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The Influence of Scale on the Profitability of Culture-Cross Breed Dairy Cattle Farms in Western Part of Turkey

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Abstract: The primary purpose of this study was to determine the influence of scale on the profitability of culture-cross breed dairy cattle farms of different sizes associated with Erikler Cooperative, which is located in Kırklareli (A province in Western part of Turkey). According to annual milk quantity delivered per farm to the cooperative, the farms were classified into 3 groups (small (<10.000 kg), medium (10.000-40.000 kg) and large-scale (>40.000 kg). The data belonged to 2006 production period and were collected from 43 dairy cattle farms face-to face by means of questionnaires. While small-scale dairy cattle farms could not afford to cover even the variable costs, which mean the gross profit was negative, the profitability rate of large-scale farms was 24.7%, which is higher than the nominal interest rate and inflation level in Turkey. Large-scale dairy cattle farms were more successful compared to small and medium scale farms in terms of efficiency of major inputs used (labor demand and feed intake per cow). Total production elasticity of inputs was 1.24 indicating that there were increasing return to scale for dairy cattle farms.

Key words: Influence, profitability, culture-cross breed, cattle farms

INTRODUCTION

A balanced nutrition is associated with sufficient milk production to meet the demand of ever-growing young population in Turkey. Dairy business contributes a lot in closing the gap between the supply of and demand for milk and milk products. There exists an abundant family labor in rural areas, which has a low opportunity costs in non-farm sectors. Dairy sector plays an important role in exploiting some part of this labor thus helps the labor remain in rural areas alleviating the migration to urban areas (Yıldırım and Şahin, 2006).

A profitability rate sufficient at least for sustainability of dairy farms is essential. It was reported that feed costs (Dedeoğlu and Yıldırım, 2006) milk yield and milk prices (Schmit *et al*., 2001; Gloy *et al*., 2002) breed (Erkuş *et al*., 1996) production system (Rotz *et al*., 2005) and organizational and personnel management (Rosenberg and Cowen, 1990) to have been effective on the profitability of dairy farms.

Scale was reported among the major factors which influence the profitability of dairy farms of New York, U.S.A (Tauer, 2001; Gloy *et al*., 2002) of Michigan, Wisconsin, U.S.A (Headley *et al*., 2002) of Utah, U.S.A (Kumbhakar, 1993) of New England (Wadsworth *et al*., 1992) of Norwey (Loyland and Ringsad, 2000) and of Turkey (Yıldırım and Şahin, 2006; Dedeoğlu and Yıldırım, 2006; Erkuş *et al*., 1996; Saner, 1993).

Cooperatives help the farm operators to increase their profitability rates in terms of providing them inputs relatively with lower costs (Ortmann and King, 2007) and securing a relatively more stable and higher income (XinHua *et al*., 2004) along with new information and technological knowledge, more efficient organizational and personnel management (Zijun, 2006) and more economical production system (Rotz *et al*., 2005). Milk yield were reported to have been higher for beneficiary farmers associated with a successful cooperative (Singh *et al*., 2005). Education, communication, gross income, farm size and technology were reported to have played important roles to join agricultural cooperatives (Karli *et al*., 2006). Dairy cooperatives are needed most in rural areas where the most dairy farmers are price-takers and fragile against the severe competition (Quach and Kawaguchi, 2003).

The primary purpose of this research was to determine the influence of scale on dairy farms associated with dairy cooperative. Our hypothesis was that the farm size would be effective on gross and net profit per cow and the profitability rates of dairy farms. Given

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the stable milk prices received by farmers associated with the cooperative, the major reasons of variations in profits of different-size dairy farms would be due to differences in cost efficiencies and partly due to milk yield variations.

MATERIALS AND METHODS

The research material included dairy farms associated with Erikli Cooperative located in Kırklereli (A province in Western part of Turkey). The number of dairy farms which delivered milk to the cooperative was 92. Out of these number 43 dairy farms was selected as a sample size randomly.

The data belonged to 2006 production period and were obtained from the farm operators face to face by means of questionnaires.

Taking into account the annual milk delivered per farm to the cooperative, the dairy cattle farms were classified into three groups small (<10,000 kg), medium (10,000-40,000 kg) and large-scale (>40,000 kg). Economic analysis was made for each group and for overall dairy farms so that the comparison could be made. Thus, the influence of scale on the profit and production costs of dairy farms was determined.

One-way ANOVA analysis was used to compare the means of some major variables of different-scale dairy farms (Miran, 2003). Milk yield and inputs relationship were determined by means of Coob-Douglas production function (Yıldırım, 2006).

RESULTS

Some general information on farms: The average farm managers' age was 50.4 years decreasing in parallel with farm size ranging from 54.9 years for small-scale to 43.3 years for large-scale dairy cattle farms. The average experience of farm managers in dairy cattle activities was 32.5 years and it decreased in proportion to farm size ranging from 36.8 years for small-scale to 23.9 years to large scale dairy cattle farms. All farm managers were literate and the average schooling rate was 5.5 years. Out of farm managers 93.0 and 7.0% graduated from primary and secondary school, respectively, which means no farm managers had a college or university degree.

The average size of households was 4 person and increased in proportion to farm size ranging from 3.2 person for small-scale to 5.0 person for large-scale dairy cattle farms. Half of the population consisted of 15-49 age groups, which are considered active working class in the region. The average illiterate rate was 5.8% for overall farms being the highest for the medium-scale with 6.3 and the lowest with 3.8% for the large-scale dairy cattle farms. The family labor potential was 847.7 man-days and it increased in line with farm size being 646.2 man-days for small-scale to 1114.3 man-days for large-scale dairy cattle farms. More than half of this potential (54.7%) remained idle. The family labor made up 87.7% of total labor used in the farm.

The average land per farm was 231 da. and it increased in parallel with farm size ranging from 201 da for small-scale to 342 da for large-scale dairy cattle farms. The owned land rate was 65.9%, while the remaining consisted of rented land. Nearly all of the land (99.78%) was not irrigated.

Cow number and milk yield: The average cow per farm was 5.65 and increased in proportion to farm-size ranging from 2.38 for small-scale to 13.29 for large scale dairy cattle farms. The daily milk yield per cow was 15.1 kg for overall farms and increased in parallel with farm size being the lowest with 14.7 kg for the small scale and the highest with 16.9 kg for the large-scale dairy cattle farms. The average lactation period was 222.6 days for overall farms being the lowest for the large-scale with 205.7 days and the highest with 230.8 days for the medium-scale dairy cattle farms. The average milk yield per cow per lactation period and milk production per farm was 3361.3 and 18991.1 kg, respectively. The milk production per farm increased in parallel with farm size being 7588.5 kg for small-scale and 46200.4 kg for large-scale dairy cattle farms (Table 1).

Table 1: Some aggregates related to milk production and inputs used per cow

	Dairy farm size (Milk delivered to cooperative-kg)			
	<10,000	10,000-40,000	<40,0000	Overall
Number of cow per farm**	2.38	5.17	13.29	5.65
Daily milk yield per cow (kg)	14.7	14.8	16.9	15.1
Lactation period (days)	216.9	230.8	205.7	222.6
Milk yield per cow per lactation (kg)	3188.4	3415.8	3476.3	3361.3
Milk production per farm (kg)**	7588.5	17659.9	46200.4	18991.1
Daily labor demand per cow (h)**	1.56	1.10	0.62	0.97
Daily feed intake per cow (kg)**	23.42	20.79	15.61	20.74
Forage feed intake per cow (kg)	11.91	11.25	9.43	11.15
Concentrates feed intake per cow (kg)*	11.51	9.54	6.18	9.59

** $p<0.01$ * $p<0.05$

Table 2: Production costs and profits per farm and per cow

	Dairy farm size (Milk delivered to cooperative-kg)			
	<10,000	10,000-40,000	<40,0000	Overall
Production costs per farm ($)	9091.9	15691.4	28838.7	15836.4
Production costs per cow ($)**	3820.1	3035.1	2167.0	2802.9
Variable costs per farm ($)	6067.6	10670.2	20281.6	10843.5
Variable costs per cow ($)**	2549.4	2063.9	1526.1	1919.2
Feed costs per cow ($)**	2136.4	1650.2	1118.8	1508.2
Costs of 1 kg milk ($)	0.45	0.32	0.11	0.26
Gross profit per farm ($)	-1299.6	155.8	11533.5	1567.8
Gross profit per cow ($)*	-546.1	30.1	867.8	277.5
Net profit per farm ($)	-4324.0	-4865.4	2976.4	-3425.2
Net profit per cow ($)**	-1816.8	-941.1	224.0	-606.2
Economical profitability rate (%)	-7.2	0.7	24.7	6.3

** $p<0.01$ * $p<0.05$

The mean differences of milk yield per cow were not significant between the dairy cattle farm groups ($p>0.05$). In terms of cow number and total milk production per farm the small, medium and large-scale farms differed statistically ($p<0.01$).

Labor demand and feed intake: The average daily labor demand per cow was 0.97 h and decreased in parallel with farm size ranging from 1.56 h for the small-scale to 0.62 h for the large-scale dairy cattle farms (Table 1). The daily labor demand per cow differed statistically among the small, medium and large-scale dairy cattle farm groups ($p<0.01$).

The daily feed intake per cow was 20.74 kg for overall farms and decreased in parallel with farm size being the highest with 23.42 kg for the small-scale and the lowest with 15.61 kg for the large-scale farms (Table 1). The forage feed made up 53.76% of total feed intake while the remaining 46.24% was concentrates feeds. The proportion of forage increased according to farms size reaching to 60.42% for large-scale from 50.85% for the small-scale dairy cattle farms.

The composition of the assets: The total assets per farm were $ 24933 and increased in parallel with farm size ranging from $ 17982 for the small-scale to $ 46785 for the large-scale dairy cattle farms. All assets were owned assets. The working assets consisted of more than half of total assets being 57.2% for overall farms and increased in proportion with farm size ranging from 35.4% for small-scale to 69.3% for large-scale dairy cattle farms. The animal assets made up 75.6% of working assets.

Gross production value: Gross production value per farm was $ 12411.3 and increased according to farm size ranging from $ 4767.9 for the small-scale to $ 31815.1 for the large-scale dairy cattle farms. The milk value consisted of 51.16% of total gross production value followed by increase in productive inventory value and manure value with 45.45 and 2.20%, respectively. Gross production value per cow was $ 2196.7 and increased in line with farm size ranging from $ 2003.3 for small-scale to $ 2393.9 for large-scale dairy cattle farms. The farms sold nearly all the milk produced (99.59%) and consumed the remaining at home for households needs.

Production costs and costs of 1 kg milk: Production costs per farm were $ 15836.4 and increased in parallel with farm size ranging from $ 9091.9 for small scale to $ 28838.7 for large scale dairy cattle farms (Table 2). The variable costs accounted for 68.47% of total production cost. The feed costs made up 78.37% of total variable costs. This ratio decreased according to farm size ranging from 83.80% for small-scale to 73.30% for large-scale dairy cattle farms. The rate of feed costs in total production costs was 42.17% followed by permanent labor costs with 17.69%.

The production costs, variable costs and feed costs per cow were $ 2802.9, $ 1919.2 and $ 1508.2, respectively and increased in proportion to farm size (Table 2).

The production costs, variable costs and feed costs per cow differed statistically between the dairy cattle farm groups ($p<0.01$).

The cost of 1 kg milk was $ 0.26 and decreased in proportion to farm size. The cost of 1 kg milk was $ 0.45, $ 0.32 and $ 0.11 for small, medium and large-scale dairy cattle farms, respectively (Table 2).

Gross profit, net profit and profitability rates: Gross profit per farm was $ 1567.82 for overall farms and increased in proportion to farm size. This figure was negative for the small-scale farms being $ -1299.6, while it was positive for medium and large scale dairy cattle farms with $ 155.8 and $ 11533.5, respectively (Table 2).

Gross profit per cow was $ 277.5 for overall farms and increased in parallel with farm size ranging from $ -546.1 for the small-scale to $ 867.8 for large-scale dairy cattle farms (Table 2).

Net profit per farm was negative for overall farms with $ 3425.2. This figure was positive for large-scale dairy cattle farms with $ 2976.4 while the small and medium-scale farms had negative net profit with $ -4324.0 and $ -4865.4 for small and medium-scale dairy cattle farms, respectively (Table 2).

Net profit per cow was negative with $ 606.2 for overall dairy cattle farms. This figure was positive for large-scale farms with $ 224.0 but negative for small and medium-scale dairy cattle farms with $ 1816.8 and $ 941.1, respectively.

Profitability rate was 6.3% for overall farms and increased in proportion to farm size. The profitability rate of small-scale farms was negative with -7.2% while the medium and large-scale farm had a positive profitability rate with 0.70 and 24.65%, respectively.

Cobb-douglas production function: Cobb-Douglas production function using stepwise method was as follows:

$$Y = 1.360X_1^{0.595}X_2^{0.294}X_3^{-0.354}$$

Where,

Y = Milk quantity per cow per lactation (kg); X_1: Number of dairy cattle.

X_2 = Concentrates feed intake per cow per production period (kg); X_3: Total man-days used during the production period.

Determination coefficient (R^2) was 0.683. The total production elasticity of inputs was 1.24. The production elasticity of all inputs was statistically significant.

DISCUSSION

In terms of daily milk yield per cow great differences didn't exist among the farm groups and differences were not significant statistically. The milk yield per cow (16.9 kg) for large-scale dairy cattle farms was only 14.5% higher than the corresponding value for small-scale dairy cattle farms.

The input efficiency of large-scale dairy cattle farms was the main factor which affected the higher profitability rates compared to small and medium-scale dairy cattle farms. In regard of daily labor demand and feed intake per cow the large-scale farms were 2.5 and 1.5 times more efficient than the small-scale farms, respectively.

Given the total production elasticity of inputs of 1.24, there existed an increasing return to scale, which indicates input increases would result in a greater milk production rises. This figure was lower than production elasticity of inputs 2.97 reported for dairy cattle farms of Eastern Anatolia of Turkey (Yıldırım and Şahin, 2006) and higher than 0.82 reported for dairy farms of Black Sea Region of Turkey, which means a decreasing return to scale (Karaaslan, 2000).

Feed costs per cow for large-scale farms ($ 1118.8) were approximately half of (52.36%) small-scale and 67.79% of medium-scale dairy cattle farms. Feed cost is a single most important variable which explain gross and net profit differences among the farm groups.

The rate of feed costs in variable costs calculated in this study (73.3%) were lower than the corresponding values of 84% (Dedeoğlu and Yıldırım, 2006) and 94.4% (Yıldırım and Şahin, 2006) reported for dairy cattle farms of Eastern Anatolia Region of Turkey while it was in consistency with the rate of 72.9 and 63.8% reported by Bal and Yıldırım (1999) and Armağan and Oktay (1999) for dairy cattle farms of Western and Eastern Anatolia Region of Turkey, respectively.

Gross and net profit per cow was negative for small scale dairy cattle farms which mean these groups of farms could not cover even the variable costs. A similar result was reported for dairy cattle farms of Eastern Anatolia, Turkey (Yıldırım and Şahin, 2006) showing consistency between 2 different regions of Turkey in this regard.

Only large-scale farms achieved a reasonable profitability rate of 24.65%, which is higher than the nominal interest rate and inflation level in Turkey. The major factors affecting the profitability rates were efficiencies of input use and economics of scale. The cooperative has contributed positively in this regard. Many previous studies results conducted on the economics analysis of dairy cattle farms showed that there existed a positive relationship between the scale and profitability rates (Headley *et al*., 2002; Loyland and Ringsad, 2000; Yıldırım and Şahin, 2006; Bayramoğlu, 2003; Karaaslan, 2000; Erkuş *et al*., 1996; Saner, 1993).

CONCLUSION

In view of profitability rate, only large-scale dairy farms could be defined as successful. Large-scale farms were efficient in input use. Given the small differences of milk yield per cow among the farm groups, we conclude that the main factor affecting the profitability was input use efficiency and economics of scale.

The sustainability of dairy business in the region will in great extent depend on farms with sufficient size to use the modern technology. To provide this environment, partnership among the producers may be a solution. To establish a relevant environment the government support may be needed.

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