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GOAT MILK PRODUCTION SYSTEMS: SUB-SYSTEMS AND DIFFERENTIATION FACTORS

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SUMMARY

The report deals with the goats'milk production systems by adapting a intersectorial and interdisciplinary system analysis. In many developping countries, goat milk produciton is not commercially marketed and produced for subsistence. When the improvement of forage production or the use of concentrates has caused an increase in milk produciton, frequently there is some difficulty due to the lack or inefficient road system in preventing such higher produciton towards processing centers or urban markets. Consequently such a system in practically immobile in progress. In a developped country as USA, 4 millions liter goat's milk is processed annually in powder and 2.5 millions is commercially marketed from individual farms. These data show a considerable progress in volume during the last 10 years.

In may countries, most of the goat's milk produced is transformed in cheese directly at the farm or skipped to a cheese factory which take care of processing and distribution. At the farm thanks to moderate investment, the direct milk transformation allows the farmer a value added sales income above the whosale price to industry. Milk transformation at the farm makes it possible to increase the gross margin. But the marmer's income depends on the quality of cheeses produced. In the South of Italy, the imporvement of farm cheese quality as a part of an important project allowed the cheese price increased by 20-30 %.

When farms sell milk to dairy factories, the gross margin is much linked to the milk price which may vary to the milk quality or to external reasons. For example, goat milk price depends on bacteriological quality, fat and protein percentages. As kidding is seasonal, milk concentration in spring determines an important price decrease. Consequently,, dynamic farmers try to produce a lot of milk in opposite season by adopting goatss mattings in advance of sexual season.

Actually the goat production systems are moving. In developping countries, the main objective is to assure the maximum of quantity to satisfy the population needs and consumers wants goat cheeses of hig dietetic and organoleptic quality. For these reasons, farmers and extension services must prc mote more quality than quantity in these countries.

KEYWORDS

Goats, milk production systems, faarm cheeses, goat cheese making dairies

A reading key for understanding the differences between the systems

In a report dealing with livestock production systems the interest of the writer and of the reader is focused on the factors which determine the difference between them, i.e. those factors which characterize a production system and, as determinants, are responsible for the different level and development rate existing between the systems. What is of interest is really to understand why a livestock farm is more efficient than another, why an area is more dynamic, and to provide for "deciders", and support the extension services with important elements on which to intervene.

Essentially, what is important in a system analysis is not so much the system description but the singling out of the various subsystems; fundamentally, the reading key used to photograph or describe a production system.

In the last few years the idea emerged that a farm is not an island but an integral part of what in French is called the "filière" and, therefore, the approach to the system analysis ought to be intersectorial and interdisciplinary. Multidisciplinarity, though, is asserting itself very slowly, especially in some areas and disciplines, while the sectorial type of research continues to be predominant.

In this report we have preferred to give a picture of the goats' milk production systems, showing the "difference factor". The obvious world view and the want for interdisciplinary data, per "filière", taken specifically according to this type of approach, do not allow us to reach completely the set objective. Within the available data we will try to be exhaustive.

The sub-systems and principal differentiation factors

A first important element differentiation is no doubt the final destination of the product. When in the same area there are livestock farms whose products reach the consumers in different forms and through different routes, the efficiency, the dynamics and the revenue level are, generally, different. Such differences are important but less taken for granted when we have farming areas with the same type of product and high level of efficiency. In that case other factors come into play which we will try each to analyze synthetically.

Milk production for drinking

In many countries, the final product of the goat production system, besides the kid and/or the fiber or skin, is the milk, directly used for family consumption or put on the market as a dietetic product.

Generally, it can be said that in developing countries milk still constitutes an important feeding resource for the rural population, while in industrialized countries the production diversification requires to find alternative market spaces, especially in the dietetic and health sectors. In most countries (Near East, Africa, Asia, South America) goat milk production is not commercially marketed. It is produced for subsistence, consumed fresh or processed within the household and for neighbors. In some systems, e.g. of the Mediterranean coasts, goat milk has no commercial value, i.e. it is not sold or purchased but given away to people in need, particularly those with young children. In many cases, milk production is of secondary importance compared with the number of good dairy goats within the size of the herd. The farmers can easily pick out the good milkers which supply the family with the dairy products (Taferrant et al., 1995).

Such a production system is, in general, imposed by environmental conditions which strongly affect the goats' milk production. In many countries, where the improvement of forage production or the use of concentrates has caused an increase in milk production, there is some difficulty, due to lack or inefficient road system, in dispatching such higher production towards urban markets or processing centers (Villemot, 1995; El Aich, 1995; Haenlein 1986).

Such a system, due to the limitations and ties of environmental nature, is practically immobile in progress, though improvement possibilities are linked to chances of placing the milk production on the market.

The long distance of many dairy goat farms from markets and/or processing centers, and the wide dispersion of dairy goat farms makes transportation to such centers expensive and adds to the higher price of goat's milk compared to cow's milk. Therefore a less than everyday shipping schedule of milk for processing and marketing is often adopted, which however, has to be in concert with milk quality regulations. Nevertheless, there is a steady, non-elastic demand for goat's milk by people and infants with cow's milk allergy and digestive malabsorption syndromes, because of the widespread testimony of success when goat's milk was substituted for cow's milk in such cases (Haenlein, 1992a; Mack, 1952-53). In many metropolitan areas with unavailability of fresh goat's milk, the reconstitution of goat's milk powder is practiced.

In USA approximately 4 million liter goat's milk are processed annually into powder and evaporated milk (Teh, 1991), while 2.5 million liter are commercially marketed from individual farms or cooperatives; over 200 dairies are licensed to process goat's milk with an average weekly output of 475 liters, of which half is sold as certified raw milk. These data show a considerable progress in volume and numbers of participating farmers during the last 10 years (Haenlein, 1986).

A serious threat to goat's milk marketing is the application of cow's milk standards to goat's milk by market regulatory health officials without sufficient evidence of their validity to goat's milk and because of lack of research data. The usually seasonal production of goat's milk accentuates biological differences in the secretory processes between goats and cows and their milk composition. The validity of the use of somatic cell counts as a monitor of goat's milk quality has been seriously questioned, when no goat's milk standards and no direct confirmation procedures are applied (Haenlein and Hinckley, 1995).

Milk production for cheese making

In many countries most of the goat's milk produced is transformed into cheese directly at the farm, promoted as "farm cheese", and recognized among system economists as vertical integration, farm retailing, value-added production or direct marketing; or the goat's milk is shipped to a cheese factory which takes care of processing and distribution. The reasons for the farm selling the milk or processing it at the farm vary from country to country, and within the same country from one farmer to the other. However, the potential for growth in many countries is considerable (CAST, 1982; Haenlein, 1992b; Devendra, 1993). In USA approximately 1 million liter goat's milk is processed into cheeses by more than 130 licensed farmers and several cooperatives handle between 2,000 and 4,000 liter goat's milk weekly for cheese making. Yet, to satisfy market demands, more than 500,000 kg cheeses, worth more than $ 15 million, are imported annually from France alone, not counting cheese imports from many other countries (Teh, 1991).

At the farm

It is generally believed that, thanks to moderate investment, the direct milk transformation allows the farmer a value added sales income above the wholesale price to industry (Toussaint, 1995; Landau et al, 1995).

Within the European Union, the role of industry in goat's milk transformation varies from country to country (Toussaint, 1995, Figure 1). In Spain 65 % of the production is transformed in cheese factories, while in France 58 %, in Greece 52 % and in Italy 75 % (according to Rubino, 1995, maybe only 35 %).

The main differentiating factor amongst farms is, therefore, the final destination of the milk.

In an economic survey carried out on 1,500 sheep and goat farms by Nencioni and Rubino (1994) it has been shown that the gross margin (Table 1) per liter of milk is much higher on farms transforming the milk than on those who sell it (168,000 LIT vs 112,400). This means that milk transformation at the farm makes it possible to increase the gross margin because there is a greater value added to the milk. A decrease of gross margin per animal can be explained when the farm transforming milk is more concerned with cheese than milk production, and therefore the performance of the herd becomes inferior. Indeed those are pastoral farms with a limited level of specialization.

According to the same authors another important factor is the stocking rate, that determines important variations in the gross margin. The most intensive farms with a stocking rate higher than 6 heads/ha show a higher gross margin per liter produced milk than the less intensive ones. A lesser gross margin per total production and per head instead is likely when a greater stocking rate is followed by less animal yield and greater costs.

Similar indications ensue from those farms which use seasonal grazing land (public or private), and are, therefore, less intensive. They may show a higher gross margin per head but a lower one per liter milk produced compared with more intensive farms, which do not need more grazing land. Lastly, we should mention the purchasing of feeds (concentrates, hay). Those farms which keep themselves below a general average, equal to about 50 kg of DM per head per year, always have a higher gross margin, though with different levels, than farms which use a great quantity of purchased feeds.

The importance of goat milk transformation at the farm is felt in both developed and developing countries. Tourism spurs a high demand of typical, local products, and therefore, in areas with a strong touristic pull (Greece, Andalusia, Corsica, Upper Galilee, Kabylie, Tunisia, California, New York City, Chicago), the farmers are trying to develop a good cheese supply (El Aich et al, 1995). Such a process is rather simple and can determine high revenues, if the extension services' efficiency and promotion is high. For these reasons in those areas the effort of technical support aims in this direction. In the South of Italy, the Basilicata region has carried out an important project to improve the quality of cheeses produced at the farms. Once this was achieved, the price increased by 20-30 %.

In developing countries as well the effort of International Organizations is directed towards the same objectives. In Niger the FAO has a project of improving the dairy techniques on 406 farms. The result has been positive as the price of tchoukou cheese has gone from 100 FCFA each (using one and a half liters of milk) to 125 (using only one liter), with an increase in revenue of 70 % (Lambert and Soukehal, 1995).

In North African countries (Egypt, Algeria, Morocco), some more dynamic farmers near large cities have managed successfully to organize small dairy factories, to produce cheese and sell it well to large hotels. The same is now found often in North America (Haenlein, 1986).

Major constraints to such progress, especially in Asia, have been described (Devendra, 1986; 1993; Saithanoo and Norton, 1991; Rathore, 1993) and include size of small farms, socially acceptable interventions, holistic appropriateness, crop-animal integration, institutional bureaucracy, climate, inbreeding, animal health, sanitation, illiteracy, urbanization, sustainability of feed resources, soil erosion, all-year-round feed supplies by intercropping, relay cropping, three strata systems, and feed storage.

At the dairy factories

The farms which sell milk to dairy factories have a gross margin much linked to the milk price as, in general, on such a type of farm the milk proceeds represent 60-80 % of the total gross margin. In other words the price of milk, in such a system, is an important differentiating element, capable of determining the differences among the systems.

Milk Price

Milk price may vary either due to the farm efficiency (milk quality) or to external reasons, not related to the efficiency and capability of the farmer. In the former case the price mirrors the farmer's capacity and/or the efficiency of the extension services. Such a mechanism is realized in very few countries where the goat dairy industry has reached natural development levels: France first of all and, farther away, Spain, Greece, Italy, USA. In France, milk quality is paramount. L'Anne Economique Caprine, (1994) report that 96 % of the goat's

milk produced in France is classified at bacteriological quality A. The South-East and the Central regions are very uncompromising as far as milk composition is concerned. Quality payment is the highest: 2.7 centimes/g fat and 7.4 centimes/g protein.

It is apparent, therefore, that in this area the gross margin reflects both the farmer's capability and the efficiency of the extension services and dairy industry. There is then the case in which the milk price depends on factors outside the farmer's control. For instance in France (L'Anne Economique Caprine, 1994) it may be due to:

The season. As kidding is seasonal, milk concentration in spring determines an important price decrease (Figure 2). Those farms which manage out-of-season births have more chances of a higher gross margin. Falagan (1995) reports that in the Murcia region of Spain the more dynamic farmers are more inclined to adopt new technologies, and are aware of the fact that the earlier the parturition the higher and more profitable the production (Table 2). The milk price is higher in winter, thus farmers separate males from females and introduce them into the flock in April.

The size of dairy factories. The larger the farms, the lower the milk production cost per unit and home-made production enjoys a better image in the market (Table 3).

The Region. The South-East and Central regions of France have a higher price for milk compared with the national average. The dairy factories in these regions, of medium to small size, base their transformation strategy on important added values thanks to DCO cheeses (Table 4).

Genetic improvement

A factor affecting the efficiency of all systems, those which sell the milk and those which transform it, is the functioning of the genetic improvement structure. This is not only for the direct effects on production - in countries such as France in the last 30 years the average production per head has almost tripled - but especially for the indirect ones. Generally, the recording technician not only carries out the monthly milk recording, but he is a means through whom ideas and technologies are spread and, therefore, the transferral of innovative techniques is speeded up. It is apparent, therefore, that in countries or areas where the genetic improvement structure exists and is working, the interested farms have a level of rhythm of development different from those farms not interested in genetic improvement. Table 5 shows clearly this situation. Countries such as France, Norway and, to a lesser extent Switzerland, Israel, USA, have a good level of rearing systems and milk recording. The effects of such an organization system are not only on milk production but, more importantly, on milk quality. Furthermore, in France the casein polymorphism is a factor under selection and in Norway and USA the milk flavor.

The future scenario

Alike other systems the goat production systems also are moving. Obviously, the evolution speed varies from area to area according to the development level of each system and the efficiency of the extension and technical services. The following are possible scenarios we can foresee:

Towards quality. This is of particular interest to Europe, America and developed countries. In those countries, the higher production in many sectors and a greater availability of money makes consumers more demanding and sophisticated. Quality, in the case of cheeses understood as the whole of organoleptic characteristics, flavor and health, is preferred to quantity. In the former case the consumer turns to raw milk cheeses, rich in particular flavors, which bring to mind a specific area, plant, and processing technique, while in the latter case the consumer prefers pasteurized milk cheeses, produced according to techniques which entail a continuous control of the milk microbiological and chemical qualities. As for both these cheeses, consumers are prepared to pay a higher price, the farmers aim at diversifying production and emphasizing those elements of uniqueness in their product in order to build up a consumer loyalty. It is for these reasons that in the EU the DOC policy is taking strengthened roots and that goat rearing will more and more be linked to the farmer and to the extension services' capabilities to characterize, determine, emphasize and promote "one's own" quality.

Towards quantity. In many developing countries the quality issue is premature. In many areas the main objective is to assure the maximum of quantity to satisfy the population's needs. Even in those areas where milk or cheese are sold, structural and infrastructural difficulties make the "filière" system difficult to organize and manage, and, therefore, the quality improvement is impossible to realize.

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Table 1 - Effect of some factors on gross margin (Nencioni and Rubino, 1994)

	Milk transformation farm				Stocking rate				Grazing outside the farm				Feeding expenses (lit/h/y)[1]			
	Yes		No		<6h/ha		>6h/ha		Yes		No		<average		>average	
	N		N		N		N		N		N		N		N	
Gross margin/ Gross production	866	0.58	487	0.57	856	0.59	487	0.56	1082	0.58	325	0.57	785	0.60	568	0.55
Gross margin/milk Lit. 000/100 l	890	168.1	530	112.4	899	127.8	511	177.8	1083	143.9	337	158.1	820	169.4	600	117.1
Gross margin/head Lit 000/n	890	132.4	530	142.3	899	142.7	511	124.7	1083	140.2	337	122.9	820	136.4	600	135.6

[1] Average 24,256 lit/h/y

Table 2 - Milk production and lactation length of goat Murciana-Granadina breed, according to the kidding period (Falagan, 1995)

Kidding period (E)	Lactation length (d)	Milk production	
		Total (kg)	Daily (kg/d)
E 1 (n = 910)	240 a	420 a	1.77 a
E 2 (n = 465)	209 b	368 b	1.76 a
E 3 (n = 230)	174 c	286 c	1.65 b
Signif.	**	**	**

n. : number of lactations ** $p < 0.01$
E : E1 = 21/08-20/11/89; E2 = 21/11/89-20/02/90; E3 = 21/02-20/05/90
a, b, c : Different superscripts indicate differences ($P < 0.05$)

Table 3 - Average price according to the industry size (L'annee economique caprine, 1994)

Industry size (1.000 litres)	-500	500-1.000	1.000-5.000	5.000-10.000	+ 10.000
Average price 1993	3.17	3.11	2.93	3.06	2.99
Average price 1994	3.11	3.18	3.05	3.06	3.02
Evolution in %	-1.9%	+2.2%	+4.0%	-0.1%	+1.1%

Table 4 - Average price according to the regions (L'annee economique caprine, 1994)

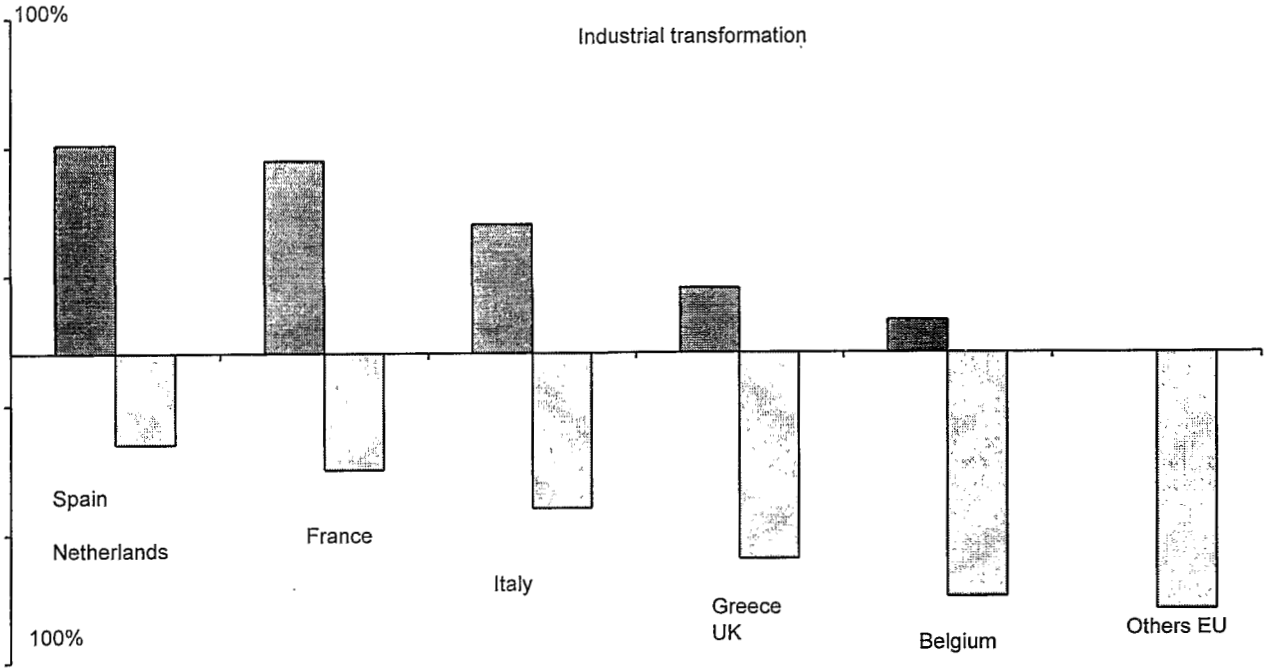
Regions	Centre	Centre-West	South-West	South-East	France
Average price 1993	3.25	2.96	2.83	3.14	2.94
Average price 1994	3.34	2.99	2.92	3.14	3.03
Evolution in %	+2.9%	+1.1%	+3.1%	+0.1%	+1.5%

Table 5 - International situation of goats milk recording

Nation	Total goat population x 1000	Recorded herdbook females	%	Number of recorded flocks
Austria	32	150	0.5	25
Bulgaria	500	687	0.1	2
Cyprus	100	3.000	3.0	20
Czechoslovakia	50	1.475	2.9	970
Denmark	-	-	-	1
Finland	2	156	7.8	19
France	1.196	240.000	20.0	2.562
German Federal Republic	36	1.741	-	-
Israel	12	1.080	9.0	18
Italy (1)	1.252	13.692	1.09	336
Luxemburg	-	400	-	1
The Netherlands	34	5.489	14.5	291
Norway	69	30.392	43.8	490
Portugal	600	400	0.07	6
Spain	2.300	16.000	0.7	170
South Africa	5.780	619	0.01	9
Switzerland	89	4.934	5.5	900
U.S.A.	1.500	14.961	1.0	1.090

(1) Data revised in 1993.

Figure 1 - Estimation of the division of milk production transformation (Toussaint, 1995)



At the farm or artisanal transformation

Figure 2- Seasonal variation of monthly price of goat milk (L'annee economique caprine, 1994)