Farm efficiency evaluation through FADN database

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SUMMARY - The aim of the work is to identify the most important factors which distinguish the different ewes and goat milk production systems found in Italy. Basic quantitative information for the analysis comes from specialized farms belonging to the Italian Farm Accounting Data Network (FADN) sample. By using multivariate statistical tools the most important economic and technical parameters defining the differences between the observed production systems are individualized and evaluated. The comparison between analysis results and production system performances allows us to identify possible constraints and/or successful conditions. Such information can be of use when orienting sectorial and local development strategies and policies.

Key words: Production systems, efficiency, database.

RESUME - *"Evaluation de l'efficience de l'exploitation à travers la base de données RICA". Cette étude a pour objectif d'identifier les facteurs les plus importants pour la discrimination entre les différents systèmes de production du lait ovin et de chèvre en Italie. Les informations quantitatives pour l'analyse proviennent des exploitations spécialisées appartenant à l'échantillon du Réseau d'Information Comptable Agricole (RICA) italien. Par les outils de statistique multivariée il est possible d'identifier et d'évaluer les principaux paramètres économiques et techniques pour la caractérisation des différents systèmes de production observés. Une comparaison entre les résultats de l'analyse et les performances des systèmes de production permet d'identifier les possibles contraintes et/ou conditions pour le succès. Ces informations pourraient être utiles pour orienter les stratégies et politiques de développement sectoriel et local.*

Mots-clés : *Systèmes de production, efficience, bases de données.*

Introduction

Sheep and goat breeding plays a very important role in the social and economic life of less advanced rural areas (Idda, 1978). These areas vary greatly in production structures and general territorial economic conditions (Giau, 1980). The relationship with the external world which characterizes sheep and goat production systems are conditioned by these differences as are technical efficiency and the organizational solutions adopted (Furesi and Pulina, 1996). Thus, it is possible to propose a territorial explanation for the existence of different production systems.

The aim of this work is to identify the most important factors discriminating between the different ewe and goat milk production systems found in Italy. The factors themselves are evaluated to see how useful they are in explaining observed differences. The work follows a multidisciplinary approach. The economic and animal-husbandry aspects as well as the production techniques are considered.

For such an analysis, a large and significant database is indispensable. A sample of pastoral farms belonging to Italian Farm Accounting Data Network (FADN) in 1994 is analysed. By Discriminant Analysis (DA) the most important economic and technical parameters to define the differences between the observed production systems are individuated and evaluated. The results can enable us to identify possible constraints and/or successful conditions. Such information can be of use when orienting sectorial and local development strategies and policies.

Materials and methods

Basic quantitative information for analysis comes from a sample of 1,457 Italian farms specialized in sheep and goat milk production recorded by FADN in 1994. All the farms are in the Centre and in

the South of Italy. The majority of them are located in Basilicata and in Sardinia, which is the most important producer of sheep milk in Italy. A preliminary analysis suggested grouping the farms in four macro-regions to emphasize the differences between the different production system models. Thus, farms located in Lazio and Campania are considered together in a macro-region called "Tyrrenum", those in Abruzzo, Molise and Puglia in the "Adriatic" one and farms of Basilicata, Calabria and Sicily in "Ionic" group. Only Sardinia remains alone in its own group, because of the specific characteristics of its pastoral farms. Table 1 shows the macro-regional means of the variables used for the Discriminant Analysis (DA).

Table 1. Means of variables used in Discriminant Analysis

Code	Description	Groups			
		Tyrrenum†	Adriatic††	Ionic†††	Sardinia
ALTIM	Altitude (m.a.s.l.)	463.80*	447.00	650.88*	340.87
PLOTS	No. plots of land	3.35	6.24	3.56	3.55
ARABL	Arable land/total land	0.94*	0.94*	0.97*	0.94*
LEASE	Ground lease/total land	0.19	0.47	0.30	0.47
FORAG	Forage grassland/arable land	0.59*	0.65*	0.50	0.91*
IRRIG	Irrigated land/arable land	0.12	0.11	0.02	0.02
HPLAN	Horse power/arable land	8.52	5.18	2.62	1.21
LIVHA	Livestock unit/grassland forage land	5.11	2.49	2.22	0.74
ARAUL	Arable land/un. lab. employed	11.01	17.85	19.32	49.82
LKTHA	Land capital/total land (.000 ltl)	15804.064	12437.002	9484.098	6963.704
LKDEB	Land cap. debts/real property	-0.037	0.001	0.004	0.055
WKDEB	Working cap. debts/working cap. prop.	0.004	0.000	0.008	0.022
SRDEB	Short run debts/anticip. capital	0.035	0.000	0.000	0.054
ANTWK	Anticip. cap./working capital	0.101	0.145	0.144	0.125
MECHP	Mechan. exp./horse power (.000 ltl)	26.243	49.220	27.836	59.083
DOMUL	Domestic un. lab./total un. lab.	0.98*	0.90*	0.98*	0.96*
PERUL	Permanent un. lab./total un. lab.	0.01	0.02	0.01	0.03
PERLC	Perm. lab. costs/perm. un. lab. (.000 ltl)	205.046	947.378	239.000	791.001
SEALC	Seas. labour costs/seas. un. lab. (.000 ltl)	86.282	1991.403	367.661	180.932
PROLU	Livest. prod./livest. units (.000 ltl)	2270.182*	2326.542*	2124.155*	2124.655*
PROFG	Livest. prod./forage grassland (.000 ltl)	11693.028	5788.134	4509.634	1521.722
MEATP	Meat prod./total livestock prod.	0.31	0.41	0.41	0.32*
FODPR	Fodder prod./total fodder used	0.30	0.51	0.59	0.12
FORPR	Forage prod./total forage used	0.81*	0.89*	0.85*	0.86*
FODLU	Fodder used/livestock units (.000 ltl)	193.413	158.750	172.263	252.045
FORLU	Forage used/livestock units (.000 ltl)	321.513	320.980	397.546	382.745*
FEEDP	Fodder forage prod./total fodder forage	0.66*	0.80*	0.78*	0.57*
SALES	Net sales/total gross production	0.85*	0.84*	0.83*	0.85*
LIVPR	Livestock net sales/total gross prod.	0.75*	0.74*	0.68*	0.89*
INPUT	(Taxes + input costs)/livest. net sales	0.15	0.11	0.12	0.17
ELAST	Variable costs/total costs	0.65*	0.71*	0.72*	0.71*
LREUL	Labour revenue/un. lab. (.000 ltl/ul)	16170.534	24031.445	18922.483	25505.760
FLREV	Farmer lab. rev./total lab. rev.	0.95*	0.90*	0.97*	0.96*
SALSG	Net sales/sheep goats heads (.000 ltl)	222.514	101.103	146.763	146.268*
PRICE	Milk market price (ltl/litres)	1187.942*	1276.355*	1047.482*	1286.513*
PROCE	Processed milk/total milk prod.	0.27	0.82*	0.70	0.07

†Tyrrenum: Lazio, Campania
††Adriatic: Abruzzo, Molise, Puglia
†††Ionic: Basilicata, Calabria, Sicily
*Denotes more than 95% significant means

This multivariate statistical tool allowed us to individuate and evaluate the most important economic and technical parameters to define the differences between the regional production systems. Here the stepwise method was adopted and the minimization of Wilks' lambda was the desired aim. Discriminant scores and groupings are associated according to the Bayes' rule (Norusis, 1990). The software package used for the data processing is SPSS/PC+™.

Results and discussion

The F value of 11.898 with (1395,138666.9) degrees of freedom resulted the Box's M test in rejecting the null hypothesis of equality of covariance matrices of all groups. This result could suggest the use of quadratic discriminant functions. On the other hand, the large width of the sample undoubtedly had a great influence on the results (Norusis, 1990). No more precise information about the basic hypothesis of the analysis can be obtained.

DA computed 3 different linear discriminant functions. In Table 2, reporting the coefficients of the only two main functions, it is easily appreciable that the first four variables reduced the ratio between within groups sum of squares and total sum of squares to about 20%.

Table 2. Wilks' lambda and rotated standardized canonical discriminant function coefficients

Variable	Wilks' lambda	Coefficients	
		Function 1	Function 2
PROCE	0.50778	0.70089	-0.03494
HPLAN	0.31970	-0.01693	0.18785
FORAG	0.22703	-0.17310	0.52957
ALTIM	0.19250	0.18115	-0.55828
FEEDP	0.17771	0.42162	0.11172
PRICE	0.16412	0.05307	0.42162
ARAUL	0.15106	-0.23716	0.19194
PLOTS	0.14358	0.04923	0.41127
PROFG	0.13865	-0.18050	-0.04423
SEALC	0.13409	0.25028	0.25413
LKTHA	0.13091	-0.06923	-0.07051
SALSG	0.12832	-0.21060	-0.13805
LIVPR	0.12579	-0.31521	0.22343
ELAST	0.12277	0.14751	-0.10022
FODLU	0.12081	-0.27990	0.16427
MEATP	0.11839	0.41107	0.08543
ARABL	0.11678	0.02804	-0.15687
FORLU	0.11554	-0.36733	-0.20448
ANTWK	0.11432	-0.03682	0.20197
INPUT	0.11272	0.35562	-0.09060
PROLU	0.11098	0.43329	-0.01858
SALES	0.10756	-0.30752	0.06736
FODPR	0.10630	0.10553	-0.02822
MECHP	0.10542	0.01428	0.13714
IRRIG	0.10453	0.10347	0.05457
FORPR	0.10381	-0.07519	-0.08724
LEASE	0.10312	0.12786	0.13732
FLREV	0.10259	-0.03049	-0.09227
LREUL	0.10222	-0.01936	0.07896
DOMUL	0.10190	-0.04647	-0.00147

The coefficients in Table 2 help us in the interpretation of the functions. The first function assigns positive values to these characteristics: milk transformed preferably in the farm (PROCE); feed preferably produced in the farm (FEEDP and FODPR), higher altitudes (ALTIM); low sales/production ratio (SALES), lower degree of specialization (LIVPR); low land/labour ratio (ARAUL); low use of fodder per head (MANG/UBA). The second function is positive related to high levels of mechanization (HPLAN).

Table 3, in addition, shows that the first two functions explain more than 95% of total variance. The eigenvalue associated to the first function is another clear index of its discriminating power.

Table 3. Canonical discriminant functions remaining in the analysis

Functions	Eigenvalue	Percent of variance	Cumulative percent	Canonical correlation	After function	Wilks' lambda	Chi squared	DF
					0	0.1019	3151.647	90
1	3.9525	82.32	82.32	0.8934	1	0.5046	943.787	58
2	0.6429	13.39	95.71	0.6256	2	0.8291	258.634	28
3	0.2061	4.29	100.00	0.4134	3			

Table 4 shows that a very satisfying discrimination was achieved: a good 90.06% of sample farms were correctly assigned to their region.

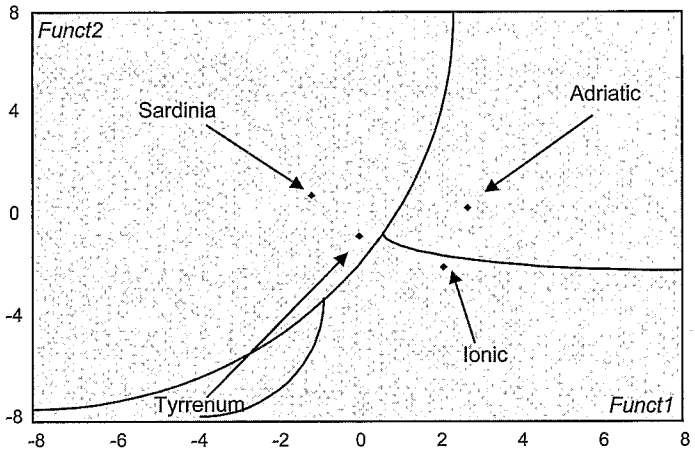
Table 4. Classification results of Discriminant Analysis

Actual group		Classification DA			
		Tyrrenum	Adriatic	Ionic	Sardinia
Tyrrenum	110 100%	*72*† *65%*	11 10%	10 9%	17 15%
Adriatic	59 100%	6 10%	*39*† *66%*	8 14%	6 10%
Ionic	375 100%	18 5%	29 8%	*315*† *84%*	13 3%
Sardinia	854 100%	10 1%	6 1%	5 1%	*833*† *98%*
Total	1398 100%	106 8%	85 6%	338 24%	869 62%

†Percent of "grouped" cases correctly classified: 90.06%

Figure 1 shows a picture of the relative position of the different regions in the bidimensional space of the two discriminant functions. The first function individuates a "Sardinian model", associated to negative values: Sardinian pastoral farms are characterized mainly by the sale of milk produced, the low productivity of animals, the limited importance of meat in the livestock production, the higher degree of specialization and the intensive use of purchased fodder, preferably associated to low altitude (vertical dimension). By contrast with this, we can distinguish an "Ionic model" and an "Adriatic model", with completely different characteristics from those of the Sardinian farms. To be more precise, the "Ionic model" can be distinguished from the "Adriatic" one by the higher altitudes, the low share of hectares used for forage and the lower market price obtained for the milk. The farms located in Lazio and Campania, on their part, can be roughly identified by a mix of the characterizing factors of the Sardinian and the Ionic models.

To sum up, DA found territorial peculiarities in sheep and goat production systems of Southern Italy. On one hand we have a strongly integrated, widespread, extensive and not very productive system such as Sardinian, then there is an Ionic system -preferably located in mountain regions, where the final product is not appreciated enough and the management does not reserve large areas for forage production- and finally an Adriatic system, where lower altitudes, higher prices for the milk and higher importance of farm forage production, seasonal labour and circulating capital are the most powerful distinguishing characteristics.



Low altitudes
High forage relative hectares
High milk price
Fragmented land
High costs seasonal labour
High anticip./work. capital ratio

High altitudes
Low forage relative hectares
Low milk price
Limited fragmentation of land
Low costs seasonal labour
Low anticip./work. capital ratio

Raw milk sold
Low production per head
Fodder forages purchased
Low meat/tot. livest. prod. ratio
High forage per head
Low input/livestock prod. ratio
Specialized farm

Milk processed in the farm
High production per head
Fodder/forage produced
High meat/tot. livest. prod. ratio
Low forages per head
High input/lives. prod. ratio
Low degree of specialization

Fig. 1. Territorial map.

Conclusions

A sample of about 1,500 specialized sheep and goat farms recorded by Italian FADN in 1994 was analysed to describe the main distinguishing characteristics of the different production systems in the Southern Italian territory. DA performed satisfying results allowing us to identify the most important structural, technical, economic and organizational factors which characterize the macro-regional breeding systems. There are clearly various limits to the analysis carried out. Among them, the lack of a dynamic dimension is the most appreciable one. This kind of analysis requires a wide, time-constant, sample of specialized farms representative of the different regional realities.

This work underlines the importance of the availability of a data base like the FADN panel to monitor the structural, technical and economic performance of breeding systems in the territory. The thirty-year experience, the accuracy of recording and the deeply detailed information supplied make FADN record the ideal database for this (Chatellier *et al.*, 1997). A monitoring project designed to observe the static and dynamic differences between the production systems *must* take into account this important resource. However, the problems linked to the dynamic dimension of analysis and observations impose a dramatic trade-off between the availability of a time-constant and of a wide, representative and reliable sample of the territorial characteristics in each moment of time.

References

Chatellier, V., Colson, F., Arnaud, F., Guesdon, J.C., Kempf, M., Legendre, J. and Perrot, C. (1997). La diversité des systèmes d'élevage bovin en France et leur contribution à la production de viande bovine. *INRA Prod. Anim.*, 3: 227-240.

Furesi, R. and Pulina, P. (1996). I sistemi di produzione al pascolo: aspetti economici ed organizzativi. *Caseus*, 1: 20-28.

Giau, B. (1980). Valorizzazione dei prati e dei pascoli. *L'Italia Agricola*, 4: 336-344.

Idda, L. (1978). Sullo sfruttamento zootecnico delle aree estensive del Mezzogiorno e della Sardegna. *Quaderni sardi di economia*, 2-3: 201-222.

Norusis, M.J. (1990). *SPSS/PC + Advanced Statistics 4.0*. SPSS Inc. Chicago, Ill.