Analysis of efficiency of pig farms in the Valencian community (Spain)

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Abstract

In recent decades, the livestock sector has been immersed in profound changes due to legislative changes, concerning both its polluting potential. Community, national and regional policies were designed to change the management of these operations, thus affecting both the number of farms and their size. Current legislation addresses multiple aspects of livestock activity, with the control and prevention of pollution primarily in the pig sector. Livestock production of the Valencian Community in Spain is characterized by family farms with high industrialization, and independent of the land factor. The aim of the paper is to analyse the level of efficiency of livestock farms in the CV, from building of representative inputs of existing provisions in the farm. Data Envelopment Analysis (DEA) is used for the accomplishment of this study. The results allow to identify which are the best patterns of behaviour to grow in competitiveness and resource savings.

Keywords: Livestock farms. Efficiency. Data envelopment Analysis.

1. Introduction

The evolution of the Spanish economy has determined the development of pig production. The country has been able to quickly adapt to changes and new demands required

by the sector, ultimately transforming it into the leading livestock sector. Specifically, during 2013, the number of pigs was 25,494,715, representing 51.07% of all livestock. Spain is a country with high pig farming production, although with serious limitations due to the market situation and environmental requirements (Lainez *et al*., 2002). In the European Union (EU), Spain is the second largest producer of pigs, followed by Germany (Eurostat, 2011).

The pig sector is considered highly vertically integrated and industrialised, and it has a high number of associations. The pig sector is closely linked to the processing industry, accounting for approximately 31.34% of Final Livestock Production and 10.7% of Final Agricultural Production, thereby contributing, in both cases, more than 4,213 million euros (Ministerio de Agricultura, Pesca y Alimentación, 2006).

Pig farms have been closely linked to the household economy of rural areas. This importance is reflected in the gastronomic habits of all Spanish communities, where the consumption of meat and its multiple derivatives is part of Spanish cultural heritage. In the Valencian Community (VC), of the four existing species of livestock, pig predominates (Figure 1), representing more than 65% of the total, followed by sheep, with 25%.

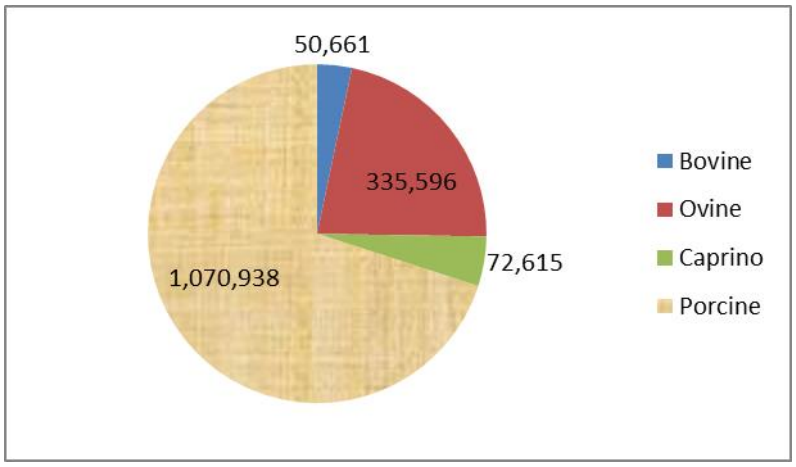

Figure 1: Livestock species distribution in Valencian Community (2013)
Source: Spanish Ministry of Agriculture, Food and Environmen, 2013

In recent decades, the livestock sector has been immersed in profound changes due to legislative changes, concerning both its polluting potential and its contribution to food safety of the products obtained. In this sense, community, national and regional policies were designed to change the management of these operations, thus affecting both the number of farms and their size (number of animals on each farm). Current legislation addresses multiple

aspects of livestock activity, with the control and prevention of pollution primarily in the pig sector being the most important.

Livestock production in the VC is characterised by high industrialisation, with enterprises operating independently from agricultural lands. Thus, universal separation has occurred between the livestock and agriculture sectors. Agricultural and sectorial policies have had different impacts depending on whether the respective geographic areas are more coastal or inland. On the coast, policies have limited agricultural production, and together with the impact of tourism activities and the residential phenomenon, they have superseded the agricultural sector. In inland areas, however, policies have been designed to boost rural communities to preserve the values and potentials of these areas, thus slowing the deterioration of their landscapes and correcting the negative effects they have suffered as a result of activities that do little to respect the environment.

The VC has always been considered a dynamic region in terms of urban and industrial development as well as population growth and agricultural activities (Cendrero *et al*., 1990). Thus, the problems arising from land use have increased, and the social pressure related to issues of environmental protection has also increased (Recatala *et al*., 2000).

In this context, the Autonomous Administration aims to establish a series of changes in livestock production to improve its competitiveness and the increasing incidence of low productivity, particularly in vulnerable areas that depend more on the agriculture sector due to their role in the economy of the VC. The Strategic Plan developed by the Government of Valencia was adjusted to the wellness policy and granted a moratorium of 10 years, which ended in 2013. Thus, time was given to farming operations to adapt to the new minimum requirements on issues related to the protection of animals confined for rearing and fattening. However, this period has meant a loss in competitiveness for farms when compared to producers in other countries, as more free space per pig is required in addition to requirements for stables, isolation conditions, heating, ventilation, equipment and cattle inspection. These requirements have resulted in greater need for space and staff to manage the operation in addition to the investments for upgrading operations.

This new scenario calls for the urgent development of operational, technological and economic measures to revitalise the sector, especially in inland areas, to support income while ensuring sustainable development in compliance with the Valencian Code of Good Agricultural Practices.

An increased competitiveness of farming operations would be possible if management efficiency is improved. The measurement of the efficiency in pig farms in Spain was studied in the Autonomous Community of Aragon by Murúa and Albisu (1993), who concluded that the most efficient farms were those with integrated systems compared to free operations and those producing new human capital. For other livestock species, there have been studies on the efficiency of beef (Iraizoz and Atance, 2004; Castillo, 2006), dairy cattle (González *et al*., 1996; Pardo, 2001; Ribas *et al*., 2006) and pasture (Gaspar *et al*., 2007) systems comparing intensive production systems with extensive systems. Studying the Valencian pig market, Lainez *et al.* (2002) described the commercial relations of pig operations in the VC based on information supplied by 202 farms.

To maintain their activity level, pig businesses should constantly develop programmes that enable them to enhance their efficiency throughout the production process. Following this line of research, the aim of this study was to analyse the efficiency of livestock operations in the VC, particularly for pig, which currently provides the greatest economic weight to the agricultural GDP of the community. By building a representative production function of the inputs on farms, the farms that reach an optimal level of production in the absence of inefficiencies will be determined. Data Envelopment Analysis (DEA) is used for the accomplishment of this study, as this method is backed by a great deal of literature on similar issues (Arzubi *et al*., 2009; Chirinos and Urdaneta, 2007, among others).

The results will help determine standards that facilitate error correction to improve the competitiveness of the sector. The novel contribution of this article is the economic approach to studying pig livestock in the VC by creating variables that are not directly identified by the Agricultural Census. The results obtained will allow identify patterns of behaviour for increasing competitiveness and resource savings.

The article is organised as follows: section 2 describes the livestock sector of the VC; section 3 presents the methodology used in the study for measuring efficiency and explains in detail the construction of the sample describing the variables used; section 4 provides efficiency results; and section 5 summarises the main conclusions of the study.

2. Characterisation of Livestock Operations in the Valencian Community

In the VC, according to the Agrarian Census of the National Statistics Institute, there are currently 3,072 livestock operations, representing a reduction of 47% over the period of

1999 to 2009. These operations are divided into 21 different types, with sheep (21.03%), pigs for fattening (18.8%) and broiler hens (13.74%) among the top types. According to the census data, the pig sector is highly disproportionate in terms of the number of farms engaged in fattening (516) versus breeding (93). This result implies a greater dependence on other regions specialised in breeding pigs of lower age.

Pig livestock in the VC has evolved, with a 28.44% decrease in the number of animals slaughtered between 2003 and 2012 (Figure 2). One of the particular traits of Valencian farms is that they are smallholders, with 54% having less than two hectares, which impedes the growth of farms to a minimum size that would help them benefit from economies of scale (Garcia et al. 2014).

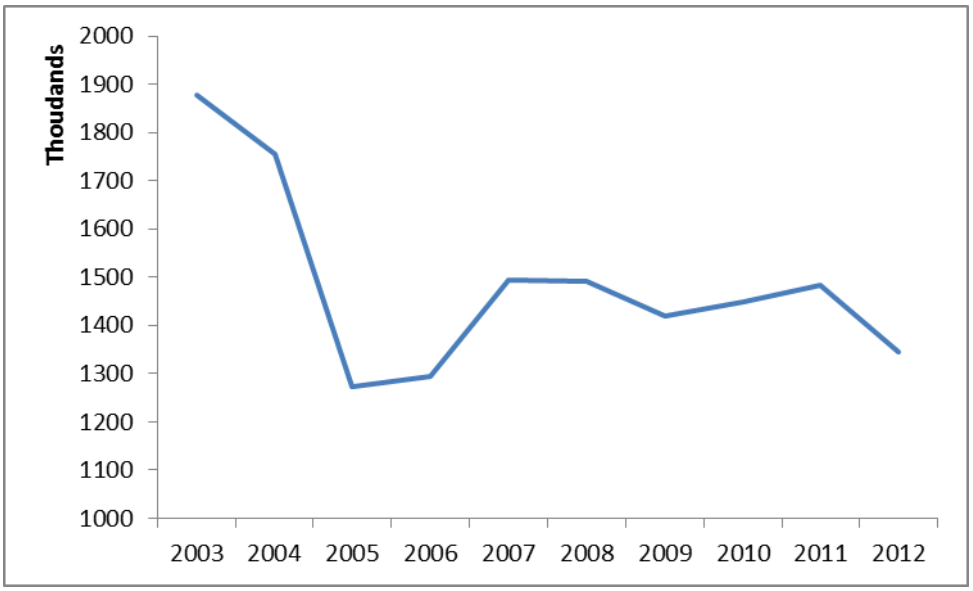

Figure 2: Sacrificed animals the pig sector in Valencian Community (2013)
Source: Compiled from National Institute of Statistics, Livestock Production

Classification of farms in the VC according to Principal Type of Farming (PTF) shows that the most numerous farms are those of sheep, pigs fattening and poultry-meat. Sheep farms are of small size and are intended for subsistence, as more than 93% of sheep farms have less than 100 Livestock Units (LU). Hence, economic research focuses on pig fattening farms, which is the sector with the highest number of farms in the VC and is highly impacted by environmental regulations due to the problems caused by excess swine-manure (De Saavedra, 2010).

Table 1 shows the characteristics and evolution of this type of farming as regards location within the VC, the number of farms, and their production capacity in terms of LU. The figures reveal that in 10 years, no significant changes have taken place as far as the number of farms is concerned. In both cases there is greater concentration in Castellon and Valencia, as there is a very small presence of this type of farming in Alicante. The table also shows that the number of LU has increased significantly, with the greatest increases being in Alicante and Castellon (127% y 33,8% respectively).

Table 1: Distribution of pig farms by province

	1999				2009			
	Nº	%	LU	%	Nº	%	LU	%
Alicante	4	0,8	1.809,5	1,1	8	1,6	4.109,9	2,1
Castellón	305	62,6	102.169,4	64,5	306	59,3	117.144,1	60,4
Valencia	178	36,6	54.330,8	34,3	202	39,1	72.707,1	37,5
VC	487	100	158.309,7	100	516	100	193.961,1	100

Source: The authors from the agricultural Census (1999 y 2009).

These are family-run smallholdings, maintaining a particular trait of the VC, 34.88% of them have less than two hectares, which prevents the growth of farms to a minimum size that would help them benefit from economies of scale (Table 2).

Table 2: Utilised Agricultural Area (UAA) of Pig farms (2009)

UAA (Ha)	AL		CS		VL	
	Nº	%	Nº	%	Nº	%
Less than 2	6	75	97	31,7	77	38,1
2 to 10	2	25	107	35,0	54	26,7
10 to 50	0	0	88	28,8	64	31,7
More than 50	0	0	14	4,6	7	3,5
Total	8	100	306	100	202	100

Note: AL: Alicante; CS: Castellón; VL: Valencia
Source: The authors from the agricultural Census (2009)

The figures also reveal a behavioural difference between the three provinces. Whereas in Valencia and Alicante the greater number of farms use less than 2 Ha. of Utilised Agricultural Area (UAA), in Castellon, the sizes of surface areas are more varied, around a third of them have a UAA of more than 10 ha. This is due to the fact that they are located in areas more towards the interior where lower cost of land allows the farmer to use a greater surface area for livestock farming.

Nevertheless, there is not always a correlation between UAA and production capacity. In Table 3 the farms have been classified according to their production capacity, considering as small those farms which have less than 120 LU, as medium-sized those which have between 120 and 360 LU and large more than 360 LU.

Table 3: Pig farms according to production capacity

	AL		CS		VL		TOTAL	
	Nº	%	Nº	%	Nº	%	Nª	%
Less than 120 LU	2	25	47	15,4	30	14,9	79	15.3
120 to 360 LU	2	25	144	47,1	96	47,5	242	46,9
More than 360 LU	4	50	115	37,6	76	37,6	195	37,8
TOTAL	8	100	306	100	202	100	516	100

Note: AL: Alicante; CS: Castellón; VL: Valencia
Source: The authors from the agricultural Census (2009)

A comparison of Tables 2 and 3 reveals that UAA is not a condition for production capacity in this type of livestock farming. In terms of LU, there is a majority of medium-sized pig farms, however, there is still a significant number of farms whose production capacity remains less than 120 LU. What is more, the greater part of the pig farms with more than 360 LU are not subject to the size of UAA, given that they intensive farms which use little agricultural area. Lastly, it is important to highlight that the management of this production is carried out by the farm manager, which is normally the owner, often a person with no further education studies, managing the farm in person with the help of family members (Table 4).

Table 4: Farm ownership and qualifications of workers in the VC.

	Pig farming		
Ownership (%)	AL	CS	VL
Individual	12,5	84,6	87,6
Registered company	62,5	6,5	6,4
Cooperative	12,5	2,0	1,4
Other types of ownership[1]	12,5	6,9	4,4
Agricultural training (%)	AL	CS	VL
Agrarian experience	75,0	78,8	69,3
Agrarian courses	25,0	18,6	25,7
Professional agrarian studies	0,0	2,6	5,0
University agrarian studies	0,0	0,0	0,0

Note: AL: Alicante; CS: Castellón; VL: Valencia
[1] Included in this group is any other person or entity not included in the other sections: Joint ownership, General partnership etc.
Source: The authors from the agricultural Census (2009)

In most farms in Valencia and Castellon, the owner is a single individual doing the job with the help of family members (84.6-87.6% is family labour input and the other is employed. The employed labour input is mainly part-time (only the 23-25% 25% is full time).

3. Methodology and Sample Description

The Data Envelopment Analysis (DEA) is a nonparametric technique to measure the relative efficiency of homogenous units. This method is used most often in the presence of multiple inputs and outputs to determine which observations are best by comparing each with all possible linear combinations of the variables of the rest of the sample. It is then possible to use these variables to define an empirical production frontier. Thus, the efficiency of each unit analysed is measured as the distance to the frontier.

Following the pioneering work of Farrell (1957), the DEA model was developed by Charnes *et al*. (1978) with the objective of finding the optimal set of weights that maximise the relative efficiency (h_0) of the company evaluated. By defining this efficiency as the ratio between the weighted quotient of outputs and inputs, it is subject to the restriction that no other company can have an efficiency score higher than one using the same weights. Specifically, the original linear programming problem based on the input orientation and with constant returns to scale is as follows:

$$\text{Max}_{u,v} h_0 = \frac{\sum_{r=1}^{s} u_r * y_{ro}}{\sum_{i=1}^{m} v_i * x_{io}} \qquad (1)$$

$$\text{s.a.} \ \frac{\sum_{r=1}^{s} u_r * y_{rj}}{\sum_{i=1}^{m} v_i * x_{ij}} \leq 1$$

$u_r , v_i \geq 0$

where

x_{ij}: amount of input i (i=1,2,…..,m) consumed by the j-th livestock operation

x_{i0}: amount of input i consumed by the livestock operation evaluated

y_{rj}: amount of output r (r= 1,2,…,s) produced by the j-th livestock operation

y_{r0}: amount of output r produced by the livestock operation evaluated

u_r: weights of outputs

v_i: weights of inputs

In this study, however, the dual problem of the linearised model (1) was solved because the number of variables was greater than the restrictions, which involved the limitation of not directly knowing the weights of the inputs and outputs considered.

When using the DEA technique, the choice for the output or input direction depends on the ability of each observation to control the amount of outputs or inputs. Because there are no pig production caps in Spain, the model output was used, which indicates how much output could be obtained with the same level of inputs if inefficiencies do not arise. Other studies have also used this approach (Arzubi and Berbel, 2002; Castillo, 2006; Chirinos and Urdaneta, 2007).

The measure of efficiency falls between the values 0 and 1, and its interpretation is as follows:

- If $h_0=1$, the operation is efficient relative to the others and therefore will be located in the production frontier.
- If $h_0<1$, a different operation is more efficient than the one analysed.

The application of the DEA methodology requires the definition of inputs and outputs that are going to constitute the model. Furthermore, it was necessary to treat the farming operations as an "industry" capable of transforming resources into a final product (outputs).

The database was constructed from microdata provided by the Agricultural Census and the Farm Accountancy National Network (RECAN). The Census is regularly conducted by the National Statistics Institute (NSI) through a process of surveys on production methods in farming operations. Given the complexity of the census, it is always published with a certain lag. Thus, the latest information available is from 2009.

The RECAN is from Ministry of Agriculture, Food and Environment (MAGRAMA, 2015), which uses a sampling system to conduct surveys each year for gathering accounting data from farms and to monitor the operating output of the agricultural activities. Clearly, it is not possible to cover all farms, which is why they devote great effort to ensure that the analysed sample is representative of the overall universe considering the region, size and type of operation. It is an effective tool for assessing the impact of measures taken under the treaties of the Common Agricultural Policy (Dono *et al*., 2013). The accounting principles of The Farm Accountancy Data Network (FADN) have been used, in order to be comparable with the other countries of the European Union (EU), and to provide harmonized data from all European countries.

The opacity of the value of some variables considered in this study required making direct inquiries to obtain them. Specifically, information on pig fattening operations in the VC was requested after verifying that the number of operations in the survey sample was representative of the entire community.

Thus, it was possible to construct a sample of 516 pig fattening farms, all registered in the Agricultural Census of the VC. From this database the farms with the most representative economic size classes (ES) were selected, leaving 457 pig farms. Total Standard Output (TSO) was taken as the only output and was identified as the gross monetary value (euros) of pig at the operation exit price. The variables that define the inputs covered the aspects inherent to pig production as follows:

- Utilised Agricultural Area (UAA): Area in hectares of land for permanent pasture and arable land (arable crops, fallow land, kitchen gardens and land devoted to woody crops).
- Total Labor Input (TLIs): Total labor input of holding expressed in annual work unit (full-time person equivent). One TLI equals the work performed by a full-time worker over one year (i.e., 1,826 hours/year).
- Livestock Unit (LU): LU is equivalent to one head of cattle and is calculated by multiplying the number of cattle by a weighting factor depending on the species and type of animal. Following the recommendations of EUROSTAT for pigs for fattening, the weighting was set at 0.3.
- Specific costs of pig operations in euros (SC): Feed cost for grazing Livestock and other livestock specific costs (veterinary fees and reproduction costs, costs incurred in the market preparation, storage, marketing of livestock products, etc).
- Overheads linked to productive activity in euros :
    - Current Cost. (CC): Costs of current upkeep of equipment and purchase of minor equipment, cars expenses, current upkeep of buildings and land improvements, and buildings insurance. Major repairs, which increase the value of buildings and machinery, are considered investments.
    - Energy Cost (EC): Value in euros of consumption of fuels and lubricants for engines as well as electricity and fuel for heating.
    - Other Direct Costs (DCs): Costs in euros of water consumption, insurance (except for buildings and accidents at work) and other farming overheads (accountants' fees, telephone charges, etc.).

- Depreciation (D): Depreciation of capital assets estimated at replacement value over the accounting year, determined from the "replacement value" at the end of the plantation year of permanent crops, operation buildings, land improvements, machinery and equipment.
- External factors (W): Costs linked to remuneration of inputs (work, land and capital) which are not the property of the holder.

Table 5 shows the main statistics of the variables that make up the database used in the empirical analysis. There is a wide and varied spectrum, ranging from small farms with very limited production to farms with an output of more than 700 thousand euros, thus leading to a high standard deviation of all the variables. This is one of the fundamental characteristics of farms in the VC, which shows the sample to be representative of the reality of the farms in this region. The average operation reached a production of approximately 251,099.27 euros, the operations had 2.03 ha of UAA, used 1.06 TLI and had approximately 271 LU, thereby meeting the smallholder description for Valencian farms.

Table 5: Principal statistics concerning outputs and input in pig farming (euros)

Variables		Maximum	Minimum	Average	Standard Deviation
Output	Total Standard Output (TSO)	745.155,63	102.850,00	251.099,27	142.823,27
Inputs	Utilised Agricultural Area (UAA)	331,92	0,01	2,03	27,41
	Total labor input (TLIs)	7,26	0,004	1,06	0,75
	Livestock units (LU)	1.035,00	13,50	271,70	210,44
	Specific costs (SC)	487.654,64	6.539,54	138192,70	109.433,60
	Current cost (CC)	1.816,95	0,01	11,30	617,42
	Energy cost (EC)	7.407,26	123,39	2.486,42	1.810,81
	Other direct cost (DCs)	6.663,10	145,21	2.563,38	1.458,52
	Depreciation (D)	12.348,68	330,19	5.470,28	2.785,40
	External factors (W)	4.840,80	9,72	495,30	1.578,54

The TSO, UAA, LU and TLI variables were obtained from Agricultural Census microdata for each operation, and the other data were obtained from the FADN. However, the latter data were published according to the Economic Size (ES) classes of farms grouped according to their TSO. Therefore, it was necessary to harmonise both bases to create a homogeneous group so that all variables could be assigned to each farm. Table 6 shows the classification of farms in the VC.

Table 6: Grouping of farms into economic size (ES) classes according to TSO

Groups (ES)	TSO
1	2000 – 7.999 EUR
2	8.000 – 24.999 EUR
3	25.000 – 49.999 EUR
4	50.000 – 99.999 EUR
5	100.000 – 499.999 EUR
6	+ 500.000 EUR

Source: FADN

This information made it possible to calculate all the variables relating to costs as belonging to one or another ES, thus determining the cost per livestock unit (Equation 2).

$$LU\ Cost_{ij} = \frac{cost_{ij}}{LU_j} \quad (2)$$

where:

$cost_{ij}$: inputs concerning to expediture i of the farm j

LU_j: livestock unit of the farm j

Similarly, each farm TSO provided by the Agricultural Census was classified following the TSO established by the RECAN (Table 5), thus providing the extrapolation of the results of equation 2 by knowing the output of each farm. Finally, after the allocation by economic size and aiming to obtain each of the variables by farms, the $LU\ Cost_{ij}$ were again multiplied by their corresponding LU.

As occurs in other studies in the field of livestock (Castillo 2006; Ribas et al. 2006; Chirinos and Urdaneta 2007), the concept of efficiency one hopes to quantify is not strictly technical efficiency because running cost is an input expressed in monetary terms. Therefore, the efficiency will be a type of hybrid efficiency similar to the concept of technical efficiency but without being allocative given that no relative price of inputs is included due to the difficulty of obtaining it in this field.

4. Efficiency Results

The efficiency results of each pig farm represented an indicator of good/bad management performed at a particular time. However, the level of efficiency obtained for each farm was relative, as it was conditioned by the other units in the sample that it was compared with. This study measured the efficiency of pig farms in the VC using a sample of

457 observations, which were all within their respective category, representing a homogeneous group in terms of their production process.

Table 7: Efficiency results of farms

	Farms total	Efficient Farms	Standard D.	Mean Efficiency	Minimun Efficiency
Al	5	0	0.2	0.6	0.102
CS	269	16 (6.03%)	0.25	0.53	0.092
VL	183	8 (4.35%)	0.24	0.54	0.092

Table 7 shows that in the VC the number of farms on the production possibility frontier is worryingly low, only 4.6% of them from the entire sample. Farms need to improve the management of their inputs in order to increase production. Although the situation is worrying in each of the provinces, in Alicante if possible, it is even worse where none of the farms were found to be efficient. However, the figures reveal that this is the province where average efficiency is highest (0.6), the farms of Alicante are the nearest to the frontier, this means that with the same inputs they could increase production by 40%, a figure which would be even higher in Castellon and Valencia.

Overall, 24 farms were found to be efficient. To identify a behaviour profile of these farms, it is necessary to know which characteristics they have regarding their legal status and training of staff (Table 8).

Table 8: Qualitative characteristics of efficient pig farms

Legal Status	%
Individual Person	73.6
Corporation	15.78
Cooperative Society	2.6
Other legal condition[1]	7.89
Agricultural training	**%**
Agricultural experience	81.57
Agricultural courses	15.78
Agricultural professional studies	2.63
Agricultural university studies	0

[1] Included in this section any other legal entity not classified in the previous sections: Community Property, Civil Society, etc.
Source: Own elaboration

Overall, the most efficient farms were established by unskilled individuals (Table 8). The heads of the operation used their own experience to set up the business, thereby achieving efficiency in production.

It is also worth determining the variables related to efficiency by analysing the inputs of farms showing a higher/lower level of efficiency, that is, their profile. The efficiency variable was categorised into two groups according whether its value was greater/less than 0.7, and the nonparametric Kruskal-Wallis test was used to identify differences between quantitative variables of both groups (Table 9).

Table 9: Efficiency and characteristics of pig farms

	Mean Value	Eff < 70%	Eff > 70%	Chi-square	p-value
No. Farms (totals obsv.)	457	328	129		
Utilised Agricultural Area	12.8	11.4	16.4	0.157	0.692
Total labor input	1.3	1.2	1.5	12.169	0.000
Livestock units	360.7	293.6	531.4	55.376	0.000
Specific costs	185,887.1	152,914.2	269,725.4	55.337	0.000
Current cost	569.0	423.8	938.0	35.649	0.000
Energy cost	3,213.9	2,939.9	3,910.5	20.569	0.000
Other direct cost	3,137.7	2,819.2	3,947.5	49.681	0.000
Depreciation	6,570.7	6,066.5	7,852.8	45.852	0.000
Contract work	1,472.6	1,224.3	2,103.9	26.135	0.000

Source: Own elaboration

The chi-square statistic from the Kruskal-Wallis test was significant for all inputs, indicating that the compared populations were significantly different according to the criteria of each of the inputs, except for UAA, that is to say, there was no difference in agricultural area between the levels of efficiency analysed.

In addition, the most efficient are larger farms whose production requires a higher volume of inputs. However, only a small number of them attain the maximum level of efficiency. It is necessary for them to continue working on unifying farms which will allow them to take advantage of economies of scale, and, on achieving better management of their inputs thus increasing their output

5. Conclusions

Livestock in the VC has been transformed in recent decades due to changes generated by regional and agricultural policies at the European, national or regional levels. Currently, the livestock sector is a key element for sustaining the population in the Valencian countryside due to the qualitative and quantitative significance it holds in overall economic activity.

The study of efficiency of pig fattening farms, which is the primary livestock species of the VC, revealed that none of the provinces in the community reached the desired levels of efficiency. This low productivity was more acute in the most vulnerable areas, such as Alicante and Valencia, where this activity is so important that it constitutes the primary support mechanism for the rural population.

A thorough restructuring of the farms is required through better utilisation of its productive factors. The legal-administrative profile of efficient farms is fragile. The individuals with experience but without academic training in the sector are unable to transfer the advantages offered by the farmer group synergies that are characteristic of cooperative societies to production. Furthermore, it is increasingly necessary to train a workforce that leads to the use of more advanced processes that meet the needs of higher productivity, thereby improving the suitability of the sector. It is necessary for workers to be motivated with sufficient technical knowledge to perform tasks belonging to pig operations.

In quantitative terms, this study revealed that it is necessary to reduce the running costs of farming operations. The smallholder farms characteristic of the VC support a significant amount of costs that would be difficult to transfer to the selling price of its product without losing competitiveness. Agricultural policies aimed at this sector should promote the efficient use of available resources, which in some cases could happen by grouping pig farms into cooperatives or by increasing the size of farms.

Therefore, it could be argued that a personnel policy regarding the organisation of work leads to greater staff involvement in the production and economic performance of farming operations.

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