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Insertion of Pyrenean farms in the lamb production chain in the region of Aragón

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SUMMARY – This work analyses different aspects of the commercialisation of lambs on farms in the three most eastern Pyrenean valleys of the region of Aragón (Spain). Different components of the Aragonese lamb agro-food chain form the framework which has been used to gain an insight into the behaviour of Pyrenean farms. A prior analysis of the lamb flows, the dynamics of prices and the spatial location of the Refrigerated General Slaughterhouses is carried out at regional scale before looking in detail at the different ways in which lambs are commercialised by the farmers. In relation to the latter, the description given essentially covers the product commercialised, destinations in spatial terms, channels used, annual seasonality and the relationship with the production system used.

Key words: Commercialisation, sheep farm, Aragonese Pyrenees, lamb agro-food chain.

RESUME – *"Intégration des exploitations des Pyrénées dans la filière viande ovine dans la région d'Aragon". Dans ce travail on analyse divers aspects de la commercialisation de l'élevage ovin dans les exploitations des trois vallées pyrénéennes les plus orientales d'Aragon (Espagne). Différents aspects de la filière viande ovine aragonaise sont analysés pour comprendre la conduite des exploitations pyrénéennes. Les flux de bétail, la dynamique des prix et la localisation spatiale des Abattoirs Généraux Frigorifiques sont analysés au niveau régional pour approfondir ensuite l'étude des formes de commercialisation au niveau des exploitations. Nous décrivons les types de produit commercialisé, leur destination géographique, les types de circuit, la saisonnalité des ventes en relation avec le système de production pratiqué.*

Mots-clés : Commercialisation, exploitation ovine, Pyrénées aragonaises, filière viande ovine.

Introduction

Despite its traditional nature and its great dependence on local agricultural resources, the lamb sector has been affected by the considerable changes which meat production systems have undergone over the past few decades and which have been the most significant in the Spanish agro-food sector (SAF) in general.

Pyrenean sheep farm type is characteristic of *depressed mountain areas* and therefore suffers a series of limiting factors both in terms of production and commercialisation. The significant natural patrimony of the area in which they are located has also determined the presence of economic activities and services related to this patrimony which, hypothetically, could lead to new alternatives for production but on occasions compete in the usage of factors (Olaizola, 1991).

Different works (Olaizola *et al.*, 1995; Manrique *et al.*, 1996) have examined the incidence that new agricultural policies (as an important element in the socio-economic environment) have had on these farms, their incidence on income and the role of grants and subsidies. However, it is also important to study the relationships of farms with specific markets (specific agrofood chain) as well as associative forms of organisation, processing and distribution of production and, in the context of farming systems, the possibility of increasing the added value of the end product by means of diversification or quality (quality products, specific denominations or "dénominations d'origine", etc.).

The use of the "agrofood chain" as a methodological instrument for the study of different aspects relating to the way in which lambs are commercialised by Pyrenean farms and the environment in which they are situated is shown to be useful in achieving the objectives which have been set. In effect, the "agrofood chain" study in practice involves identifying products, itineraries, agents, operations and flows as well as analyzing the mechanisms governing them.

The first objective of this study has been to measure the flows of lambs (entries and exits of live animals for slaughter or fattening, origins and destinations) and the volume of slaughters on a global level, i.e. in the whole of Autonomous Community of Aragón. This allowed the area under study to be examined within a regional context.

Another aspect of the lamb agro-food chain which is examined is the evolution of slaughters throughout the year and its relationship with prices. As is already known, the time of the year that animals are commercialised significantly affects the sales price and accordingly the income obtained by farmers. A significant factor in the price of lamb in Aragón and in the rest of Spain is its great variability which is determined by the effects of the foreign market and by factors linked to production and demand (Esteban, 1990). An unequal production throughout the year causes an imbalance in supply and demand which leads to significant variations in price. In general terms the lowest prices coincide with the first half of the year during which production is high and consumption does not absorb the full market supply, whilst during the second half of the year prices reach their highest peak due to the fact that production is not able to satisfy demand.

The problem described has been examined in a part for the Aragonese region in order to determine the fluctuations in lamb production and prices throughout the year as well as to quantify the degree to which slaughters are correlated with price variations. This information has been compared with that supplied by farmers from the area of the Pyrenees under study.

Another objective, again of a general nature, has been to examine, from a spatial point of view, the relationship that the greater or lesser production of lamb in the region's different areas has with quantified variables which are a priori explanatory of said production. In effect, having seen from statistical sources and previous studies that in Aragón the greatest number of sheep farms is found in those areas with the largest agricultural population, which generally coincide with irrigated zones and not with depressed zones as in other areas of the EU, an additional objective was set: that of examining the role played by elements which form part of the first processing stage of the agro-food industry, those most closely linked to lamb production –the slaughterhouses. As is known, in numerous rural areas the agro-food industry is the one that is most closely related to local agricultural resources and its positive influence on this environment derives from the fact that it is able to generate employment and infrastructures and from the modernisation it generally produces in the agricultural sector.

The previous considerations have led to study the factors or causes which influence the location of agro-food industries prior to any in-depth examination of aspects of regional development. In relation to this, if we look at the studies carried out on the location of industries, we find that there is an underlying, constant debate on which areas, production or consumption are most closely linked to the agro-food industry (Nowak and Romanowska, 1981; Rodríguez-Zúñiga et al., 1983; Terrassi, 1985).

The objective of this study has been firstly to show the linkage, in spatial terms, between the first-stage processing industry and the production sector on the one hand, and the consumption sector on the other in order to determine whether or not the present location of the main lamb slaughtering centres responds to that dual structure indicated by certain authors and the role played by other location factors.

After the description of different aspects of the lamb agrofood chain in the region of Aragón (flows of animals, annual oscillations in prices and slaughter numbers, location of slaughterhouses, etc.), the systems used for the commercialisation of lamb in the sample of Pyrenean farms studied have been typified: product commercialised, destination, channel used, time of the year, relationship with production system, etc.

Methodology

In our approach to the study of the agro-food chain for lamb production two spatial areas have been delimited: the three eastern valleys of the Aragonese Pyrenees when considering aspects related to direct commercialisation by mountain sheep farms and the region of Aragón as a whole when examining aspects which go beyond the framework of the farm and which are related to the product's agro-food chain.

The product is lamb and within this denomination Spanish statistics include different commercial types. In Aragón the most important type is the category known as "ternasco" (young light lamb) which accounted for 85.8% of the sales of lambs for slaughter in Aragón in 1990. However, the study also considers the rest of the commercial types because they form part of the range of lamb which is commercialised, although they are not of such importance in quantitative terms.

Different sources of information have been used. Firstly, official statistics have been used to calculate the production of lambs for slaughter using the exact census of breeding animals which is kept by official regional bodies as a base for awarding grants and subsidies. The entries and exits of live animals both for fattening and slaughter have also been calculated. These figures refer both to the national situation (data is available at provincial level) as well as to the flows of animals to and from other countries. Lastly, the volume of animals slaughtered in Aragón is calculated. Data exist per type of animal slaughtered (sucking lambs, "ternasco" or older animals) and per type of slaughterhouse (owned by municipal authorities or private) and with the added spatial factor of "veterinary zone" which includes a small number of points of slaughter.

Other first-hand information has been obtained by questionnaires.

A general questionnaire was prepared for sheep farms. It included a specific section on commercialisation that gave us information on the type of animal commercialised in the sample of Pyrenean farms studied (weight in kilos, age/type, place and date of sale), on the type of agents the farms sell to (butchers, dealers, slaughterhouses...) and the opinion of the farmer with respect to the best markets, weights and times of the year for selling.

For slaughterhouses and butchering facilities, a specific questionnaire was prepared. It has revealed for this type of processing industry, amongst other things, structural aspects, productivity, the volume of animals slaughtered and their origin as well as the industry's opinion on certain issues.

An interview was also carried out with the main sheep cooperative in the region which provided information on aspects of supply, sales, slaughter, butchering, etc., both in relation to this agent and to general agents of the agrofood chain.

The models of Boutonnet (1988) have been used to prepare these questionnaires.

To process and analyse the information collected we have used different statistical methods of differing degrees of complexity but in line with the objectives set in each case:

(i) *Simple correlations* have been used to quantify dependence between the two series of variables which correspond to the number of lambs slaughtered weekly in each one of the Refrigerated General Slaughterhouses (RGS) with the greatest volume of lambs slaughtered in the region and to the prices of the meat markets of Zaragoza and Talavera in the area of the slaughterhouses, the prices of which were used as a reference.

(ii) *Calculation of coefficients of demand elasticity* in relation to the prices for each one of the weeks in which there is a variation in price. It has been measured by the number of animals slaughtered given that this meat does not undergo further industrial processing. This method allowed to measure the sensitivity of demand to price variations. Taking the weekly observations as precise points of reference, mean elasticity or arc elasticity was calculated.

(iii) *Multiple linear regression* has been used to resolve the problem of the location of lamb slaughters (Lebailly and Burny, 1989). This multi-variable analysis technique has been used in many works (Richter, 1969; Streit, 1969) and for similar problems. These methods have permitted us to examine the potential influence of different causal elements such as location factors. They have a clear advantage over the use of different association coefficients and measurements and indeed, over the "shift and share" method in which the behaviour of one single variable is analyzed and, at the most, comparisons are carried out in relative terms (Sanz, 1993).

In our case the choice of slaughter units or points of slaughter as the spatial basis presented us with the problem of the unavailability of data at this level so that a higher aggregation unit was chosen, i.e. the "veterinary zone" which comprises a differing number of slaughter points.

The dependent variable is the amount of meat (measure in t) which was produced in 1993 in the forty nine veterinary zones into which the Autonomous Community of Aragón is divided. The independent variables or those which explain lamb production in each zone were of three types: those related to production ("upstream" in "agrofood chain" terminology); another type which is represented by a single variable which indicates the number of points of slaughter in each zone and lastly a type of variable which refers to the "downstream" part of the agrofood chain, the number of slaughterhouses which are able to send meat outside the municipality (RGS) and the real population (population census of 1991) as an indicator of consumption.

A separate analysis was made of the three provinces of Aragón, allowing a comparative study to be carried out. This approach involves prior knowledge of the differences between the provinces in relation to the aspects analyzed.

The BMDP statistical package was used. Two programmes were applied: BMDP1R and BMDP2R, allowing us to compare the results obtained.

Results and discussion

Global flow diagram

With the global data available (1991) a flow diagram of lamb production in Aragón was prepared (Fig. 1):

(i) *The production of lambs for slaughter in Aragón*. It has been calculated from the 1990 census of breeding sheep (2,425,279 breeding ewes). The production of lambs commercialised from this flock has been estimated to be 0.95 lambs/ewe/year. This coefficient is used in various cooperatives and can be considered to be correct. The number of lambs commercialised would therefore be 2,304,015.

(ii) *Trading balance of lambs*. To the previous figures we have added the number of lambs for slaughter which are brought in from outside Aragón and we have subtracted the number of lambs for slaughter which are sent out of the region. In 1991, according to figures referring to transactions carried out with animals for slaughter, there was a positive balance of 567,050 animals, without taking into account those transactions carried out in the region itself, nor those with the other countries. If we subtract this figure from the previous one the result is 1,736,965 animals for slaughter.

(iii) *Volume of animals slaughtered in Aragón*. In 1991, 1,881,540 lambs of the classes of milk lambs, heavy animals and "ternasco" (light animals) were slaughtered.

(iv) The difference between lambs produced for slaughter and animals which are really slaughtered (144,575 lambs) is relatively small and we consider that this may be due to not having taken into account the export-import balance which, as shown by the figures in thousands of pesetas published by the Official Chamber of Commerce and Industry, is negative in this region. In 1991 the most relevant figure is that of imports of live animals, basically from France, Belgium-Luxembourg and Portugal. Imports of lamb were not very significant in the same year and originated mainly from the United Kingdom.

With regard to the movements of animals for fattening or slaughter at an overall regional level, the trading balance is found to be positive in the case of lambs. Sales are higher than purchases both in the case of animals for slaughter and those for fattening although there is a greater volume of trade in animals for slaughter. In 1991, according to the figures relating to animals for slaughter, there was a positive balance of 567,050 animals as already mentioned, and Teruel was the province with the best balance (44.6%). There were not many transactions which involved animals for fattening in 1991, 22,013 animals of which 66% of the transactions took place in the province of Zaragoza (Table 1).

With respect to the regions with which transactions were carried out and referring only to lambs for slaughter, which represents the largest number, sales vary considerably in terms of geographical destination, according to the province (Table 2). In the case of Huesca, 90% of lambs for slaughter are sent to Catalonia and 9% to the North (Basque Country, Navarre and Rioja), this Aragonese

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                    ┌─────────────────┐
                    │Production of lambs│
                    │ for slaughter in │
                    │     Aragón       │
                    │                  │
                    │  2,304,015 heads │
                    └─────────────────┘
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┌──────────────────┐   ┌──────────────────┐   ┌──────────────────┐
│ Slaughter outside│   │Slaughter in Aragón│   │Lambs for slaughter│
│   Aragón   │   │of animals produced│   │from other regions │
│   │   │ in the region   │   │   │
│ 895,291 heads   │   │ 1,408,724 heads │   │ 328,241 heads   │
└──────────────────┘   └──────────────────┘   └──────────────────┘

┌──────────────────┐   ┌──────────────────┐
│ Total slaughters │   │ Auto-consumption │
│   in Aragón   │◄──────────────────────│and rural consumption│
│   │   │ Export-Import   │
│ 1,881,540 heads │   │ 144,575 heads   │
└──────────────────┘   └──────────────────┘

                    ┌──────────────────┐
                    │   Direct human   │
                    │   consumption   │
                    └──────────────────┘

┌──────────────────┐   ┌──────────────────┐
│   Direct human   │   │   Direct human   │
│   consumption   │   │ consumption in │
│ outside Aragón   │   │   Aragón   │
│ Including exports │   │   │
└──────────────────┘   └──────────────────┘

                                           ┌──────────────────┐
                                           │ Carcasses from │
                                           │ outside Aragón │
                                           │ Including imports │
                                           └──────────────────┘
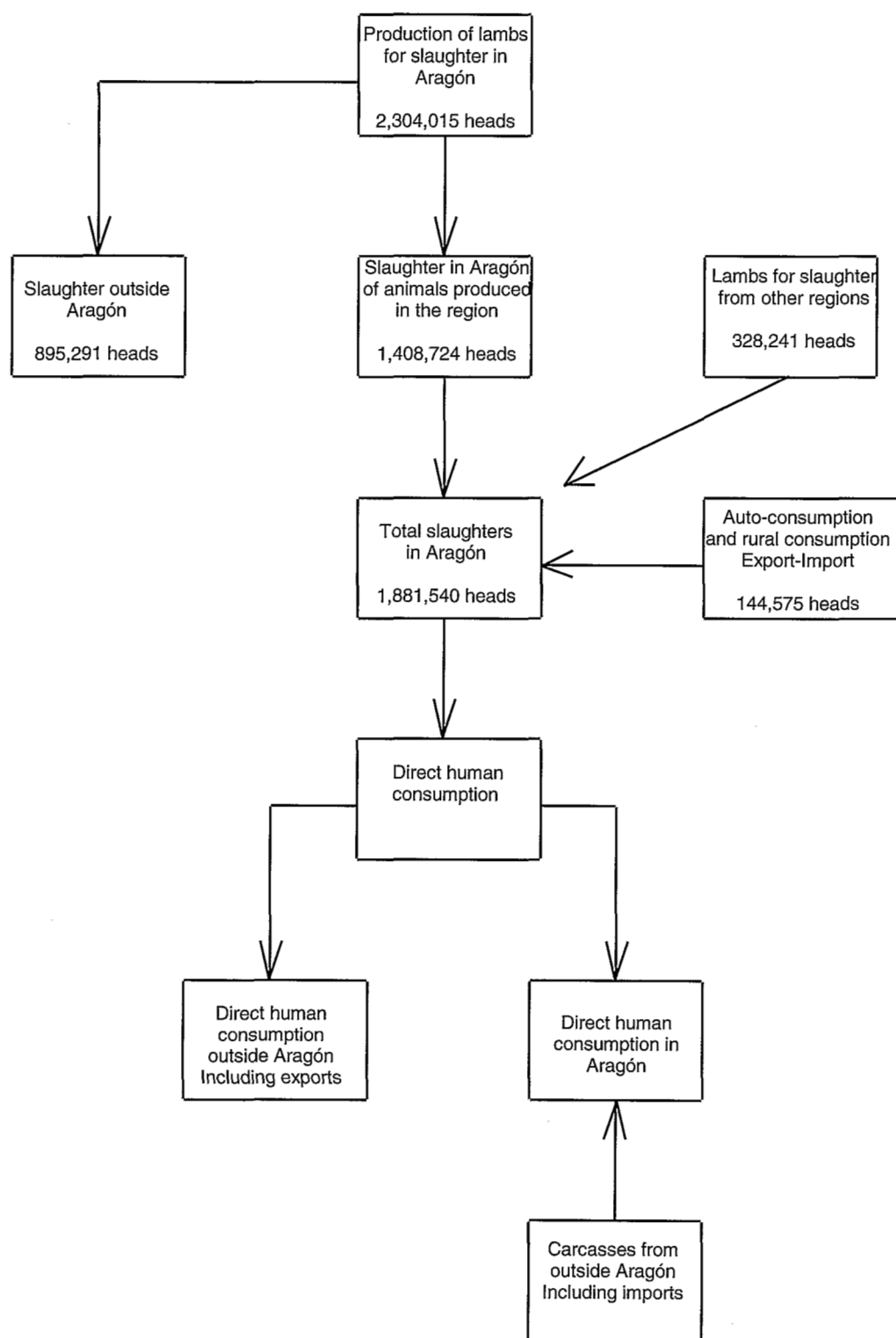
Fig. 1.   Balance of annual flows of lamb in Aragón.

province being the one with the highest concentration of sales. It is important to remember that Huesca has good road connexions with Catalonia, whose market has great consumption potential. Teruel also mainly sells to Catalonia (56.6%); but a large percentage of its sales is also carried out with the south-east of Spain (38.6%). With regards to the province of Zaragoza, its main buyer is also Catalonia (63.7%) but also it also sells to the north of Spain (29%).

Table 1.   Trading balance of lambs[†]

	Slaughter			Fattening		
	Sales	Purchases	Balance	Sales	Purchases	Balance
Huesca	243,305	79,948	+163,357	14,536	15,702	−1,166
Teruel	372,634	119,908	+252,726	56,125	47,589	+8,536
Zaragoza	279,352	128,385	+150,967	31,225	16,582	+14,643
Aragón	895,291	328,241	+567,050	101,886	79,873	+22,013

[†]Source: prepared by authors using data provided by the Agricultural Studies Section, Provincial Office of the Ministry of Agriculture, Fishing and Food (1991)

Table 2.   Destinations of lambs for slaughter (%)[†]

	Huesca	Teruel	Zaragoza
North (Basque Country, Navarre, Rioja)	9.1	1.1	29.1
Catalonia	90.0	56.6	63.7
South-east	0.5	38.6	1.5
Others	0.4	3.6	5.6

[†]Source: prepared by authors using data provided by the Agricultural Studies Section, Provincial Office of the Ministry of Agriculture, Fishing and Food (1991)

When considering purchases of lambs for slaughter there are also differences between each province of Aragón but one constant feature is the greater diversity of supplying provinces (Table 3). In general, without entering the details of the results obtained, the south of the Peninsular is the most important supplier for the provinces of Zaragoza and Teruel.

Table 3.   Source of lambs for slaughter (%)[†]

	Huesca	Teruel	Zaragoza
North (Basque Country, Navarre, Rioja)	5.7	4.0	18.9
Catalonia	49.8	0.3	1.7
Castilla-León	15.3	8.8	7.6
Castilla-Mancha	1.7	27.9	2.8
South (Extremadura, Andalucía)	25.7	53.3	68.9
Others	1.8	5.7	0.0

[†]Source: prepared by authors using data provided by the Agricultural Studies Section, Provincial Office of the Ministry of Agriculture, Fishing and Food (1991)

Seasonal fluctuations in the commercialisation of lamb

The two slaughterhouses studied deal with almost two thirds (62%) of the total number of lambs slaughtered in the RGS of the region (Maza and Manrique, 1994). Calculations of the coefficient of correlation between the fifty two pairs of values which refer to the number of lambs slaughtered in both slaughterhouses, obtained from weekly observations, show that there is a high correlation

(r = 0.675) which surpasses a confidence level of 99%. The same occurs with the series of prices of the meat markets of Zaragoza and Talavera with an even higher correlation coefficient (R = 0.836).

The coefficient of the correlation between the slaughter data of the slaughterhouse in the province of Zaragoza and prices of Zaragoza's meat market has been calculated to find the negative correlation between the two which would indicate a lower demand when prices are high and vice versa (Fig. 2). The negative correlation was found to exist but it was not significant. The same occurs in the case of the other slaughterhouse in the province of Teruel in which the slaughter data is negatively correlated to the prices of the Talavera meat market although, again, not to a significant extent (Fig. 3). A detailed look at the data reveals that December is the month which differs most, undoubtedly due to the fact that consumption of lamb increases over the Christmas period. If the observations for the month of December are disregarded, there is a significant correlation in both slaughterhouses with a 99% level of confidence.
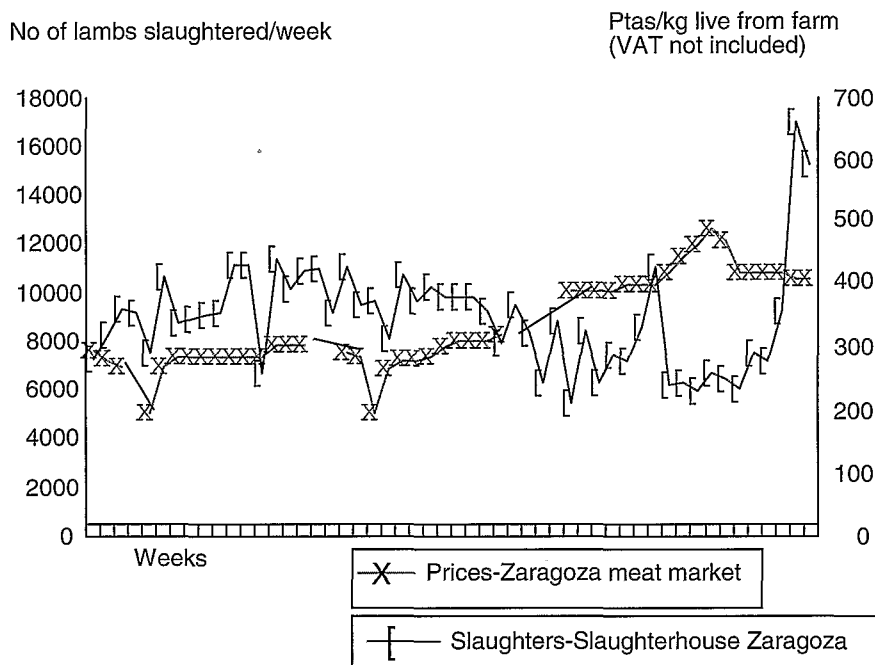

Fig. 2.   Weekly observations of slaughters and prices of lamb in a slaughterhouse in Zaragoza, 1991.

Lastly, we have calculated the coefficients of demand elasticity (measured in slaughters) in relation to the prices for each of the weeks in which there was a variation in price. In the slaughterhouse in Zaragoza two thirds of the values calculated refer to elastic demands, i.e. coefficients higher than one. These coefficients reached very high levels during festive weeks such as Easter, the week of local festivities and Christmas, indicating a large increase in slaughters and price variations. These large increases in slaughters are not, however, necessarily linked to reductions in price. In some cases (e.g. Easter week) the coefficient value is positive. In the slaughterhouse in the province of Teruel the coefficients of elasticity are higher than one in 75% of the cases, thus indicating elastic demands and said values are abnormally high in non-festive periods. This fact, together with the not necessarily negative relationship, would seem to indicate that there is less linkage to the satisfaction of local demand and that this slaughterhouse should be analyzed in the wider context of its connections with other markets, including foreign markets. The private nature of this slaughterhouse and the data obtained in the survey would seem to support this hypothesis.
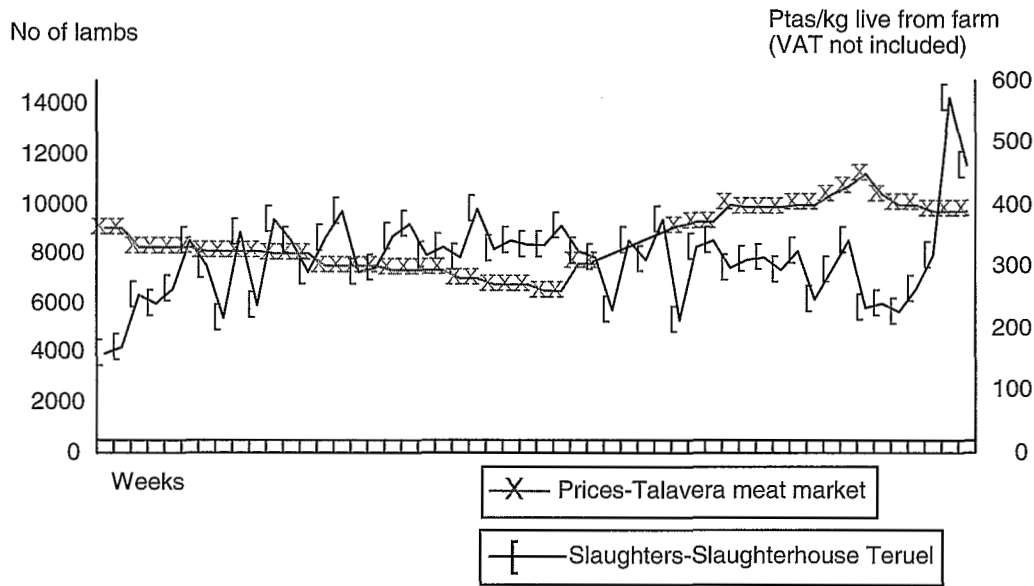
Fig. 3.   Weekly observations of slaughters and prices of lamb in a slaughterhouse in Teruel, 1991.

An analysis of the location factors of lamb slaughterhouses in Aragón

The results obtained point to considerable differences between the three Aragonese provinces which was a fact that was considered as an hypothesis in our initial approach to the problem. It has led to different analyses being carried out.

The Huesca province

The data matrix for the province of Huesca is shown in Table 4. The equation obtained with the first method is as follows:

$$Y = 286.70853 - 0.0145X_2 + 31.0606X_3 + 508.7952X_4 + 0.0216X_5$$

$$(0.0055) \quad (36.3163) \quad (166.1767) \quad (0.0098)$$

$$r^2 = 0.6670$$

The standard errors of regression coefficients are indicated in brackets.

Y = amount of meat (measure in t)
X_2 = number of heads of lambs
X_3 = number of points of slaughter
X_4 = number of slaughterhouses (RGS)
X_5 = population

The coefficient of multiple correlation indicates that 66.7% of the individual differences of Y can be attributed to variations in the explanatory variables chosen and the remaining 33.3% is due to unforeseen causes. The significance test carried out on the regression analysis measured by "F", which in this case is 4.50 for 4 and 9 degrees of freedom, reveals that the analysis is satisfactory with a confidence coefficient of 95%.

The application of "t" test to each of the variables shows that the variables X_2 (number of lambs), X_4 (number of slaughterhouses) and X_5 (population) are significant. The number of RGS which exist in each veterinary zone is that which contributes most in explaining the amount of meat produced, whilst the number of lambs contributes negatively to the explanation. When quantifying the residual values it

was seen that there are two atypical values for case 12 (Binéfar) and case 14 (Fraga) which differ from the mean value once and twice the typical deviation, respectively.

Table 4.   Variables for the province of Huesca[t]

Huesca zones	Lamb produced (t)	Number of heads of lambs	Number of points of slaughter	Number of RGS	Real population
1 Jaca	216.3	69,318	4	1	20,495
2 Sabiñánigo	186.7	27,608	1	0	14,426
3 Broto	26.4	6,819	2	0	
4 Ainsa	110.7	33,691	6	0	
5 Castejón	49.3	39,250	5	0	
6 Huesca	717.9	130,350	13	1	69,456
7 Barbastro	212.3	55,786	7	0	23,719
8 Graus	496.2	37,847	5	1	
9 Benabarre	27.1	29,516	3	0	
10 Sariñena	189.9	71,991	2	1	10,580
11 Tamarite	67.4	33,617	4	0	
12 Binéfar	243.0	36,637	3	1	14,482
13 Monzón	185.1	54,062	1	0	21,377
14 Fraga	1,475.4	30,659	5	1	19,273

[t]Source: prepared by authors using data provided by the Agricultural Studies Section, Provincial Office of the Ministry of Agriculture, Fishing and Food

The application of the second procedure, i.e. step by step, results in similar data to those previously described. The difference lies in that just one variable is chosen, X_4, (number of RGS) with an acceptable value of 6.54. With this variable the following regression equation, accounting for 35.29% of the variance, is obtained:

$$Y = 108.12497 + 448.32501X_4$$

$$(175.2636)$$

None of the three remaining variables have been selected, since in the F test, they do not reach the minimum value required. The residual values reveal that there are two atypical values, one of them is Fraga and the other Sariñena. This procedure is thus found to coincide only partially with the first method.

The Zaragoza province

The data matrix for the province of Zaragoza is shown in Table 5. The following regression equation is obtained by applying the first method:

$$Y = 162.47711 - 0.0040X_2 + 25.2254X_3 + 287.2071X_4 + 0.9289E{-}02X_5$$

$$(0.0013) \quad (14.0969) \quad (88.4518) \quad (0.1952E{-}03)$$

with $r^2 = 0.9960$

The coefficient of multiple correlation indicates that 99.6% of the variance in the amount of lamb produced is accounted for by independent variables. The regression significance test reveals a high value, much higher than the table value for a level of significance of 0.99 from which it can be concluded that significance is very high.

Table 5.   Variables for the province of Zaragoza[†]

Zaragoza zones	Lamb produced (t)	Number of heads of lambs	Number of points of slaughter	Number of RGS	Real population
1 Sos	7.3	19,155	1	0	1,487
2 Ejea	114.9	135,573	6	1	22,570
3 Tauste	159.7	71,161	3	0	13,731
4 Tarazona	643.3	29,683	1	1	14,253
5 Borja	182.1	42,121	3	0	13,533
6 Alagón	247.2	46,837	4	0	16,570
7 Zaragoza	6,129.4	76,235	3	1	636,183
8 Zuera	125.8	44,614	3	0	11,445
9 Alfajarín	35.7	39,296	2	0	6,194
10 Quinto	255.1	70,200	6	0	14,251
11 Bujaraloz	56.0	33,781	1	0	4,019
12 Caspe	212.4	48,774	4	0	4,976
13 Illueca	100.3	17,496	2	0	7,598
14 Almunia	350.5	82,610	7	0	23,323
15 Cariñena	188.0	52,079	7	0	11,048
16 Belchite	127.9	55,124	2	0	5,674
17 Ariza	127.2	41,816	3	0	5,567
18 Calatayud	383.7	54,333	8	0	32,356
19 Daroca	86.7	43,658	1	0	6,724

[†]Source: prepared by authors using data provided by the Agricultural Studies Section, Provincial Office of the Ministry of Agriculture, Fishing and Food

When the t test is applied to the coefficients of the variables it is seen that the X_5 variable (population) is the most significant with considerable differences with respect to the other variables. The variable of number of heads of lamb is also negative in the explanation of the dependent variable in this province too.

If the residual values are observed it can be seen that there are atypical values in which the deviation is once the standard deviation in relation to the mean value in five cases: 1 (Sos), 2 (Ejea), 4 (Tarazona), 13 (Illueca) and 14 (La Alumnia).

The application of the step by step procedure results in the choice of one single variable, X_5, with a force F of 2181.28. With this variable we obtain the following regression equation which accounts for 99.23% of variance:

$$Y = 75.07281 + 0.95206E–02X_5$$

$$(0.2038E–03)$$

From the observation of the residual values it can be seen that there are two atypical cases which are 2 and 4 (the veterinary zones of Ejea and Tarazona).

The Teruel province

The data matrix for the province of Teruel is shown in Table 6. The following regression equation is obtained by applying the first method:

$$Y = –1108.11914 + 0.0322X_2 – 64.4082X_3 + 1142.0245X_4 – 0.0158X_5$$

$$(0.0119)\quad (214.2140)\quad (560.0958)\quad (0.0371)$$

Table 6.   Variables for the province of Teruel[†]

Teruel zones	Lamb produced (t)	Number of heads of lambs	Number of points of slaughter	Number of RGS	Real population
1 Calamocha	6,897.7	120,872	5	2	13,664
2 Muniesa	49.2	54,829	2	0	3,559
3 Bajo Martín	109.5	45,976	2	0	8,169
4 Alcañiz	199.7	16,335	1	0	20,179
5 Valderrobres	122.1	19,601	2	1	8,957
6 Montalbán	66.8	24,412	3	0	7,949
7 Alcorisa	227.7	50,248	5	0	18,095
8 Santa Eulalia	70.5	76,408	2	0	7,158
9 Alfambra	3.0	71,528	0	0	2,999
10 Aliaga	0.7	21,025	0	0	1,385
11 Cantavieja	16.6	24,853	3	0	2,166
12 Albarracín	123.2	64,778	4	0	4,738
13 Teruel	393.2	75,090	3	1	34,220
14 Cedrillas	8.1	30,368	0	0	1,762
15 Mosqueruela	25.6	19,570	1	0	1,260
16 Sarrión	254.1	34,069	6	2	4,604

[†]Source: prepared by authors using data provided by the Agricultural Studies Section, Provincial Office of the Ministry of Agriculture, Fishing and Food

The coefficient of multiple correlation r^2 indicates that 64.12% of the individual differences of Y are explained by the variations in the variables chosen and 35.88% must be attributed to unforseen causes. This value is similar to that obtained for the province of Huesca. The significance test of regression reaches an F value of 4.913 for 4 and 11 degrees of freedom which means that the analysis is satisfactory for a significance level of 95%.

The t test reveals that the variable X_2 (number of heads of lambs) is significant with a degree of significance of 95% and that moreover it contributes with a positive value to accounting for the dependent variable Y (amount of lamb produced). If the residual values are observed it can been seen that there are three atypical cases which have once the standard deviation: zones of Calamocha, Teruel and Sarrión.

With the other procedure similar results are obtained in terms of accounting for the variance and the variables chosen. In the first step the variable X_2 (number of heads of lamb) is accepted with an F value of 12.75. With this variable the following regression equation is obtained:

$$Y = -1357.88623 + 0.04039X_2$$

47.66% of the variance is accounted for in this first step. In the second step the variable X_4 (no. of slaughterhouses) with a force of F = 5.45 is chosen, producing a new regression equation accounting for 63.11% of variance which is very similar to that obtained with the first programme.

$$Y = -1275.44751 + 0.03054X_2 + 1011.47601X_4$$

$$(0.107) \qquad (433.4231)$$

The observation of the residual values also reveals three atypical cases which, as in the previous procedure, are the zones of Calamocha, Teruel and Sarrión.

Discussion

In Huesca most of the RGS are located in zones bordering Catalonia (Fig. 4). Although we do not have quantified information available, surveys carried out on some of the private slaughterhouses of these zones confirm that there are considerable flows of carcasses towards the neighbouring Catalonian provinces.

In the case of Zaragoza, a province in which the concentration of the population accounts for meat production, it is interesting to note that the analysis reveals atypical cases such as the zones of Ejea and Tarazona which are the only points, together with the city of Zaragoza, in which RGS are located (Fig. 5). A similar comment could be made in relation to Teruel where meat production would appear to be accounted for in the province in general by the number of heads of sheep in the census. The atypical cases revealed by the analysis are practically the only zones in which RGS are located: Calamocha, the site of the largest provincial slaughterhouse, Teruel and Sarrión (Fig. 6). In these two provinces the presence of more industrialised slaughterhouses is a factor which has distorted or has meant that the values obtained bear no relation to the general dynamics of slaughters which are accounted for by the factors of population or production.

Commercialisation of lambs on Pyrenean farms

The results refer to a sample of thirty five specialised sheep farms in the eastern valleys of the Aragonese Pyrenees. On these farms a study has been carried out not only on the way their lamb production is commercialised but on many other aspects of the farming system. The results of this study have been used to evaluate the possible incidence which some of the farming system traits (stabling or seasonal migration farming, breeding management, location, etc.) have on commercialisation.

The type of product which is most frequently commercialised by these farms is lambs of 22 to 25 kilos (live weight) and two to three months old. In the valley of Baliera, however, there is a set of farms which regularly sell lambs for fattening. The weight of these lambs varies from approximately 14 to 20 kilos. They are sold to a commercial agent ("live animal dealer") in the area who has fattening facilities which could also be considered as a classifying farm for homogenising the product. This agent has commercial and family links with another agent in Barcelona (probably an "entrador": agent in charge of receiving the animals and their entry in the slaughterhouse) and most or all of these animals are slaughtered in this city. There is another agent who also carries out this classification function (probably an "animal broker") with a farm or fattening installations in Lérida. He sends part of the production to the north of the Peninsula. There are only two farms which breed lambs and classify them, one of them with commercial links with a French municipality.

The commercial channel which is most frequently used by the farmers is selling through "dealers" (in some cases they are really "brokers") in the same area or in the neighbouring province of Lérida or directly to butchers. In the case of the latter, it is usually a small number of lambs which are sold sporadically. The farmer is also the butcher in two cases. As previously mentioned, the term "dealer" also implies that these operators sometimes also carry out other operations such as fattening or classification as well as the formation of lots and the typical purchase and sale operations of this commercial figure.

There are only two farmers who sell directly to a small slaughterhouse nearby. Another two farms in the Broto valley commercialise their production through cooperatives.

The farmers' opinion on the best time of the year for saling the lambs tends to be the same. Most consider that autumn and Christmas are the best periods. Nevertheless, there is a fairly generalised opinion that August is also a good month. The sale of lambs during this month would seem to be out of line with the most frequent breeding operation which consists of separating the rams from the flock from October to December and allowing them back with the ewes in March and April. It has been seen, however, that some farms bring this operation forward to January, and in those which organise lambing in two periods during the year one of the lambing periods takes place in April, May and June so that sales can be carried out in the month of August.
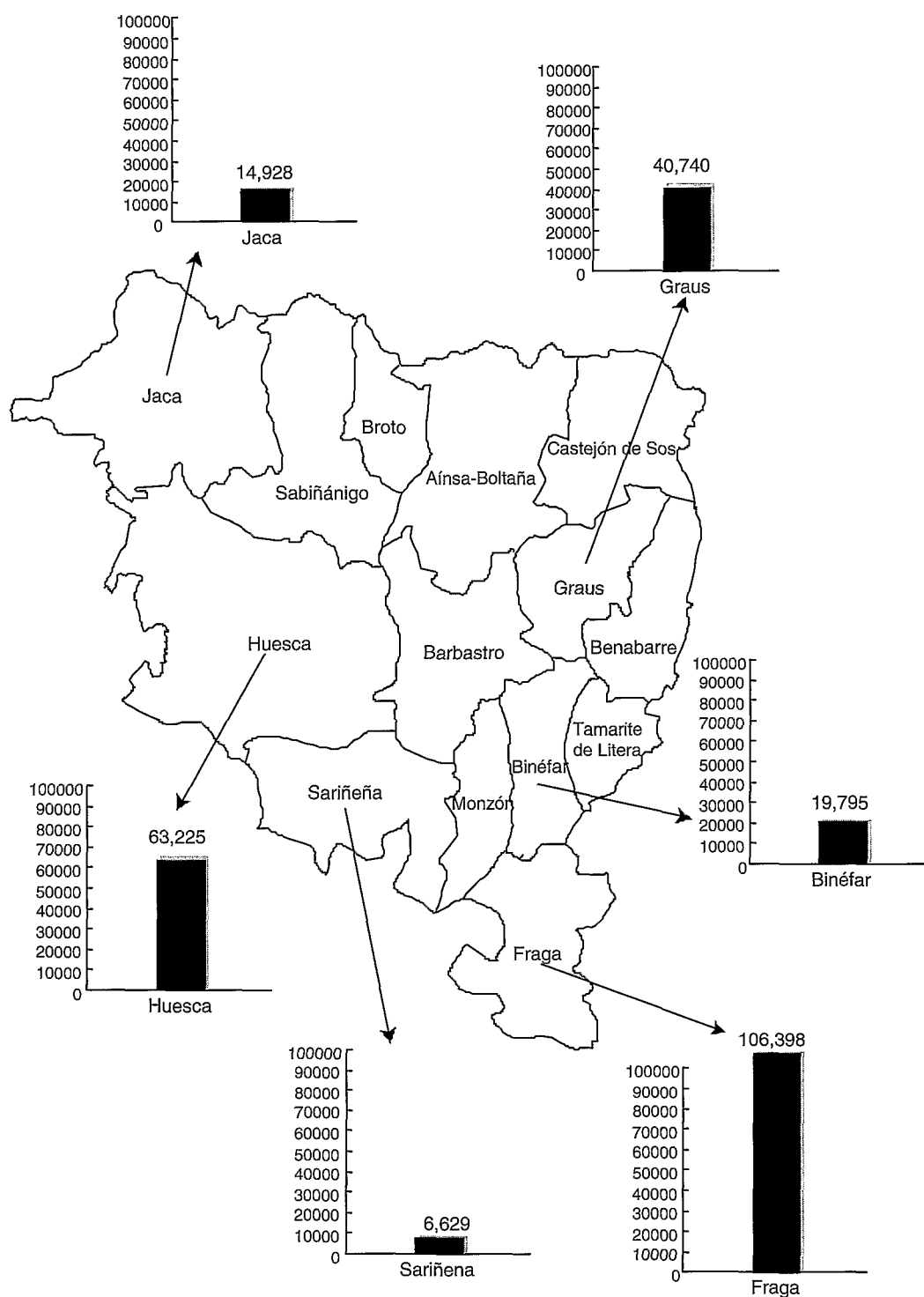
Fig. 4. Refrigerated General Slaughterhouses (RGS) location and volume of slaughters in the Huesca province.
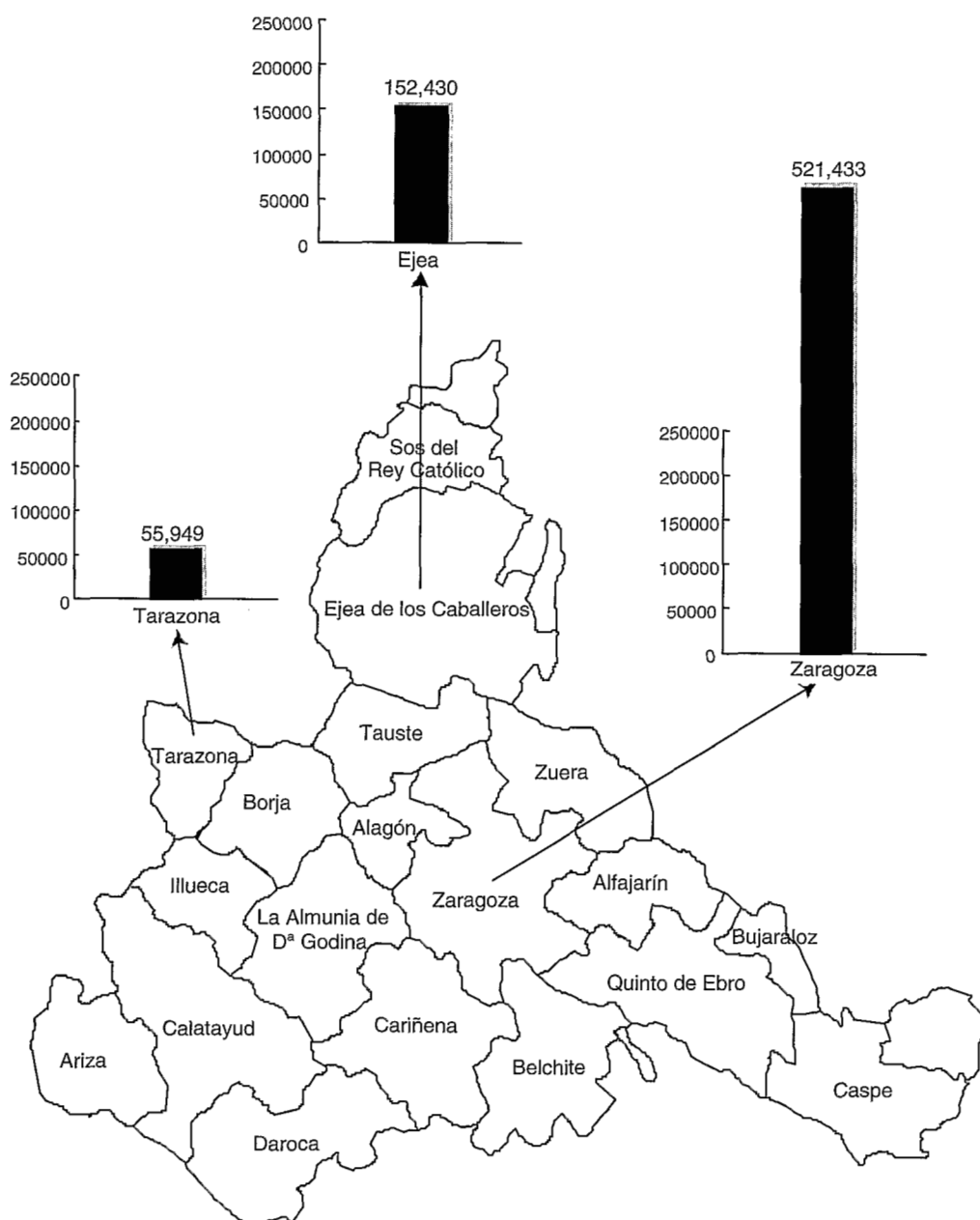
Fig. 5.   RGS location and volume of slaughters in the Zaragoza province.

Breeding management tends to be aimed at ensuring that lambing does not occur during the summer months when the sheep are grazing on the high pastures rather than obtaining lambs at a certain time of the year. With respect to this, better planning of lambing dates could be introduced as the sale date determines the price received by the farmer. However, the farming system used by almost all of the farms which includes summer grazing in high mountain areas, and the practice of seasonal migration practised by many of them affects considerably current breeding management. Another significant fact is that of the six farms which have two lambing seasons a year, five are farms which employ permanent stabling methods.
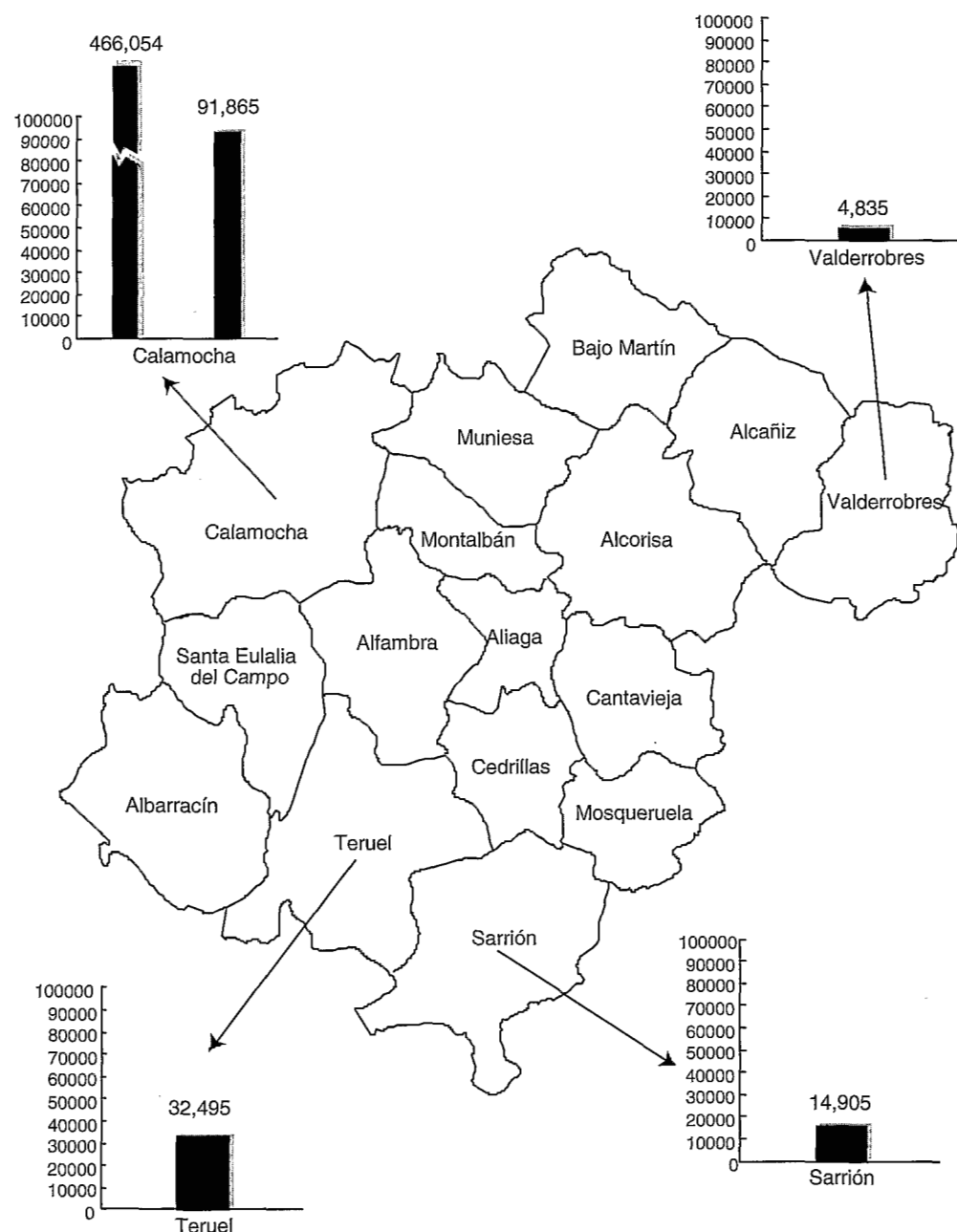
Fig. 6.   RGS location and volume of slaughters in the Teruel province.

Conclusions

From the *global flow diagram* for lamb in the Autonomous Community of Aragón it can be seen that there is a positive trading balance. It means that the region is a net exporter of animals for slaughter. The most frequent destination of the exports is Catalonia. However lambs are exported, to a greater or lesser extent, to other neighbouring regions, especially to the areas where there are concentrations of population in the north and south east.

The region of Aragón is *supplied* with animals for slaughter by a large number of regions but especially by the southern part of the Peninsular.

At the present time the majority of *slaughters* (approximately two thirds of the total number of lambs slaughtered) are carried out by two slaughterhouses in Aragón.

The *demand* for lamb is elastic with a high, significant negative correlation between prices and slaughters. However, at certain times of the year, for example December, the increase in slaughters does not appear to be related to a reduction in prices. This could be accounted for by the festive nature of lamb consumption at the end of the year.

The results previously described indicate that in the province of Huesca the amounts of meat produced in the different zones are influenced by the possibilities to send the meat outside the municipality where the animals are slaughtered. In Zaragoza lamb production is accounted for by the population, whilst Teruel has the particularity of being the province in which there is a greater relationship between meat production and the local sheep census. From the point of view of the location of production, there is a "dual" factor in the sense that in some cases the amount of meat produced is accounted for by the lamb production in the zone and the possibility of sending the meat outside the zone (the case of Teruel) or merely by this second factor (Huesca), whilst in the other case (Zaragoza) production is explained by the existence of a demand by the local population.

The "number of points of slaughter" variable does not explain the amount of meat produced in any of the three provinces which confirms that the greater or lesser number of points of slaughter is related to factors such as habitat dispersion, difficulties in road connections, etc. rather than to the requirements generated by greater production.

According to the division used in the location study, the sample of farms examined fall into the veterinary zones of Broto and Castejón where the absence of RGS means that the existing points of slaughter satisfy local consumption and the rest of the production is commercialised as live animals in the markets of Catalonia and northern Spain.

Pyrenean sheep farms mainly *send* their *production* to the Catalonian region. In the province of Huesca, 90% of the lambs for slaughter being sent to that region.

The *type of product* which farms commercialise is not substantially different from that commercialised by the farms in the rest of the region (lambs weighing 22 to 25 kilos). However, in the highest, most isolated areas (Baliera) the commercialisation of lambs of weights ranging from 14 to 20 kilos for fattening is frequent.

The *basic trading agent* is the "dealer" who often has a classifying-homogenising fattening farm and contacts in markets further afield (Barcelona). There is also an area of activity carried out by "brokers" who work for agents in other locations. The predominance of these agents restricts the business opportunities of the farmers in the zone. Other practices of sale have very little incidence (butcher's, slaughterhouses, farmer-butcher) and are not significant. It is also worth mentioning that associative commercial structures which are widespread in the rest of the region and which provide farmers with greater negotiating power or allow more regular supplies are not well-developed in this area.

The general belief of higher *prices* for lamb in autumn and Christmas are in line with the tendency observed at regional level; nevertheless the farming systems used determine to a large extent the periods when production is commercialised.

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