Hayvancılık Araştırma Dergisi (2006) 16, 1: 1–7

EFFICIENCY in AGRICULTURAL FARMS INVOLVING CATTLE FATTENING: A CASE of KONYA PROVINCE, TURKEY*

Arzu KAN[1*] **Mithat DİREK[1]**

Sığır besiciliğine yer veren tarım işletmelerinde etkinlik; Konya ili örneği

ÖZET

Hayvancılığın geliştirilmesi aşamalarından biri de işletmelerin optimal ölçekte, uygun girdi bileşimlerinin etkin olarak kullanılmasıdır. Bu araştırma ile besicilik faaliyetinin yoğun olarak yapıldığı Konya ili Merkez ilçesinde sığır besiciliği faaliyetine yer veren tarım işletmelerinin etkinlik ölçümü ve analizlerinin yapılması amaçlandı. Bu şekilde herhangi bir girdi bileşimi kullanarak en çok çıktıyı üretmelerindeki teknik etkinlikleri ve uygun ölçekte üretim yapmalarındaki başarılarını gösteren ölçek etkinlikleri hesaplandı. İşletmeler mevcut besi hayvanı sayılarına göre 3 farklı tabakaya (10–25, 26–50, 51 ve üzeri) ayrıldı ve analizler tabakalara göre yapıldı. Konya ili merkez ilçelerinde sığır besiciliğine yer veren 51 işletme ile yapılan çalışma sonucunda 21 işletmenin ölçeğe göre artan getiride, 22 işletmenin ise ölçeğe göre azalan getiride faaliyette olduğu hesaplandı.

ANAHTAR KELİMELER: Sığır besiciliği, etkinlik, veri zarflama yöntemi

SUMMARY

One of the stages in developing cattle fattening is the effective use of appropriate input compounds of companies at optimum scale. The objective of this study was to analyze the efficiency measures of cattle fattening enterprise in a central distinct of Konya where feeding activities take place intensively. Thus, scale efficiency which refers to producing in appropriate scale and technical efficiency referring the performance of the holdings in producing most outputs by using any input compounds was calculated. Farms were divided into 3 scales (10–25 heads, 26–50 heads, 51 heads and above) according to the numbers of beef cattle they had and all analyses were done in respect of those 3 scales. According to the results, out of 51 farms, 21 farms were in increasing return to scale whereas 22 farms were in decreasing return to scale were calculated.

KEY WORDS: Cattle fattening, efficiency, data envelope analyses

INTRODUCTION

The stock-breeding, which is an impulse of agricultural economics in developed countries, is of ultimate importance for two reasons. One is to create employment opportunities with a lower cost and the other is to transform food supplies in poor quality and improper to human feeding into quality human foods.

According to 2001 Agricultural Survey Data of TURKSTAT, the number of agricultural holdings was specified as 3.075.516 in agricultural sector. Of these holdings; 67.42% accounted for the ones involving both plant and livestock production while 30.22% were the ones involving only plant production and 2.30% were only in livestock production. The 69.89% of total animals were goat/sheep and 10,81% were cattle in where both plant and livestock production took place altogether (TUIK 2004).

The cattle fattening is such a sector improving national economics, making the greatest supplementary budgets to per unit investments and providing some employment opportunities with the lowest cost. According to 2002 data, the economically active population was 23.8 million

*The data were gathered from Arzu KAN's Master Thesis "The Economical Analysis of Beef-Cattle Fattening Farms in Konya Province" (Konya İli Merkez İlçelerindeki Sığır Besiciliğine Yer Veren Tarım İşletmelerinin Ekonomik Analizi)

1:Selcuk University, Agriculture Faculty, Department of Agricultural Economics, KONYA/TURKEY
E-mail: akan@selcuk.edu.tr

people in Turkey. About 21.4 millions of current productive efforts has been employed whereas 2.5 million people were still unemployed (TUİK 2003). Therefore, unemployment is one of the major problems in Turkey. Today, minimally 80.000 $ investment is required for any individual employment while one-fifth of this amount is enough in stock-breeding. With the same amount of investment, it has been achieved to create job opportunities for people five times more than that of industrial portion (Kutlu et all. 2003).

The most important part of unstable nutrition is the inadequacy of animal food production in Turkey. First of all, there has been retrogression at animal numbers in Turkey other than world's improvement. Although the animal numbers in Turkey have slightly been decreasing, Turkey is the second in Europe and the sixth in the world as with respect to numbers of cattle and goat/sheep (http://faostat.fao.org).

One of the stages in developing cattle fattening is also the effective use of appropriate input compounds of companies and the companies own at optimum scale. This study investigates the efficiency measures and analysis of agricultural holdings involving cattle breeding in a central distinct of Konya where feeding activities take place intensively. Thus, to satisfy these objectives, we calculated scale efficiency referring to producing in appropriate scale and technical efficiency referring the performance of the holdings in producing most outputs by using any input compounds.

MATERIALS and METHODS

The main material of this study was composed of data from agricultural holdings supplied by 2003-2004 cattle breeding period. According to Neyman method, the equation for determining number of samples can be formulated as follows (Yamane, 1967);

$$n = \frac{N\sum (N_h S_h)^2}{N^2 D^2 + \sum N_h S^2{}_h}$$

Where "n" represents sample numbers, "N" plant numbers in main heap, "N_h" plant numbers at "h" level rank and "S_h^2" the variance of "h" level rank. D^2 is equal to $d^2 \backslash Z^2$ where "d" is error amount tolerated in heap average and "Z" shows the Z values at Standard normal distribution table according to the determined error amount. To determine the sample volume, it was studied at the ranges of 95% reliability and 5% error tolerance.

Thus the sample volume consists of 3 scales. These include the first scale which refers to 14 agricultural holdings involving cattle breeding with 10–25 animals, the second scale which refers to 19 agricultural holdings involving cattle breeding with 25–50 animals and the third scale which refers to 18 agricultural holdings involving cattle breeding with 51 and more animals.

The structure and general characteristics of farms in the area were given in Table 1.

In calculation of holding activity values, Data Envelopment Analysis (DEA) was used DEA has been applied to assessing the activities of certain production units. DEA is a strong method used for determining the recent commonly active frontiers. In order to estimate the relative activity of production units, linear programming procedures have been used to constitute a non-parametric frontier. Effective production frontier is constituted with the help from all the observation included into sample whether effective or not and effectiveness (activity) of each production units is calculated according to that frontier. The frontier of effective units also indicates the aims which are expected from other units.

For one output and several inputs, using the Cobb-Douglas function for measuring efficiency scores is a well-known method. The contribution of the DEA is in dealing with multiple outputs and multiple inputs. The Cobb-Douglas method finds a production function for each output and for the same inputs separately, and afterwards aggregates all the production functions into one. The DEA method finds one production function for all the outputs and inputs. The advantages of the methods are to rank all the units on one scale according to their common weights and to find the degree of homogeneity of the whole sample and its Return-to-Scale (Yossi and Lea 2005).

The first DEA model, which was suggested by Charnes et all. (1978), is called as CCR representing the first letters of its authors. This model is based upon the constant return to scale hypothesis.

Banker et all. (1984) developed DEA model based on the constant return to scale hypothesis considering the variable return and so the model is known as BCC (Banker, Charnes and Cooper). In case of that all production units does'nt act by optimal scale, the application of term "Constant Return to Scale (CRS)" result in a technical activity measurement intervened with the scale activity. Therefore, the application of term "Variable Return to Scale (VRS)" allows to calculate technical activity isolated from the influences of scale activity.

When the technical activity value of CRS is different from that of VRS in a certain production unit, this will become the indication of production unit without scale activity. Depending upon that fact, the scale activity can be explained as (Miran and Günden 2001):

Total Technical Efficiency=Net Technical Efficiency x Scale Efficiency

$TE_{CRS} = TE_{VRS} \times SE$

Regarding to aim, $N1\lambda = 1$ convexity restriction will be included to the linear programming problem of CRS:

$\min_{\theta\lambda}\theta$,

st.-$y_i+Y\lambda\geq0$,
$\theta x_i - X\lambda\geq0$,
$N1'\lambda=1$
$\lambda\geq0$,

Where θ represents a scaler and λ does a Nx1 constant vectors. The resulting value, which indicates the activity value of "i" production unit, will be between 0 and 1. If θ is equal to 1, then it shows that the production unit will be on the frontier and according to Farrell (1957)'s definition, it has the technical activity (Miran and Günden 2001). In non-effective units, θ value will be lower than 1.

The technical and scale activity in the VRS hypothesis was calculated by DEA using DEAP computer program (Coelli 1996). DEA model activity values were calculated considering the following variables (Coelli 1996).:

Y_1 : Live weight increase at the end of fattening (kg/per livestock animal (PLA))
X_1: Production effort (hours/PLA)
X_2: Concentrated (Kg/PLA)
X_3: Roughage (Kg/PLA)
X_4: Cost of vet&drug ($/PLA)
X_5: Cost of electricity water and cleaning ($/PLA)

Besides, weight loss per live cattle in terms of amount (kg) and percentage (%) can be calculated as follows:

$$Weight\ loss\ per\ live\ cattle\,(kg) = \mathrm{Re}alised\ weight\ gain\,(kg) - Ideal\ weight\ gain\,(kg)$$

$$Weight\ loss\ per\ live\ cattle\,(\%) = \frac{Live\ weight\ after\ fattening\,(kg)}{Available\ weight\ gain\,(kg) - Ideal\ weight\ gain\,(kg)} x100$$

To investigate the difference among various holding sizes with respect to technical activity (VRS), net technical activity (CRS) and scale activity values; variance analysis were applied where provided normal distribution and homogeneity of variances hypothesis. Moreover, in case of not providing those hypotheses, a non-parametric test, Kruskall-Wallis test were applied (Alpar 2001).

RESULTS

Data obtained from questionnaire results with agricultural holdings involving cattle fattening in Central Distinct of Konya were classified to various holding size groups according to breeding animals ranging 10–25, 26–50 and 50 and more. Technical activity, net activity and scale activity of all the holdings belonging to each size groups were calculated. The non-activity of a holding which is not technically- effective can be resulted from either being unable to produce at appropriate scale or insufficient production sources resulted from managerial disorders (Table 2).

The summary of data gathered through questionnaire which applied to some holding involving cattle fattening is presented in Table 1. Results showed that the small-sized holdings hold animals at a short breeding period and carry out a denser feeding than the big-sized holdings do. Increase in PLA live weight gain was 244.14 kg/animal, 250.68 kg/animal and 255.57 kg/animal at 10–25, 26–50 and 51 and more, respectively (Table 1).

Table 1. General characteristics of sample farms

	Small scaled farms (10-25 animals)	Medium scaled farms (26-50 animals)	Large scaled farms (>51 animals)	All farms
Average livestock animal numbers	18.64	37.26	102.06	55.02
Average breeding period (Day)	236.43	262.90	280.28	261.77
PLA concentrated (kg/day)	8.15	8.11	8.03	8.09
PLA roughage (kg/day)	8.29	7.53	7.59	7.76
Veterinarian animal health costs ($/PLA)	33.39	22.65	22.40	26.15
Cost of water-electricity and cleaning ($/PLA)	10.35	8.95	9.55	9.62
Production effort (hour/PLA)	97.38	70.13	44.20	70.57
Live weight gain (kg/PLA)	244.14	250.68	269.61	255.57

Table 2. Activity measures of agricultural holdings involving cattle breeding compared to their size groups

10-25 heads				
Farm number	CRS[1]	VRS[2]	Scale efficiency	The Side of Scale
1	0.783	0.863	0.907	irs[3]
2	0.625	0.743	0.841	drs[4]
3	0.877	0.943	0.929	irs
4	0.784	0.913	0.858	irs
5	0.522	0.685	0.762	drs
6	0.456	0.696	0.655	drs
7	1.000	1.000	1.000	-
8	0.814	0.825	0.986	drs
9	0.826	0.829	0.997	irs
10	0.543	0.691	0.786	drs
11	0.707	0.762	0.928	irs
12	0.742	0.775	0.956	irs
13	0.686	0.861	0.797	drs
14	0.600	0.686	0.874	drs
Average	**0.712**	**0.805**	**0.877**	

25-50 heads				
Farm number	CRS	VRS	Scale efficiency	The Side of Scale
15	0.716	1.000	0.716	irs
16	0.904	1.000	0.904	irs
17	0.678	0.728	0.932	drs
18	0.921	0.932	0.988	irs
19	0.663	0.672	0.986	irs
20	0.548	0.651	0.842	drs
21	0.571	0.686	0.832	drs
22	0.898	1.000	0.898	irs
23	1.000	1.000	1.000	-
24	0.643	0.697	0.922	drs
25	0.706	1.000	0.706	drs
26	0.699	0.805	0.868	drs
27	0.510	0.576	0.885	irs
28	1.000	1.000	1.000	-
29	0.315	0.536	0.588	drs
30	0.700	0.955	0.733	drs
31	0.551	0.559	0.985	irs
32	0.759	1.000	0.759	irs
33	0.693	0.707	0.980	irs
Average	**0.709**	**0.816**	**0.870**	

50 heads-+				
Farm number	CRS	VRS	Scale efficiency	The Side of Scale
34	0.910	0.928	0.980	drs
35	0.598	0.628	0.951	drs
36	0.836	0.917	0.911	irs
37	1.000	1.000	1.000	-
38	0.512	0.556	0.921	drs
39	0.891	0.898	0.991	drs
40	0.726	0.727	1.000	-
41	0.616	0.617	0.998	drs
42	0.857	0.914	0.938	irs
43	0.903	0.954	0.946	drs
44	1.000	1.000	1.000	-
45	0.763	0.865	0.882	irs
46	0.984	1.000	0.984	irs
47	0.667	0.676	0.987	irs
48	1.000	1.000	1.000	-
49	1.000	1.000	1.000	-
50	0.661	0.671	0.986	irs
51	0.510	0.902	0.566	drs
Average	**0.802**	**0.847**	**0.947**	

[1] Constant Return to Scale
[2] Variable Return to Scale
[3] Increasing Return to Scale
[4] Decreasing Return to Scale

Table 3. Live weight loss per beef cattle because of producing in increasing return to scale in farm size

Farm size	Farm number	Weight loss per live cattle (kg)	Weight loss per live cattle (%)
10-25 heads	1	33.23	7.91
	3	12.67	3.79
	4	18.01	4.62
	9	51.50	9.36
	11	57.82	17.26
	12	56.46	16.36
Average		**38.28**	**6.95**
26-50 heads	18	19.38	4.31
	19	85.24	18.94
	27	91.92	20.43
	31	118.31	25.72
	33	78.72	18.74
Average		**78.71**	**18.44**
50 heads-+	36	22.61	4.52
	42	21.29	4.73
	45	27.27	6.06
	47	115.07	20.55
	50	93.28	17.27
Average		**55.90**	**12.18**
Between of the groups average weight loss		**56.42**	**12.03**

Table 4. Live weight loss per beef cattle because of producing in decreasing return to scale in farm size

Farm size	Farm number	Weight loss per live cattle (kg)	Weight loss per live cattle (%)
10-25 heads	2	107.31	21.46
	5	114.78	22.96
	6	131.15	23.85
	8	65.57	11.21
	10	112.63	22.44
	13	49.37	9.40
	14	103.10	24.26
Average		**97.70**	**19.56**
26-50 heads	17	102.75	18.68
	20	134.28	24.41
	21	137.27	22.88
	24	108.46	18.08
	26	75.18	13.43
	29	207.64	38.45
	30	20.00	2.67
Average		**112.23**	**20.45**
50 heads-+	34	23.73	4.27
	35	133.11	28.02
	38	159.92	35.54
	39	39.79	6.12
	41	144.38	28.42
	43	14.05	2.64
	51	43.26	8.65
Average		**79.75**	**14.60**
Between of the groups average weight loss		**96.56**	**16.81**

The live weight loss and rate of the farms which are in increasing return to scale are given in Table 3. According to the table, the numbers of farm which are in increasing return to scale are 16. While the most live weight loss is in Group 2. (78.71 kg/per cattle), Group 3. (55.90 kg/per cattle) and Group 1. (38.28 kg/per cattle) are following that respectively. These 16 farms aren't producing in optimal scale because of more input usage. If the farms decrease of using input amounts, they could close the gaps according to the farms which are producing in optimum scale (Table 3).

The live weight loss and rate of the farms which are in decreasing return to scale are given in Table 4. According to the table, the numbers of farm which are in decreasing return to scale are the same in all farms groups. While the most live weight loss is in Group 2., Group 1. and Group 3 are following that respectively. For example, 29th farm used more input in return to production of 207.64 kg live weight because of not producing in optimal scale. If the 29th farm had produced in optimal scale or constant return to scale, it would have used less input for its production excess (207.64 kg) and produce in optimal scale as decreasing its amount of input (Table 4).

Whether there are any differences or not in the efficiency values of the farms involving beef cattle is tested statistically and given in Table 5. According to that Technical Efficiency Values (CRS) showed the normal distribution and their variances are homogeny. Because of that Variance Analyze were applied in this study. Because Net Efficiency (VRS) and Scale Efficiency values didn't show normal distribution, Kruskall-Wallis Test which is non-parametric test was applied.

While Technical Efficiency Values (CRS) and Net Efficiency Values (VRS) in farm size are not significant statistically in 95% confidence level, Scale Efficiency values are important statistically (Table 5). In this situation, on account of scale efficiency, while there was not a difference between small and medium farms statistically, large farms were different from small and medium farms.

Table 5. Description statistics of the farms efficiency values in farm size

Efficiency values	10-25 (n=14)	26-50 (n=19)	51-+ (n=18)
Technical efficiency (CRS)	0.712	0.709	0.802
Net efficiency (VRS)	0.805	0.816	0.847
Scale efficiency	0.877 (a)	0.870 (a)	0.947 (b)

DISCUSSION

Livestock production in the industrialized world is under pressure from two sides: the increased competition in the global market may decrease farmers' income through a decrease in product prices and increased costs; this encourages farmers to switch to more intensive production systems (Schwabenbauer 2004). Sometimes in intensive production system, agricultural holdings may not use their production factors efficiency either couldn't product in appropriate scale or couldn't use their inputs properly. Therefore, production loses occur in these agricultural holdings. Because of that, scale is very important factor in farming system. When the scale is getting together with economic components, it affects the farming income in negative or positive side.

In this research, the average daily weight gain per cattle was 976.32 g .The reported figures of daily weight gain of 850 g in Çorum, Turkey (Fidan 1992), 730 g in Ankara, Turkey (Kıral 1993) were lower while the 1.051 g in Bayburt, Turkey (Özkan and Erkuş 2003) were higher compared with the results found in this research.

The result of this survey, which was conducted on 51 farms involving beef cattle in central districts of Konya province in Turkey, showed that although there is no statistically difference in technical efficiency (CRS) and net efficiency (VRS) among the 3 scales, scale efficiency value was found as statistically important in 95% confidence level as to Kruskall-Wallis Test. According to the statistical result, while 21 of 51 farms produced in increasing return to scale and 22 farms produced in decreasing return to scale. When the farms, which were producing in increasing return to scale, were working under the optimal scale, they didn't reach the live weight which the farms should reach. Because of that, they had 56.42 kg live weight loss. Owing to the live weight loss, these farms should enlarge. Using of more input amount because of producing in decreasing return to scale causes efficiency loss. This type farms should become small and decrease their using of input amounts. Average live weight loss of the farms which were producing in decreasing return to scale was 96.56 kg. Actually when we examined the farm size, we can say that the bigger agricultural holdings can use scale efficiency better than the other groups which are 10–25 and 26–50. In a study conducted in the Basin of Kucuk Menderes on dairy farms, 3 outputs and 8 inputs of production were utilized according to the output-oriented approach of evaluation at Odemis 63%, Tire 65%, Bayindir 62% and at the Torbali 80% dairy farms appeared to be full efficient as far as assumption of constant return to scale (CRS) taken in consideration. On the other hand overall technical efficiencies of 55% percent of 80 dairy farms selected from for districts in the Basin of Kucuk Menderes were calculated as been equal to 1. On the other hand, in Odemis, Tire, Bayindir and Torbali districts the average efficiency indices in the dairy farms were calculated under constant returns to scale 0.939, 0.943, 0.984 and 0.989 respectively. As a consequences of the result, in the research area, dairy farms couldn't use their sources effectively was notified (Koyubenbe and Candemir 2006).

As results of the research we can say that in the Konya province, agricultural holdings were engaged with beef cattle need to reach optimum scale to use their production resource effectively. In that situation, these agricultural holding can reach maximum output.

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