method

The paper is based on bibliographical references and statistics. It starts by outlining the current situation of genetic selection in the goat sector and explains how important this selection is to current environmental issues. Different experiences are described and compared to identify possible ways of developing and improving the environmental efficiency of goat production systems and organization. Contributions from research are explored through bibliographical analysis of data basis and several other references.

## Results and discussion

The current situation of genetic selection and breeding in the goat sector

Breeding and genetic selection have been an important lever of progress in livestock production for the last 50 years.

The increased productivity of livestock breeds selected to valorize rationalized nutrition programmes has enabled more than fivefold growth in milk yields and in conversion rates in pig, poultry and cattle meat production.

Although the goat sector has often been undervalued economically and commercially during the twentieth and twenty-first centuries, several specific dairy and goat meat sectors have been developed locally with significant outputs and results. This is particularly true of the dairy goat sector in France, where the organization and selection of Alpine and Saanen breeds are often considered a model for success. In 2013, in France, average milk production was 915 kg/doe/lactation for Alpine dairy goats and nearly 1 000 kg/doe/lactation for Saanen goats registered in the milk control system (Institut de l'élevage, 2012). Over the past 20 years, this productivity has continued to grow at about 20 percent per year.

However, in spite of this success, most goats all over the world belong to uncharacterized populations or unselected local breeds. Among these breeds are the 136 identified by Gall (1996), but this number now needs to be updated. Far fewer breeds are involved in true selection schemes: Dubeuf and Boyazoglu (2009) estimate about 20. The conser-

vation of animal breeds is an important issue for world biodiversity (FAO, 2000), while for goats the preservation of local genotypes is of major importance in favouring use of the natural resources of rangelands (Hoffmann, 2004). Some rare breeds with small populations have been identified and selected, mainly for conservation. In France, for instance, seven rare goat breeds are supported through various types of organization, but these management programmes meet points of tension between conservation and development objectives (Lauvie et al., 2011).

### **Dynamics of goat activities and environmental issues**

Goats have been the most rapidly expanding livestock subsector for more than 20 years. The world goat population has increased by about 66 percent over the past 20 years, compared with 14 percent growth for cattle (FAOSTAT, 2013). However, most of this growth has occurred in low-income countries (which account for about 80 percent of the world's goats), and most of the goat milk or meat produced is for own consumption on farms, with a very small share traded – probably less than 5 percent (Dubeuf et al., 2004).

This means that most goat production systems are managed by smallholders with low incomes. These production systems are based on low inputs, low investments and the use of natural resources (rangelands, scrub, forage trees or by-products). A recent study has shown (IGA/IFAD, in press) that in favourable conditions and with few investments, goats can be profitable for poor households and can help them to rise out of poverty, with possible significant impacts not only for communities but also at the regional level. Goat farming can be introduced anywhere, and not only to fight poverty. Compared with other animals, goats would be a better lever for developing the agro-ecological principles for animal production defined by Altieri (1983), which promote ecological practices not only for technical and economic purposes but also to promote social improvements:

Goat production systems are generally integrated into complex livelihood systems and are multifunctional in providing – often simultaneously – milk, meat, fibre, manure and sometimes even recreational activities. In addition, goat products are often typical to their local areas, and their marketing could be improved by emphasizing the environmental role of goats and the organic production model as part of the development of tourism in many low-resource areas.

Goats, particularly local rustic genotypes, have a high capacity to valorize low-quality forage and recover rapidly after periods of water and food shortage (particularly for meat production), which would be a major advantage in facing climate change.

Goats are well adapted to grazing on rangelands and, when correctly managed, can protect and enhance biodiversity. Many references confirm that goat grazing does not degrade rangelands, in spite of the many claims to the contrary.

### **Perspectives and orientation of goat research focusing on genetics**

A survey of the scientific areas investigated by research between 2005 and 2011 (Table 1) shows that most publications are dedicated to biotechnical science, while strategic issues are not frequently considered.

Nearly half of research projects are oriented towards nutrition and improving the efficiency of feeding in somewhat intensified controlled systems. Publications on genetics and breeding are less numerous. Genomic research has advanced more rapidly since the goat genome was sequenced in 2010, with outputs that include (Laroque et al., 2012) genetic control of the casein composition; selection to improve resistance to scrapie disease; identification of the gene that controls milking speed; and development of selection on a larger number of genetic markers. This research has been undertaken through collaboration among France, China, Malaysia and the Netherlands. Although

some local breeds – such as Creole, Savanna and Kacang – have been studied, most research has involved Saanen, Alpine and Boer breeds.

These observations are consistent with the general conclusions of Morand-Fehr (2000), given that most research on goats focuses on intensive dairy systems and that goats are an easy animal to work with in developing scientific knowledge. Research on strategic social and environmental issues is still very scarce. The survey also confirmed that multidisciplinary approaches are still infrequent. There are still few links between human social sciences and animal sciences, and scientific knowledge to guide actions that consider both social and environmental issues is lacking.

### **The innovations needed to improve the environmental performance of goats**

Many innovations could improve the environmental performance of goats (Bocquier et al., 2011). A main issue is improving the animals' capacity to adapt to changing conditions. This objective could be achieved by developing innovative observation criteria to help breeders or extension agents manage pasture and grazing more dynamically. Nutritional risks could be managed by observing the diversity of pastoral resources. Territorial incentives and changes in regulations to promote environmental practices could also be considered as possible innovations to support environmentally safer goat breeding. So far, animal breeding has been based mainly on individual selection. The coordination of reproduction cycles in groups of animals, and the organization of animal replacement according to herd management objectives would also be innovations to develop (Santucci, 1991). The complex relationship between goat farming and country planning needs to be modelled to facilitate an approach that allows changes to production systems. All these innovations emphasize the need to articulate scientific and expert knowledge.

Environmental issues could be incorporated into all research topics. For reproduction control, hormonal treatments should be decreased and, ultimately, suppressed, to be replaced by methods associated with light treatment and male effects. Parasitism could be controlled by alternative natural treatments rather than chemical ones.

Precision breeding is now applied less in goat than in other livestock production. On more technical farms, precise monitoring of animals using electronic tools could enable examination of individuals' behaviour to optimize feeding or reproduction, the challenge being to decrease the use of fossil fuel and the greenhouse gas emissions by unit produced.

## **Conclusions**

In Eastern and Central Europe, goat cheese production systems have good prospects. Most of the innovations mentioned in the previous section could be implemented. Public authorities would need to be involved; their awareness of the need to transition to agro-ecological practices and the role of goats has to be enhanced so that they can define appropriate public policies. These activities are public services and should not be provided by private companies because they involve public goods (pastoral and protected areas, marginal lands, rural communities, preservation of local breeds). To promote social capacities, training and extension would be a key factor in favouring these innovations.

For the past 40 years, the number of jobs in agriculture and livestock has dramatically decreased as a consequence of constantly increasing productivity. Social and environmental problems lead societies to change their paradigms. In many countries, underemployment is still a severe problem. In contrast, goat farming produces positive environmental externalities for preserving biodiversity, natural ecosystems and land-



scapes. So far, remuneration for these externalities has not been fully debated, but such innovations could also be particularly relevant for goat farming.

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TABLE 1. MAIN TOPICS QUOTED FROM THE WEB OF SCIENCE IN SMALL RUMINANT RESEARCH AND LIVESTOCK SCIENCE, 2006 AND 2011

Journal	Marketing, development, management and production systems	Nutrition	Genetic breeding	Physiology	Pathology and parasitology	Technology	Reproduction
Small Ruminant Research (1 160)	219 (18.9%)	495 (42.6%)	287 (24.7%)	338 (29.1%)	315 (27.1%)	26 (2.2%)	227 (19.5%)
Livestock Science (1 470)	334 (22%)	770 (52%)	345 (23.4%)	547 (37.2%)	141 (9.5%)	23 (1.5%)	233 (15.8%)

Source: Dubeuf, 2011.