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Goat Farming in the Mediterranean basin: Main issues and challenges for mountain and pastoral areas

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Abstract – *The goat sectors in the Mediterranean, their issues and challenges are presented to document policy makers and professional stake holders. The objective is to guide them in defining strategies and relevant projects regarding the development of goats. The provided information is based on articulated statistics, testimonies, bibliography and comparisons. After a short general review on the importance of goats in the Mediterranean and their commodities, the main existing production systems are described in relation to their value chain with a focus on some specific cases in France, Spain, Morocco… The contribution of livestock in general to global food security, poverty reduction and its environmental social and economic functions are reminded. In a context where livestock development strategies have to build consensus on a path toward sustainability and contribute significantly to climate change mitigation, goats, once considered as marginal activities of the past, have winning cards to face the challenges to produce more using fewer resources. Both organizational and technical innovation strategies to develop them are explored and discussed.*

Key words: *Goats, Innovation strategies, Mediterranean area, development, prospective*

Introduction: the importance of goats in the Mediterranean and main commodities

Until the beginning of the 21st Century, the publication and information on the goat sectors were very scarce as goats were considered traditional and marginal activities but the new challenges, the world has to face have changed this situation and goats, animals often owned by small holders have been the fastest growing specie since 20 years at the world level (FAO stat, 2012).

The Mediterranean area is characterized by a high diversity of livestock and agricultural systems and although goats are not the dominant livestock, they always have had a special economic, cultural and environmental importance. Statistics confirm it and the Mediterranean herd, is 39 391 000 heads (table 1) compared to 61 232 249 cattle heads, (FAO Stat., 2012).

All the Mediterranean countries have goats (table 1) but the most important goat herds are in Southern and Eastern countries (Algeria, Egypt, Morocco, Tunisia, Middle East and Turkey). In these countries most of the goats are raised out of any organized sector and value chain.
In most of Mediterranean Countries (except in France and Israel), goats are raised for dual purpose (milk and meat, sometimes skins) and products are still often marketed informally (Dubeuf et al., 2004). The productions for each commodity are sum up in Table 2. Although most of the goats are milked only for auto consumption, goat milk is processed and marketed at a large extent only in a limited number of countries (France, Greece, Spain, Italy, Romania, Spain and Turkey). Except in France, goat milk is often processed with ewe milk (Dubeuf et al., 2009, Vallerand et al., 2007).

1. The diversity of goat production systems: pastoral or intensive systems?

The goat production systems are very diverse. A large majority of goats is still managed under pastoral systems with local breeds or populations well adapted to local conditions. These herds are generally very traditional, out of organized markets. They often face the rural decline of the mountainous areas but these production systems have been generally resilient and have contributed significantly to the survival and food safety of marginal poor populations without many other sources of income. These production systems have often enabled local typical products such as cheeses, fermented milks or meats. Meanwhile since 50 years, controlled production systems and breeds have been improved mainly for milk production with a high level of production. Although the size of this sector is very small, their performances have reached the same levels than for the dairy cow sector but also with the same negative externalities.

The intensive dairy goat production systems; at what extent it would be relevant to develop them?

<u>The French dairy goat model</u>

An unique dairy goat production model has been created and developed in France after the 50's and an organized goat sector has been built thanks to several convergent factors (Table 3, Dubeuf et al., 2004, Dubeuf, 2004):

- Specific initial conditions in Central Western France where many dairy producers had tried to develop different systems from dairy cow after the 50's.
- A dynamic national and export market for the lactic goat cheeses that have steadily expanded since 50 years. Thanks to this market, the demand for goat milk has enabled goat milk prices significantly higher than cow milk (around € 0,55/liter between 2010 and today versus 0,3€/l for cow milk)
- A state supported French inter professional organization with specific regulations and financial support that encouraged the creation of National professional organizations (FNEC, French National Breeders Federation; ANICAP, National Inter professional Goat Association,…), Technical Centers to develop product innovations on cheeses, artificial breeding and selection centers (Caprigène, Capri IA),…
- Consequently, the success of the selection scheme of the Saanen and Alpine dairy breeds and the rationalization of their nutrition and management; the performances of dairy goats have increased regularly about 2% per year (data of the milk control system) since 20 years and have passed 1000 l/lactation and French genetics has been exported all over the world.
- The subsidies decided by the European Common Agricultural Policy: Each goat farm of more than 25 goats receive € 8,5 /goat and /year (until 400 goat i.e € 3400 per farm .
- The dynamism of farm goat cheese makers processing the milk of their own herd; they have got a special status and special regulations adapted to their process and different from industry. They developed collectively good hygiene practices with specific subsidies (€ 3/goat) for farm cheese makers applying them. Although their number has decreased significantly due to the working and financial conditions of these activities, the farm cheese makers have maintained goat activities in many regions and particularly in low favored mountain areas.

The French dairy goat model has been based on a high level of intensification and artificialisation of the production system. Although breeders are now encouraged to develop grazing, most of the herds are kept indoor receiving hay, alfalfa and a large amount of concentrates. The negative impact of intensification can be observed at several levels: development of specific viral (CAEV) or metabolic diseases, lower microbiological quality of milk (Pirisi et al., 2007) … We observe also that the natural and ecological image of these

dairy goat products, often associated with agri – tourism does not match much with the realty of the production systems and is more a part of marketing strategy

Other dairy goat sectors

Similar strategies have been developed in other countries at a large extent and Netherlands for instance, has become a very competitive goat milk producer with the same type of production system (producing 75 million to 182 million liters from 2000 to 2011).

In Spain like in other Mediterranean countries, goat milk has been often less appreciated than sheep milk. The production systems were dual purpose and goat milk was previously mixed with cow or sheep milk without a specific valorization. The price of goat milk is about € 0,4/l specialized dairy goat sector has developed after the 90's particularly in Andalusia thanks to the investments of the French dairy goat industry to answer the rising demand for raw goat milk or frozen curd for export in other Spanish regions, in France or Netherlands. The local dairy breeds (Murciana Granadina, Malagueña) have been improved and reach a good genetic level (about 500l/lactation). However the valuation of goat milk remains low with only few PDO goat cheeses and the situation has became fragile in case of overproduction on the market. The Spanish goat milk production system has nevertheless became more artificial and dependant on irrigated alfalfa, citrus, olive, or vegetables and fruit by- products or feed stuffs.

Greece and the Balkan countries are important producers of milk of small ruminants. The production is boosted by high level of consumption of sheep and goats cheeses (often more than 15 kg/hab.). Most of the cheeses like Feta, Halloumi etc… are made with sheep and goats mixed milks. The dairy industry is well developed but until recently a specific dairy goat sector did not exist. Most of the production systems were half extensive with a general use of pastoral areas but recently intensive both sheep and goat farms have been settled in intensive conditions.

In Northern Africa (Maghreb, Machrek), there is few tradition for cheeses and sheep and goat are raised mainly for meat. Milk is generally consumed directly or processed in white cheese (jbem). Some individual initiatives have been developed by investors to supply the growing urban markets but several collective development projects have been failures or half failures.

From these cases, we could deduce that the organization of a specific dairy goat sector is very dependent on the specific valuation of goat milk products and their ability to reach large markets. (Dubeuf and Le Jaouen., 2005, Dubeuf and Vallerand, 2007). In spite of the success of the intensive model, it has become very dependent on external forage and feeds stuffs and the goats have lost much of their specificities. The intensive dairy goat model is often seen and quoted as a model to imitate and follow. The analysis of the situation developed above has clearly showed that the prospects for such a model are limited to small niche situations

A majority of "traditional" pastoral goat production systems around the Mediterranean

Most of the goats in the Mediterranean are still raised by traditional breeders under pastoral conditions. The herds are generally for dual purpose. Does are milked for local auto consumption and the main income comes from kids for meat.

The improvement of pastoral systems is difficult because they are generally managed by traditional shepherds with few basic education and not supported by efficient extension services. Their real local know how to valorize rangelands of scrubs, forests, herbaceous

pastures with long periods of heat and droughts and feed shortage has never been supported by public services and they are still considered often as a survival of the past with few capacities to modernize. Besides, goats are often considered by Forest Services as a factor of degradation of the forests areas which have restricted their access when many references have shown that the problem is due to the lack of management of pasture to avoid overgrazing. At the opposite, a controlled presence of grazing goats could be positive for the forests and a part of their ecological area. Very diverse local goat breeds adapted to each bio –tope have been selected for years but until now very few have been integrated in a rational genetic scheme.

Issues for pastoral milking goat systems

The development of dairy and cheese commodities under pastoral conditions has to face several specific difficulties: to bring back the herds, at least once a day to be milk, to avoid under nutrition after kidding to optimize milk production, to organize milk collection.
Consequently, the milk yield of pastoral goats is often very low. For instance in Corsica, a Mediterranean French island where the dairy goat system is only pastoral and based on the use of "maquis", composed by small trees and scrubs, a small Corsican breed adapted to the use of these spaces has been selected and used. The productivity of goats keeps low (around 150 l/goat/lactation), with a high quantity of feed stuffs (1kg/goat/day) and in spite of a high price of milk (€ 0,9/l), and a high level of subsidies from the second Pillar of the CAP (Compensatory Allowance for areas with Natural Disadvantages) the farms have difficulties to be enough profitable.

Goat meat production system : the example of the kid of the Argane tree area

The main incomes under pastoral conditions come from the sale of kids as the main product for goat meat (Table 2). But the trading of goat meat is still dominated by informal markets and local traders. The development of urbanization and the consumer's taste in favor of more dietetic meats could be an opportunity for pastoral goat systems around the Mediterranean.
A recent project to develop goat meat in the South Western Morocco Argane tree area has been studied (Dubeuf et al., 2013). In this area, goats have been always associated to the forest with a complex traditional system to prevent grazing at critical period for goats. The analyzed project aims to create a breeder's association, improve the carcass qualities, the conditions of slaughtering and the organization of trading. The results show that the ongoing initiatives lead to more specialized activities and each development logics has ignored the others. As enhancing more indicators of resilience would be useful to look for the preservation of the argane tree eco system, it would be probably highly relevant to associate more livestock and oil. The creation of a Protected Geographical Indication would be relevant and efficient only if it could consider the specific advantages and characteristics of the local system.

Main challenges for the future of livestock. What strategies to enhance innovation for the goat sectors.

The context has to be reminded. Growing populations, rising affluence and urbanization are translating into increasing demand for livestock products, everywhere including in the Mediterranean. This global demand is projected to increase by 70 percent to feed a population estimated to reach 9.3 billion by 2050 (Global agenda for sustainable livestock, 2013).

Demand growth has made livestock one of the fastest growing sub-sectors of agriculture, particularly in emerging economies and has been associated with a widespread transformation of the livestock sector. While the sector provides high value food and many other economic and social functions, its resource use implications are large. The livestock sector is the world's largest user of agricultural land, through grazing and the use of feed crops, and plays a major role in climate change, management of land and water, and biodiversity. The natural resources that sustain agriculture, such as land and water, are becoming scarcer and are increasingly threatened by degradation and climate change.
The resources of pastoral areas which cannot be used for any other purposes have to be managed both to preserve the ecological balance and the bio – diversity of these spaces and to use them as a renewable well managed resource.

Changing practices requires an enhanced flow of knowledge and innovation among actors and countries allowing them to transfer and adapt improved practices from different sources. It also, critically, needs policy change and investments to end the political and geographical marginalization of many traditional producer groups, to reward efficiency gains and resource stewardship, and to discourage waste and pollution. The goats have real opportunities under both pastoral and Mediterranean conditions.

Why the pastoral goat production systems are well adapted to the Mediterranean climatic conditions?

The Mediterranean area is characterized by severe climatic conditions with long periods of heat and drought. Goats are well adapted to these conditions and more than sheep they are the principal ruminants in many scrublands and are a part of traditional extensive grazing systems of all the Mediterranean countries (Alexandre and al., 2005). The terms hardiness and adaptability are attached to this animal, because of their adequate production performances attained under harsh conditions. Silanikove (2000) stated "goats living in harsh environments represent a climax in the capacity of domestic ruminants to adjust to such areas". He considered heat a major constraint on animal productivity also in sub-tropical Mediterranean zones. Growth, milk production and reproduction are impaired under heat stress as a result of the drastic changes in biological functions caused by stress.
The forage of most rangelands that offer the potential for raising meat type goats, consists of leaves of woody forbs and native grasses during the rainy season and a wide range of native range plants, including foliage from trees and shrubs during the dry season. Underfeeding is defined as an intake below maintenance requirements without modifying the composition of the diet or environmental conditions. The lack of forage is the main cause of underfeeding and is a frequent situation for small ruminants in summer dry seasons in the Mediterranean. Another constraint is that browse is rich in tannins, terpenes, or alkaloids that have toxic effects (damage to the liver, kidneys and epithelium of the digestive tract). Their use is restricted also, because palatability, voluntary intake, digestibility, nitrogen retention and energy utilization are inversely related with high tannin levels (Silanikove et al., 1996, Ramirez, 1999 and Landau et al., 2000).
Goats indigenous to harsh environments perform better than other ruminants. Silanikove (2000) provided a comprehensive explanation of this ability: firstly, the incidence of small body size, high digestive efficiency, low metabolic requirements, an ability to reduce metabolism, efficient nitrogen economy, and efficient use of water contributed to drought resistance in goats. Goats pant and sweat and therefore do not lose salt and their blood plasma volume is maintained better. Goats have great capacities to survive in extensive systems, i.e. thriving on unimproved rangelands owing to their feeding behavior. The goat's grazing strategy protects it from fluctuations in resource abundance. In conditions of low availability and /or quality goats perform well because of their opportunistic and selective grazing behavior. These animals use a wide variation of plants and select from amongst them the materials with the highest nutrient concentration, the leaves more than the stems, the thin stems more than thick ones. They are able to maintain a constant level of energy

and nutrient intake, despite wide fluctuation in supply from ranges or even to select a relatively high quality diet from a variety of available feeds (Ramirez, 1999). Knowing that the diets are of medium nutritive value and that the demand for nutrient is affected by the physiological status of the animals, the internal productive rhythm of a ranging goat seems to be a short lactation allowing for rapid recovery of body reserves and high probability of successful mating, and their motto seems to be 'stability'. One could also add 'fitness'. As a matter of fact, one of the best attributes of goats as meat producers is their high reproductive capacity specifically under harsh conditions

What innovations to improve the environmental performances of goats?

Many innovations could improve the environmental performances of goats (Bocquier et al., 2011). A main issue is to improve the adaptation capacities of animals to changing conditions. This could be achieved by developing innovative observation criteria to help the breeders or the extension agents to manage more dynamically pasture and grazing. Observation could be mobilized to manage the nutritional dangers to face by considering the diversity of pastoral resources. Territorial incentives and changes in regulation in favor of environmental practices could be also considered as possible innovations in favor of an environmentally safer goat breeding. Animal breeding has been based mainly until now on individual selection. The coordination of reproduction cycles by group of animals and an organization of their replacement according to the herd management objectives could be also another innovation to develop (Santucci, 1991). The complex relationship between goat farming and country planning would need to be modeled to favor a prospective approach in the changes of production systems. All these innovations enhance the need to articulate scientific and experts' knowledge. The new Technologies of Information and communication is already an efficient lever to improve the control of herds under pastoral conditions.
All the topics could be involved in environmental issues. For reproduction control, the decrease and later the suppression of hormonal treatments will be replaced by methods associating light treatments and male effects. Parasitism could be controlled by alternative natural treatments to chemical ones.

Precision breeding has now less application in goat production. In more technical farms, monitoring precisely the animals thanks to electronic tools could integrate the individual's behavior and optimize feeding or reproduction, the challenge being to decrease the use of fossil energy and green house gas emission by unit produced.

Conclusion: What orientation for goat development

More than other animals, goats would be a good lever to develop the agro ecological principles in animal production defined by Altieri (1983), as the application of ecology at technically socially and economically levels. The situations described above have shown that the goat sectors in the Mediterranean have to face complex issues but with real opportunities. A country like Turkey with deep small ruminant roots and know–how has obviously winning cards to meet this agro–ecological challenge.

Innovations must mobilize multidisciplinary both technical and sociological skills. The orientations of development have to be decided after participatory approaches. The public authorities have to increase their awareness about these challenges to define appropriate innovation because until now, their mental models were dominated by the paradigm of progress ("any technological innovation would produce progress"). We have enhanced the following points :

- Organizing local genetic resources by selecting and valorizing local breeds
- Developing innovation and technology to improve the use of natural resources and pastures by developing new models and references
- Identifying and mobilizing local capacities and know–how to include them in training programs and associating local communities
- Analyzing the value chain of goat products at territorial levels and developing initiatives for the certification of geographical local products with specifications based on the real specificities of local production systems
- Developing a relevant system of financial support based on the positive eco-systemic services provided by the activities.
- Anticipating and planning the governance of the development projects with all the stake holders

Table 1 - Total number of goats (1000 heads) – FAO Stat (2012)

Country	Value
Albania	810
Algeria	4594
Bulgaria	341
Cyprus	271
Egypt	4 306
France	1 307
Bosnia and Herzegovina	65
Greece	4 238
Croatia	72
Israel	100
Italy	960
Jordan	792
Lebanon	550
Malta	5
Morocco	5 601
Portugal	404
Romania	1 236
Slovenia	27
Spain	2 637
Syrian Arab Republic	2 293
Tunisia	1 272
Turkey	7 278
Serbia	232

Table 2- Fresh goat meat goat milk and cheeses - FAO stat, 2012

nda : no data available

Country	**Goat meat** (tonnes)	**Fresh goat milk** (tonnes)	**Pure goat milk cheese** (tonnes)
Albania	6390	67 741	1000
Algeria	17500	267 000	nda
Egypt	55352	20 000.	nda
France	12023	624 016	88 290
Greece	44600	407 000	40000
Italy	2024	27 944	1394
Jordan	6066	9 939	nda
Lebanon	2584	34 000	2040
Morocco	24196	60 000	6000
Portugal	899	30 413	nda
Romania	7718	369 429	nda
Spain	9680	443 625	38094
Syrian Arab Republic	18506	138 676	6000
Tunisia	8996	14 000	1500
Turkey	49275	369 429	92

Table 3. - The French dairy goat sector: situation 2012 and change from 2000 to 2012

	Mean 2012	Changes 2000 to 2012 (%)
Goat milk production (million l, estimate 2000)	657	+18%
Total number of goat farms (estimate 2000)	5500	-35%
Collection of goat milk by dairies (million l)	524 (80%)	+25%
Total number of goat farms selling their milk	4400 (80%)	−350
Number of collecting dairies	117	–
Total milk production (l per farm selling milk)	119000	+60%

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