Economics of Small-Scale Dairy Farms Having Robotic Milking

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Introduction

Increasing farm size, lack of skilled workers and striving for more flexible working hours have entailed investments in automatic milking systems (**AMS**). Conventional milking systems (**CMS**) are replaced by milking robots which decrease the need of human labor in this burdensome work. In the past few years, the number of farms with AMS in Finland, among others, has increased rapidly regardless of small herd size (an average of 24 dairy cows in 2008). At the end of 2008, the total number of farms with AMS was 385, their share being 3.1% of all Finnish dairy farms.

Besides better life quality, economic benefits, such as savings in labor costs and higher milk yields per cow, are important incentives for farmers in switching to new technology. Hence, more emphasis should be put on the economic aspects of AMS. The considerable size and long-lasting impacts of the investment also require economic analysis. Being capital intensive, farms with AMS should be able to improve the present very low productivity of agricultural capital to reach profitability which is a prerequisite for production in the long run. In the short run, increased volatility of both input and output prices may incur liquidity problems which are intensified in the occurrence of deficient planning or poor implementation of the investment. In this study, we investigated the economic performance of dairy farms with respect to their milking system.

Material and methods

We employed data on Finnish dairy farms from the EU Farm Accountancy Data Network (FADN) (Table 1). Farms having loose-housing systems with CMS were used as a control group for farms with AMS. The total production cost of milk was estimated as a function of farm size. A regression model of the form $\ln Y = a + b \ln X + \varepsilon$ was developed for both milking systems separately. Differences between the milking systems were analyzed with statistical tests.

Table 1. Number and size of farms in sample

	Conventional milking system			Automatic milking system			Total / Mean		
	Number of farms	Cows per farm	Milk, kg/farm	Number of farms	Cows per farm	Milk, kg/farm	Number of farms	Cows per farm	Milk, kg/farm
2005	58	49	417,713	16	58	507,233	74	51	437,069
2006	67	52	454,069	25	64	564,457	92	55	484,066
2007	82	53	461,727	36	64	572,993	118	56	495,673

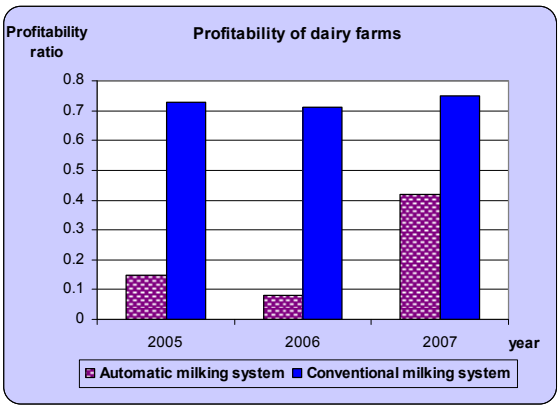

Fig. 1. Profitability of dairy farms

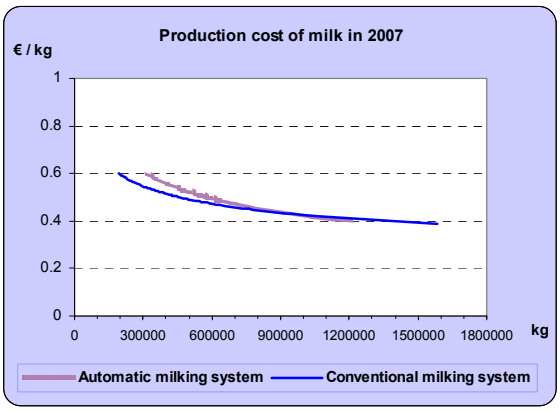

Fig. 2. Production cost of milk

Results

Profitability (calculated for the whole farm) was lower for farms with AMS in 2005 and 2006 ($p < 0.001$). In 2007, no statistically significant difference between AMS and CMS was found (Fig. 1). Regardless of the milking system, the profitability ratio correlated significantly e.g. with interests paid, depreciations on buildings and labor costs.

The unit cost of milk was higher with AMS as long as the quantity of milk produced was less than about 800,000 kg per year (Fig. 2). Production costs divided into capital costs, labor costs and other variable costs were 38%, 18%, 44% with AMS and 30%, 25%, 45% with CMS, respectively. Labor input (h/cow) in livestock production was about 30% lower with AMS than with CMS ($p < 0.001$). Depreciations on machines ($p < 0.001$) and buildings ($p < 0.05$) were higher with AMS than with CMS. Interest claim for equity was higher with CMS ($p < 0.01$) whereas interest paid was higher with AMS ($p < 0.001$).

In 2007, the average yield of a herd was 8,985 kg with AMS and 8,710 kg with CMS, with no statistically significant difference. Returns of milk (€/kg) were higher with CMS than with AMS ($p < 0.01$). This difference was related to the composition and quality of milk.

Conclusions

In the first few years after the robot investment, high capital costs decrease the profitability of milk production on farms with AMS. Another reason for the decline in profitability is underutilizing the capacity of the robot. Thus, more attention should be paid to the transfer into the new milking system, including plans on how to increase the number of cows rapidly to intended herd size. When the robot is working at full capacity, the unit cost of milk is about the same as with CMS. The lower labor costs then compensate the higher capital costs of AMS. Yet, our results did not support the hypothesis of milk yields being higher with AMS than with CMS, perhaps due to the different age distribution of dairy cows in the milking systems concerned.