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TECHNOLOGY EFFICENCY OF VOLUNTARY MILKING SYSTEM

EFEKTYWNOŚĆ TECHNOLOGICZNA SAMOISTNEGO SYSTEMU UDOJOWEEGO

Key words: cost-benefit analysis, sensitivity analysis, technology adaptation

Słowa kluczowe: analizy kosztów i korzyści, analizy wrażliwości, adaptacja technologii

JEL codes: M21, Q12, G11

Abstract. The installation of a voluntary milking system – automatic milking robot – leads to numerous changes in the milking process for example in breeding and feeding technology on the farm. Due to the robotic milking, the biological hazards are less than past. This modern robotic system helps to harmonize the milking, feeding and relaxing period of the herd, and also makes the compliance with food safety regulations easier. The payback period of this robotic milking technology is relatively high. The main objective of this paper is to find the level of cost changes and the level of benefit changes which is able to reduce the payback period. The sensitivity analysis is applied to find these levels. Under the proper conditions the voluntary milking system is able to increase the competitiveness of dairy farm.

Introduction

The EU dairy industry is dominant in the world market. This can be characterized as an innovative and a global player, but it is losing market share. The competitive position is just below average, mainly due to the loss in the world market share. Although the export value is increasing, the world market share of the EU is decreasing. The world market is growing faster than European exports [Tacken et al. 2009]. European Commission [2016] was given an account of EU dairy farms. The study analysed the competitiveness of EU28 members. The basis of competitive advantages is linked to the existence of natural resources, infrastructures, high population density, economies of scale and of scope and market orientation. There are three parts of economies of scale: output increase, input decrease (reduction of the production costs) and higher profitability of the investments. Three of the greatest losses in the dairy cattle industry are reproductive disorders, mastitis, and lameness. The economic losses, due to animal health problems, are the results of production losses rather than the cost of treatment of the affected animals [Ózsvári et al. 2003].

Farms can keep competitive and profitable production only if they continuously follow the latest innovations and they have adopted the innovations in their own farms with the necessary conditions [Illés 1998]. For example, the robotic and automatic milking system is an innovation which is able to improve the competitiveness of the dairy industry. The technology of milking robot make reducing human intervention possible. The decrease in human intervention improves the parameter of milk production and reduces stock disease like mastitis [Ózsvári et al. 2003].

Material and methods

Based on the article Attila Kovács et al. [2014] the payback period of the VMS investment is 7 years. This period is true under certain conditions. This paper is examined that how the payback period change when the yield price, yield quantity and feed cost are changed. The basic conditions were the following: total investment cost is 200 thousand EUR (contain the VMS

robot and the building conversion), yield price is 354 EUR/t, yield quantity is 7907 kg/year/cattle, and feed cost is equal to 8800 EUR/year. Variable conditions combined in two different cases:
1) case: yield price and yield quantity are change,
2) case: yield price and the feed cost are change.

In this paper, sensitivity analyze was used to examine the change of payback period in case of yield price, yield quantity and feed cost change. The basic model for our sensitivity analysis is the present value of the extra profit according to Csaba Székely et al. [2000]:

$$AI_{PV} = -(IC - DI) + (AS - AC \pm IE)_{PV}$$

where: AI_{PV} – the present value of additional income, IC – the additional investment cost of the equipment to be purchased (EUR), DI – possible support and discounts (EUR), AS – the additional sales revenue resulting from the additional yield or increase in quality attributed to using the given technology (EUR/year), AC – the balance of the given technology's additional costs and its possible savings (EUR/year), IE – the indirect economic impacts (environmental effects, effects on society) of using the given technology and the value of GHG reduction (EUR/year).

This additional income model is calculated with the economic and social benefits and cost of the investment [Kovács et al. 2016].

Results

The dairy sector preserves its position in the agriculture industry. For saving the good credit rating provides the investment opportunities. The dairy farms need to produce on competitive terms if they continuously monitored the changes and the latest innovations and adopt them in the appreciate condition [Illés 1998]. An important change in the operation of dairy farms is the price change. According to the milk price (EUT/t) the dairy farms have a very similar situation in V4 countries. The milk price is around 330 EUR/t which is lower than the average of EU28. During the examined period the feed cost in the V4 countries, was realized that in the cases of Hungary and Slovakia the feed cost is higher than the EU average. As opposed to the case of Czech Republic and Poland the feed cost is lower than the Union average. From the total cost the biggest rate comes from the feed cost. Usually the 50 percentages of the total cost is the feed cost in the dairy industry. The feed cost is higher in Hungary and Slovakia than in Czech Republic and Poland (tab. 1).

In case of competitiveness, the yield price and feed cost are very important factors. Not only are these two values the most important in the management of dairy farms, but alsoit is important to understand the variability of the price. The examination of the milk prices between 2007 and 2013 in V4 countries was given that the variability of milk price is very similar in each country. From the low peak in 2009 there is a constantly increasing in milk price. In 2009

Table 1. The milk yield, price and costs in the V4 countries and in the EU28 (in 2013)
Tabela 1. Wydajność, cena i koszty mleka w krajach V4 oraz w UE28 (w 2013 roku)

Specification/*Wyszczególnienie*	Hungary/ *Węgry*	Czech Republic/ *Czechy*	Slovakia/ *Słowacja*	Poland/ *Polska*	EU- 28/ *EU-28*
Milk yield [kg/cow]/*Wydajność mleka [kg/krowa]*	6749	7073	6318	5358	6819
Milk price/*Cena mleka [EUR/t]*	332	333	338	307	380
Feed cost/*Koszty karmienia [EUR/t]*	154	116	156	103	124
Total cost/*Koszty całkowite [EUR/t]*	291	266	321	179	246

Source/*Źródło:* [EC 2016]

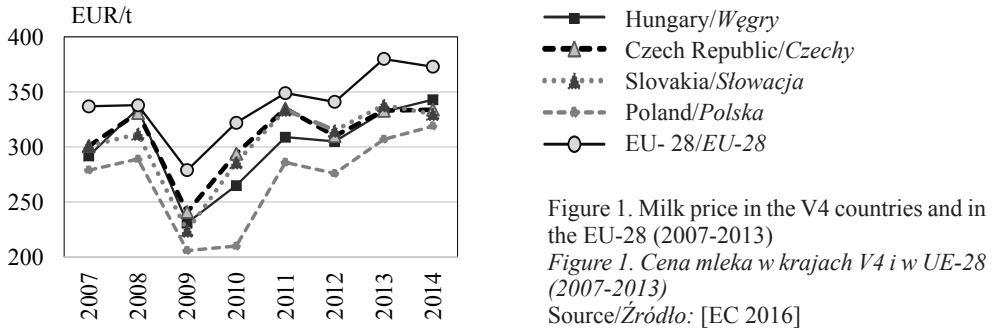

Figure 1. Milk price in the V4 countries and in the EU-28 (2007-2013)
Figure 1. Cena mleka w krajach V4 i w UE-28 (2007-2013)
Source/*Źródło:* [EC 2016]

the milk price where under 250 EUR/t that is very close to the cost price.

The lowest milk prices are in Poland during the examined period. The highest milk prices are found in Hungary and the Czech Republic till 2009. From 2010 to 2013 the highest prices are found in Slovakia and in the Czech Republic. The highest prices is found in 2014 in the case of every V4 countries in the examined period (fig. 1).

The changes of input and output prices affect profitability and viability of dairy farming. Farmers try to find technologies which are able to increase profitability with higher efficiency and lower cost. According to our opinion, voluntary milking system (VMS) is a very good technology for farmers to make their production more predictable and more efficient.

VMS contain automatic feeding, milking, milk analyzing and reproduction monitoring too. VMS is required the continuous circulation of the herd. The cattle feed, milk and relax when they want to, according to their own habits and needs. The application of this system delivers lower feeding costs, improve breeding performance and health as well as production. The milking capacity of the modern VMS is 60-65 cattle per day [Lencsés et al. 2014 a,b] The yield per VMS per year could be increasing with 20-90%. [Castro et al. 2012]

Figure 2 shows that how the yield price and yield quantity changes affect the payback period

Table 2. Sensitivity analyze (case 1.)
Tabela 2. Analiza wrażliwości (przypadek 1.)

Payback period/ *Okres zwrotu*		Δ yield quantity/*wydajność mleczna*										
		-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
Δ yield price/*cena mleka*	-50%	>15	15	14	14	13	13	12	12	11	11	10
	-40%	14	13	13	12	10	11	10	10	9	9	9
	-30%	13	12	11	11	10	10	9	9	8	8	8
	-20%	12	11	10	10	9	9	8	8	7	7	7
	-10%	11	10	9	9	8	8	7	7	7	6	6
	0%	10	9	9	8	8	7	7	6	6	6	5
	10%	10	9	8	7	7	7	6	6	5	5	5
	20%	9	8	8	7	6	6	6	5	5	5	5
	30%	9	8	7	7	6	6	5	5	5	4	4
	40%	8	7	7	6	6	5	5	5	4	4	4
	50%	8	7	6	6	5	5	5	4	4	4	4

Notes: initial yield price 354 EUR/t and initial yield quantity 7907 kg/year/cow/*Uwagi: cena wyjściowa 354 EUR/t oraz wydajność mleczna 7907 kg/rok/krow*ę
Source: own study
Źródło: opracowanie własne

Table 3. Sensitivity analyze (case 2.)
Table 3. Analiza wrażliwości (przypadek 2.)

Payback period/ *Okres zwrotu*		Δ feed cost/*koszt paszy*										
		-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
Δ yield price/*cena mleka*	-50%	10	11	11	11	12	13	13	14	14	15	>15
	-40%	9	9	10	10	10	11	11	12	12	13	13
	-30%	8	8	9	9	9	10	10	10	11	11	11
	-20%	7	8	8	8	8	9	9	9	9	10	10
	-10%	7	7	7	7	8	8	8	8	8	9	9
	0%	6	6	7	7	7	7	7	7	8	8	8
	10%	6	6	6	6	6	7	7	7	7	7	7
	20%	5	6	6	6	6	6	6	6	6	7	7
	30%	5	5	5	5	6	6	6	6	6	6	6
	40%	5	5	5	5	5	5	5	5	6	6	6
	50%	5	5	5	5	5	5	5	5	5	5	5

Notes: origin yield price 354 EUR/t and feed cost 8800 EUR/year/ *Uwagi: cena wyjściowa 354 EUR/t i koszt karmienia 8800 EUR/rok*
Source: own study
Źródło: opracowanie własne

of the VMS investment. According to earlier analyze by A. Kovács [2014] the payback period is 7 year. In Figure 2 the white cells shows the combination where a payback period does not change. When the yield price and the yield quantity are changed simultaneity, the effect was a big growth in the payback period. Otherwise, the only growth in yield quantity is not enough to increase the payback period. The yield price changes have a stronger effect on payback period than the yield quantity (tab. 2).

The yield quantity cannot be infinitely increased if the farmers had high productivity before the VMS investment. That is why, the other case are examined – when the variable factors are the yield price and feed cost.

In the case 2, the feed cost has a great effects on the payback period. We can see that increase in yield price is able to offset the effect of feed cost. If the yield price is decreased and the feed cost is increased in a same time, the farmers would be in an uncertain position (tab. 3).

Conclusions

3. According to the FADN data, the dairy farms are mostly in the same situation in V4 countries. The yield prices are changed with a same dynamic.
4. In this age, the farmers need to face by numerous changes such as yield price and feed cost. The farmers realized the importance of the investment analysis. But classical investment analysis had been calculated with statically value. The sensitivity analysis is able to examine the investment indicators in case of changes.
5. This sensitivity analysis shows that the yield price is the most effective factor on payback period. A lower yield price increase makes a high effect on payback period. The farmers need to monitor the yield price and try to keep the price above 350 EUR/t.
6. It is suggested that for the future examinations, the effects of feeding technology on payback period should be analyzed. More expensive feed may results in a higher yield. The question is that how much price growth is permissible for dairy farms in case of V4 countries.

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Streszczenie

Wprowadzenie samoistnego system udojowego bazującego na robotach udojowych prowadzi do wielu zmian w procesie chowu bydła. System taki zharmonizowany jest m.in. z technologiami karmienia i utrzymania higieny zwierząt, pozwala także na uzyskanie lepszej zgodności z wymaganiami bezpieczeństwa żywności. Celem opracowania jest określenie zmian poziomu korzyści i kosztów w wyniku wprowadzenia takiego systemu w gospodarstwie. Stwierdzono, że przy określonych warunkach system taki może podnieść konkurencyjność gospodarstwa.

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