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DETERMINANTS OF ECONOMIC EFFICIENCY IN DAIRY CATTLE AND SHEEP

M. MICHALIČKOVÁ[1]*, Z. KRUPOVÁ[2], E. KRUPA[2]

[1]NAFC - Research Institute for Animal Production Nitra, Slovak Republic
[2]Institute of Animal Science Praha-Uhříněves, Czech Republic

ABSTRACT

The objective of this study was to analyze the determinants of economic efficiency in milk production and milk and lambs production on dairy cattle and sheep farms, respectively. Economic efficiency was evaluated by the synthetic indicator of the total profit to cost ratio and by the individual indicator of the profit to individual costs-items for the database of farmers of the Animal Production Research Centre Nitra for the period 2006 to 2012. Economic efficiency with and without direct subsidies was expressed per kg of milk in dairy cattle and per ewe and year in dairy sheep. The average value of profit to cost ratio was - 9 % and - 48 % for cattle and sheep farms, respectively. Costs of feeds, depreciations and other direct costs were of higher proportion on the total costs in cattle and sheep. The profit to cost ratio on these costs items was the lowest. On the contrary, proportion of profit per unit of costs for repairs and services, management of overhead costs and for other direct material costs was higher in dairy and sheep analysed farms. Economic efficiency of milk production calculated in 2007 and 2008 for cattle farms was positively determined by lower value of costs per milk unit along with increase in milk price. The sharp fall in milk price, reduction in the number of cows per herd and savings in the feeds consumption resulted in the lower economic efficiency of milk production in period 2009 - 2012. In sheep farms, positive impact of demand for dairy products on the sheep milk price over the whole time period was found. Contrary, price of lambs remained on its low value. Size of flock and milk yield increased in the consequence. In spite of these facts and of reduction in some inputs, it was not sufficient for profitability in sheep. Level of animal performance, market price of dairy cattle and sheep commodities, input prices (feed, labour, other direct costs and depreciations) along with the value and scheme of subsidies were found as the most important determinants of economic efficiency in dairy cattle and sheep farms.

Key words: economic efficiency; profit to cost ratio; ruminants; milk; lambs

INTRODUCTION

Economy of animal production is closely associated with the biological efficiency of breeding. It is generally understood as the company's ability to change the material inputs (expressed as costs) into the marketable product under the common production conditions (Samuelson and Nordhaus, 1992; Tess and Davis, 2002; Gunlu *et al.*, 2003). Some of the biological aspects of the animal production efficiency were summarized previously (Tess and Davis, 2002; Krupová *et al*., 2012). Profit to cost ratio is usually used as the indicator of the economic efficiency (Foltýn *et al*., 2010). Many papers dealing with the analyses of profitability using these parameters in dairy cattle (e.g. Ubrežiová and Mihina, 1995, 1998; Chrastinová *et al.*, 2011;) and in sheep (Jávor *et al.*, 2005; Vláčil, 2005; Benoit and Laignel, 2011) have been published till now. To the best of our knowledge, neither the value of profit to cost ratio for individual cost items defined in the calculation formula nor the detailed analysis of the development of base macro and microeconomic factors (determinants) have been evaluated until now for dairy cattle and sheep. The objective of this study was to analyze the economic

***Correspondence:** E-mail: michalickova@vuzv.sk
Monika Michaličková, NAFC - Research Institute for Animal Production Nitra,
Hlohovecká 2, 951 41 Lužianky, Slovak Republic
Tel.: +421 37 6546 386

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efficiency and to identify key factors (determinants) of dairy cattle and sheep in Slovakia for the period 2006 to 2012.

MATERIAL AND METHODS

Data description

The economic efficiency of milk in cattle and of milk and lamb in sheep was evaluated in period 2006 to 2012. In total, data from 141 dairy cattle and 51 dairy sheep farms recorded in the database of Animal Production Research Centre (APRC) Nitra were analysed. These farms were chosen randomly to represent the individual production regions and breeds of dairy cattle (Holstein, Slovak dual purpose cattle - Simmental and Slovak Pinzgau and crosses) and sheep (Improved Valachian and Tsigai) in Slovakia. The basic production characteristics of dairy cattle and sheep farms for the period 2006 to 2012 are summarised in Table 1. For dairy cattle farms a classical indoor production system was typical with the cows in a free housing system. Integrated intensive indoor fattening of surplus male progeny and selling of the surplus pregnant breeding heifers was practised. Age at first calving reached 940 days and the average number of lactations finished per cow was 3.0 during the evaluated period. For analyzed dairy cattle herds as well as for all dairy cattle herds in Slovakia the continuous milk production during the year was typical. Dairy sheep flocks were kept mainly in semi-extensive (so-called Carpathian) production system. Farming of domestic multi-purpose breeds (Improved Valachian and Tsigai) was characterised by a seasonal lambing in winter and by pasture grazing during the summer. Lambs were weaned and sold before Easter at the average age of 50 days. After weaning of lambs, ewes were milked until the end of the breeding season (autumn). Natural mating was used only. Ewes gave birth to lambs for the first time at 2 years of age and average length of productive life of ewes was 3.85 years in the widespread production system.

Basic economic indicator

The base indicator of economic efficiency (profit or loss) in dairy cattle and sheep for period 2006 to 2012 was calculated as the difference between total revenues and total cost per animal products with and without including of direct subsidies[1]. Profit or loss was defined in € per kg of milk and in € per ewe and year in cattle and sheep farms, respectively. Total costs in cattle and sheep were quantified by a countdown calculation method

[1]Payment per livestock unit (2007-2012), additional national direct payment per dairy cow (2010-2012) and support per dairy cow - help in milk crisis (2010). For more details see Krupová *et al*. (2013).

Table 1: Basic production indicators in analysed dairy cattle and sheep farms from 2006 to 2012

Indicator	2006	2007	2008	2009	2010	2011	2012	Mean value	*v* (%)[a]
Dairy cattle									
Number of cows in herd	308	334	328	312	350	314	296	320	6
Losses of cows (%)	7	6	5	5	6	5	6	6	13
Milk yield in kg per FD	14.55	16.36	17.27	16.47	15.31	16.16	17.19	16.19	6
Fertility (%)	89	90	90	89	87	97	98	91	5
Calving interval (days)	491	410	431	433	431	418	421	434	6
Age at first calving (days)	1035	1018	919	921	906	885	899	940	6
Dairy sheep									
Number of ewes in flock	349	366	512	482	436	452	437	433	13
Losses of ewes (%)	12	6	10	13	7	9	11	10	24
Milk yield (kg per ewe and year)	61.78	73.79	65.17	45.58	70.82	66.04	58.77	63.14	14
Lambs born per ewe[b]	1.15	1.24	1.04	1.11	1.08	1.39	1.18	1.17	9
Lambs sold per ewe and year	0.67	0.71	0.59	0.52	0.68	0.86	0.73	0.68	15
Weaning weight of lambs (kg per lamb)	12.54	12.60	11.78	11.72	12.14	12.01	10.41	11.89	6
Wool production (kg per ewe)	2.50	2.70	3.20	2.90	3.51	3.04	3.39	3.03	11

Source: economic database of APRC Nitra, own calculations
[a]Coefficient of variation
[b]Parameter is influenced by the average litter size and proportion of ewes which give birth to lambs in the flock per year

when by-product value (manure and live born calf in cattle and manure, wool and live born lambs in sheep, respectively) were eliminated from the direct and indirect costs (Krupová *et al*., 2012).

In cattle, total revenues based on the market price per kg of milk and total costs per kg of milk were defined (Table 2). In sheep, milk and lambs were the two main products of the farming. Therefore, milk yield per milking period and number of lambs sold per ewe and year and market price per milk unit and per lamb (Table 1 and 3) were consider when calculating the total revenues. Regarding the direct subsidies, value of the subsidies per kg of milk in dairy cattle was based on the sum of all direct subsidies (payments per livestock unit and per dairy cow) and the amount of milk produced by the individual farmers during the evaluated years. Contrary in dairy sheep farms, direct payments per livestock unit (ewe = 0.15 livestock unit) were only provided for farmers. In 2006, subsidies were not taken into account due to the absence of direct payments to dairy farmers (MA SR, 2013). Other subsidies (e.g. LFA, SAPS) were not considered to analyse the direct impact of costs, market prices and animal performance on the economic efficiency in the evaluated period. The average exchange rate of 30.126 Slovak Crowns (SKK) per Euro was used in the calculations for the period from 2006 to 2008. For more details see Table 2 and 3 where basic economic indicators of dairy cattle and sheep farms

Table 2: Basic economic indicators of milk production in analysed cattle farms from 2006 to 2012 (in € per feeding day (FD), in € per kg of milk, respectively) and average proportion of individual costs items on the costs (%)

Indicator	2006	2007	2008	2009	2010	2011	2012	Mean value	*v* (%)[a]	Cost proportion (%)
Labour costs	0.370	0.459	0.404	0.399	0.548	0.531	0.550	0.466	17	8
Own feed	1.358	1.687	2.179	1.819	0.984	2.316	1.954	1.757	26	29
Purchased feed	0.430	0.635	0.717	0.513	1.025	0.600	0.814	0.676	29	11
Other material costs[b]	0.215	0.209	0.236	0.193	0.212	0.352	0.310	0.247	24	4
Repairs and services	0.079	0.110	0.079	0.081	0.095	0.058	0.086	0.084	19	1
Depreciation of tangible property	0.309	0.276	0.363	0.405	0.423	0.354	0.663	0.399	32	7
Depreciation of basic stock	0.640	0.647	0.599	0.609	0.746	0.900	0.737	0.697	15	11
Other direct primary costs[c]	0.457	0.614	0.541	0.526	0.573	0.690	0.729	0.590	16	10
Other direct secondary costs[d]	0.458	0.538	0.570	0.534	0.639	0.802	0.726	0.609	20	10
Production overhead	0.238	0.265	0.307	0.243	0.386	0.461	0.469	0.338	30	6
Management overhead	0.172	0.227	0.201	0.191	0.145	0.404	0.431	0.253	46	4
Costs together	4.727	5.669	6.196	5.511	5.775	7.467	7.470	6.116	17	100
By-product[e]	0.273	0.268	0.273	0.273	0.274	0.281	0.289	0.276	2	-
Total costs per FD	4.454	5.401	5.923	5.239	5.502	7.186	7.181	5.841	17	-
Total costs per kg of milk	0.306	0.330	0.343	0.315	0.359	0.445	0.418	0.359	15	-
Subsidies in € per kg of milk[f]	0	0.009	0.006	0.030	0.034	0.042	0.015	0.019	75	-
Market price per milk without subsidies	0.321	0.348	0.348	0.252	0.284	0.331	0.307	0.313	11	-
with subsidies	-	0.356	0.355	0.282	0.318	0.373	0.323	0.334	10	-
Profit or loss per milk without subsidies	0.015	0.017	0.006	-0.063	-0.065	-0.114	-0.110	-0.045	-128	-
with subsidies	-	0.026	0.012	-0.033	-0.042	-0.072	-0.095	-0.034	-138	-

Source: economic database of APRC Nitra, own calculations

[a]Coefficient of variation

[b]Purchased medicines, disinfectants, other material used in the office

[c]Include breeding and veterinary treatments, energy, social costs and other services

[d]Include own trucking and other own services

[e]Value of manure (0.036 t of manure per FD * 3.65 € per t) and calf born alive (35 kg*1.66 € per kg of live weight * average number of calves) per FD of cow

[f]Sum of all direct subsidies (payments per livestock unit and per dairy cow) per milk unit. For more details see section "Material and Methods"

for the analyzed period are given.

Profit to cost ratio

Detailed analysis of economic efficiency in cattle and sheep was based on the synthetic indicator of profit to cost ratio and on the individual indicators of profit to cost ratio. The synthetic parameter of profit to cost ratio including the direct subsidies (PCR) of milk production in cattle was measured as follows:

$$PCR = \frac{profit}{total\ costs}$$

and the synthetic parameter of profit to cost ratio without direct subsidies (PCR_2) was calculated as:

$$PCR_2 = \frac{profit - S}{total\ costs}$$

where: *profit* is profit or loss in milk production (€ per kg) with including direct subsidies (*S*) and costs are total costs per kg of milk (Chrastinová *et al.*, 2009, 2011; Foltýn *et al*., 2010). In dairy sheep farms, the synthetic parameter of profit to cost ratio with and without direct subsidies (*PCR* and PCR_2) was calculated as defined before, where *profit* was profit or loss in € per ewe and year with including direct subsidies (*S*) and costs were total costs per ewe and year.

The same algorithm was used for calculation the individual indicators of profit to cost ratio. The only difference being that the values of individual cost items of the calculation formula were used. Absolute values of profit to cost ratio were applied to compare the significance of individual costs items given in the calculation formula over the analyzed period and to objectify proportion of the profit or loss on the individual cost items.

RESULTS AND DISCUSSION

Basic economic indicator

Basic economic indicators in cattle farms over the analyzed period (Table 2) showed that the profit in milk production was only achieved in the year 2007 and 2008. Market price of milk and milk yield in dairy cattle were higher (by 0.041 € per 1 kg milk on average and by 0.88 kg milk per feeding day, respectively) compared the rest of the studied period. In addition, the lower level of costs per feeding day (FD) in dairy cattle (by 0.250 € per FD) were achieved in the mentioned years. Due to combination of these factors the profit in milk production was achieved. It is very important to note that the higher value of loss was achieved in the years 2011 and 2012. It was related to the higher costs per FD (+ 35 %) compared to the rest of the mentioned years. The value of unit costs in milk production increased mainly due to the higher feed prices and the cancellation of tax benefits for fuel (2011) which were implicated in the agriculture sector in previous period.

Compared to dairy cattle herds, economic efficiency in sheep farms was influenced by two products. Therefore combination of production and economic parameters of the individual sheep commodities on the economic efficiency should be considered. In dairy sheep farms negative efficiency (loss) was found over the whole time period (Table 3). However, the loss value was not constant. At the beginning of the evaluated period, the loss per ewe deepened and reached the bottom in 2009 (- 99 € without subsidies and - 77 € with subsidies). In the next three years, positive impact of milk yield (+ 20 kg per ewe and year), number of lambs sold per ewe (+ 0.24) and market price of lambs (+ 5 €) was found. Compared to 2009, total revenue per ewe and year finally increased by 18 € on average in these years but it was still not sufficient for profit. Considering the whole time period, increase of costs value (+ 41 %) compared to revenues (+ 4 %) probably plaid a role in sheep farms. Moreover, mentioned disproportion was not absorbed by subsidies, especially if its value declined in the last three years (Table 3).

Profit to cost ratio - synthetic indicator

Synthetic indicator of profit to cost ratio (profitability) of milk production in cattle (Figure 1) ranged within the interval from - 26 % (without subsidies in 2010 and 2011) to + 8 % (with subsidies in 2007) during the analyzed period (Figure 1). This range is in accordance with the results of Chrastinová *et al.* (2009) and Foltýn *et al*. (2010). In our study, the negative value of profit to cost ratio in milk production (with and without direct subsidies) was found in the years from 2009 to 2012. The average market price of milk dropped down (by 0.033 € per 1 kg milk on average) during this period. The lower value of revenues was not compensated even the higher value of subsidies (+ 0.025 €) per 1 kg of milk (Table 2). Profit to costs ratio in analysed dairy cattle herds reduced in the individual year by 5 p.p. (percentual point) after adding of subsidies (Figure 1).

Wider range of interval for profit to cost ratio (from - 42 % without direct subsidies to 22 % with direct subsidies) was noted by Ubrežiová and Mihina (1995, 1998) and Chrastinová *et al.* (2011). It was mainly due to the higher variability of production and economic indicators of the herds they evaluated. For example, the milk yield varied from 7.56 kg to 16.68 kg per FD and unit costs from 0.270 € to 0.380 € per 1 kg of milk. The system of regulation within the economic reform practised in the nineties of the past century was an important factor for these results. Appropriate values of these indicators valid for dairy cattle farms of APRC are

Table 3: Basic economic indicators of milk and lamb production in analysed sheep farms from 2006 to 2012 (in € per ewe and year) and average proportion of individual costs items on the costs (%)

Indicator	2006	2007	2008	2009	2010	2011	2012	Mean value	*v* (%)[a]	Cost proportion (%)
Labour costs	16.59	21.86	31.32	33.64	40.40	37.81	34.49	30.87	26	18
Own feed	36.48	45.91	45.95	48.11	44.11	34.91	32.76	41.18	14	24
Purchased feed	4.30	14.52	9.08	3.61	2.05	6.19	10.82	7.22	57	4
Other material costs[b]	5.60	1.91	7.02	2.05	4.66	5.67	6.27	4.74	39	3
Repairs and services	1.96	2.62	3.92	1.39	3.00	4.05	1.48	2.63	38	2
Depreciation of long-term tangible property	17.19	17.85	14.85	16.29	9.42	12.15	15.40	14.74	19	9
Depreciation of basic stock	11.96	13.91	18.74	15.33	14.97	10.65	12.24	13.97	18	8
Other direct primary costs[b]	13.82	15.90	19.33	27.58	27.60	28.06	25.90	22.60	25	13
Other direct secondary costs[b]	17.48	25.84	10.93	12.39	14.51	19.04	21.11	17.33	28	10
Production overhead	6.79	2.99	5.90	8.66	9.72	10.52	12.66	8.18	36	5
Management overhead	1.71	0.38	2.49	7.87	6.80	8.99	6.45	4.96	63	3
Costs together	133.88	163.70	169.54	176.92	177.23	178.04	179.59	168.42	9	100
By-product[c]	20.72	18.99	21.51	21.63	19.15	21.59	19.47	20.44	5	-
Total costs per ewe and year	113.16	144.72	148.03	155.29	158.08	156.45	160.12	147.98	10	-
Market price per kg of milk	0.707	0.701	0.766	0.835	0.745	0.836	0.883	0.782	8	-
Market price per lamb	38.17	29.59	28.70	20.61	22.96	28.31	27.15	27.93	19	-
Total revenues per ewe and year[d]	69.25	72.74	66.85	56.37	68.37	79.56	71.71	69.26	9	-
Subsidies per ewe and year[e]	0	21.41	20.89	22.20	21.45	16.43	5.37	15.39	54	-
Profit or loss per ewe and year without subsidies	-43.91	-71.98	-81.18	-98.92	-89.71	-76.90	-88.41	-78.71	-21	-
Profit or loss per ewe and year with subsidies	-43.91	-50.57	-60.29	-76.72	-68.26	-60.47	-83.04	-63.32	-20	-

Source: economic database of APRC Nitra, own calculations
[a]Coefficient of variation
[b]For more details see notes to Table 2
[c]Value of manure (0.0055 t * 3.65 € per t), wool (production in kg * 0.664 € per kg) and lambs born alive (3.8 kg of live weight per lamb * 3.319 € per kg * number of lambs) per ewe and per year
[d]Based on the milk yield, milk price, number of lambs sold per ewe and year and lamb price
[e]Appropriate value of subsidies paid per livestock unit (LU; one ewe = 0.15 LU). For more details see section "Material and Methods"

summarized in Table 1 and 2. The higher values of profit to cost ratio of milk production (from 63 % to 72 %) was published by Arbel *et al.* (2001) in spite of the comparable value of market prices of milk and of costs per cow and feeding day. High level of milk yield (26.71 kg to 31.70 kg per feeding day) which finally reduced the unit cost per kg of milk (0.190 € per 1 kg) was the main determinant of difference in this case. Contrary to our study, almost two times higher value of cost per milk unit was found (0.359 € per kg, Table 2). On the other hand, Roest (2000) noted comparable value for the profit to cost ratio (- 6 %) in milk production in spite of extremely low milk yield (6.73 kg per feeding day) per cows reared in mountain and foothill regions. Positive impact of higher market price of milk (0.510 € per kg) on the profit to cost ratio was confirmed in this study.

Total profit to cost ratio in dairy sheep varied from - 64 % (without subsidies in 2009) to - 35 % (with subsidies in 2007) over the analysed period (Figure 1). Negative value of profit to cost ratio - 40 % and - 38 % was found also for dairy sheep farms in 2002 and 2003 (Vláčil, 2005) based on comparable value of production (58 kg of milk and 0.69 of lambs per ewe and year) along with market prices of dairy sheep commodities (0.594 € per kg of milk and 33 € per lamb). Economic situation in these farms changed to profitable (10 % and 16 %) when support per sheep breeding and cheese production (95 € and 102 € per ewe and year) was considered (Vláčil, 2005). Negative ratio of economic efficiency in sheep farms analysed in our study reduced in the individual year by 10 p.p. after adding of subsidies (Figure 1). Positive influence of subsidies on profitability was confirmed also

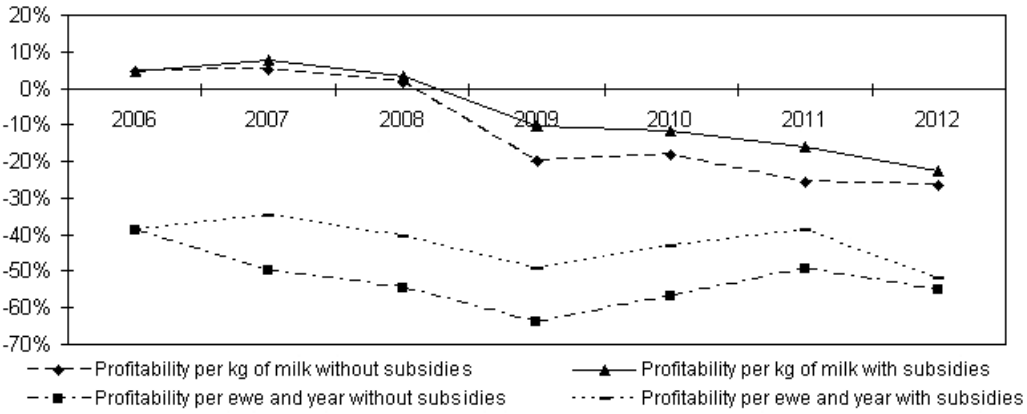
in other dairy (Benoit and Laignel, 2011) as well in meat sheep farms (Milerski *et al.*, 2006; Cehla *et al.*, 2012).

Positive value of profit to cost ratio (+ 119 % and + 54 %) was published for extensive and intensive dairy sheep farms in Hungary, respectively (Jávor *et al*., 2005). Apart from the higher value of milk yield in these flocks (90 L and 280 L per ewe and year, resp.) compared to our study (63 kg per ewe and year, Table 1), the main reason is that gross margin (9.800 and 15.100 HUF per ewe and year) was used as the basic economic indicator in this paper. Based on this methodology, all of the costs items were not considered and therefore value of annual costs per ewe was lower (8.300 HUF ≈ 33 €) compared to our study (148 € per ewe and year on average over the analysed period, Table 3). Positive economic results in family farms were also found in meat sheep for period 2005 to 2008 (Benoit and Laignel, 2011). Likewise in previous paper, gross margin was used in the economic evaluation. Moreover, revenues were not drawn exclusively from sheep farming, since there were also other activities (e.g. crops production). These authors also stated a lover value of revenues and incomes per meet sheep farms compared to dairy cattle herds. Likewise, value of incomes in meat sheep farms located in upland zones (which is typical for dairy sheep farms in our study) was lower than those in plaintland farms in their paper. This would be also the case of disproportion in the economic efficiency between cattle and sheep farms analysed in our study. Trend of profitability ratio declined in period 2006 – 2009 in analysed dairy cattle (by 15 % and 25 % with and without of subsidies) and sheep farms (by 11 % and 25 % with and without of subsidies) which is comparable with foundlings of Benoit and Laignel (2011) for cattle and meat sheep farmers.

Profit to cost ratio - individual indicator

For the profit to cost ratio of the individual cost items similar characteristic were found in dairy cattle and sheep farms. The lowest proportion of the economic result (profit or loss) on the own feeds, depreciations in basic stock and on the other direct costs for the analyzed farms was recorded (Table 4 and 5). On the contrary, the higher share of economic efficiency was calculated per repair and services costs, overheads and other material costs. Results published by Ubrežiová and Mihina (1995; 1998) for cattle and by Vláčil (2005) for dairy sheep correspond to our founding. Differences between the cattle and sheep were in profit to cost ratio for purchased feeds and labour costs only. Higher intensity of production in dairy cattle compared to sheep (semi-extensive farms) lead to upper consumption of purchased feeds. Therefore, purchased feeds belonged to the costs items with lower value (0.07 and 0.08 with and without of subsidies) of profit to cost ratio in cattle (Table 4). Contrary, for dairy sheep farms, a higher need of human labour is typical compared to cattle. According to this, labour costs took the place among the cost items with lower value (2.12 and 2.61 with and without of subsidies) of profit to cost ratio in sheep (Table 5). In respect of labour costs it should be also mentioned that investment into the technological equipment for milking will be accompanied with higher material consumption (disinfecting, spare parts), energy consumption (electricity and water), and the cost of repairs and depreciation of fixed assets. However, savings in labour costs and charges will be higher than operating costs for parlours (Vláčil and Mihina, 2007).

Generally it can be said that value of profit to cost ratio of the individual cost item (given in Table 4



Source: economic database of APRC Nitra, own calculations

Fig. 1: Profit to cost ratio (profitability) of milk production in cattle and in sheep flocks from 2006 to 2012

and 5) was preliminary determined by the value of the individual costs items per FD of cow as well per ewe and year (see last column of Table 2 and 3). Profit to cost ratio was lower for the cost items with higher value in farming and vice versa. Moreover, higher value of loss reached in sheep farms compared to cattle (Table 3 and 2) resulted to higher absolute values of profit to cost ratio in sheep (Table 5 and 4). Nevertheless, values intended inside the production system were only relevant for evaluation of the individual indicators of profit to cost ratio. When negative profit (loss) was calculated (from 2009 to 2012 in cattle farms and over the whole time period in sheep) a slightly lower ratios of profit to the individual cost items was found after including of subsidies.

Determinants of economic efficiency

Level of animal performance (e.g. milk yield, number of sold lambs), price of the main inputs (feeds, other direct costs, labour and depreciations), market price of products along with the value and type of subsidies are the most important determinants of economic efficiency in dairy cattle and sheep farms. Individual influence of these factors on the economic efficiency of cattle and sheep production was outlined above. Therefore a comprehensive analysis along with development of further micro and macro economic factors will be taken into account in the following text.

During the period 2006 - 2008, milk yield per cow and number of dairy cows in the analyzed dairy cattle herds increased (Table 1). Average level of milk yield in Slovak cattle herds slightly increased as well, but the number of dairy cows decreased nearly by 9 % during this period (Figure 2). Similarly in dairy sheep farms, an increase in milk yield and in size of analysed dairy

Table 4: Profit to cost ratio of the individual cost items and its basic statistical characteristics in the analysed dairy cattle farms from 2006 to 2012 (€)

Individual items of cost's formula	2006	2007	2008	2009	2010	2011	2012	Mean value	*v* (%)[a]
Labour costs without subsidies	0.04	0.04	0.01	0.16	0.12	0.21	0.20	0.11	73
with subsidies	-	0.06	0.03	0.08	0.08	0.14	0.17	0.09	57
Own feed costs without subsidies	0.01	0.01	0.00	0.03	0.07	0.05	0.06	0.03	80
with subsidies	-	0.02	0.01	0.02	0.04	0.03	0.05	0.03	61
Purchased feed costs without subsidies	0.03	0.03	0.01	0.12	0.06	0.19	0.14	0.08	82
with subsidies	-	0.04	0.02	0.06	0.04	0.12	0.12	0.07	66
Other direct material costs without subsidies	0.07	0.08	0.03	0.33	0.31	0.32	0.36	0.21	69
with subsidies	-	0.12	0.05	0.17	0.20	0.20	0.31	0.18	49
Repair and services costs without subsidies	0.19	0.15	0.08	0.78	0.68	1.96	1.28	0.73	95
with subsidies	-	0.24	0.15	0.41	0.44	1.24	1.10	0.60	77
Depreciation of long-term tangible property without subsidies	0.05	0.06	0.02	0.16	0.15	0.32	0.17	0.13	77
with subsidies	-	0.09	0.03	0.08	0.10	0.20	0.14	0.11	53
Depreciation of basic stock without subsidies	0.02	0.03	0.01	0.10	0.09	0.13	0.15	0.08	74
with subsidies	-	0.04	0.02	0.05	0.06	0.08	0.13	0.06	60
Other direct primary costs without subsidies	0.03	0.03	0.01	0.12	0.11	0.16	0.15	0.09	71
with subsidies	-	0.04	0.02	0.06	0.07	0.10	0.13	0.07	55
Other direct secondary costs without subsidies	0.03	0.03	0.01	0.12	0.10	0.14	0.15	0.08	69
with subsidies	-	0.05	0.02	0.06	0.07	0.09	0.13	0.07	53
Production overhead costs without subsidies	0.06	0.06	0.02	0.26	0.17	0.25	0.24	0.15	67
with subsidies	-	0.10	0.04	0.14	0.11	0.16	0.20	0.12	45
Management overhead costs without subsidies	0.09	0.07	0.03	0.33	0.45	0.28	0.26	0.22	72
with subsidies	-	0.11	0.06	0.17	0.29	0.18	0.22	0.17	47

Source: own calculations
[a] Coefficient of variation

Table 5: Profit to cost ratio of the individual cost items and its basic statistical characteristics in the analysed dairy sheep farms from 2006 to 2012 (€)

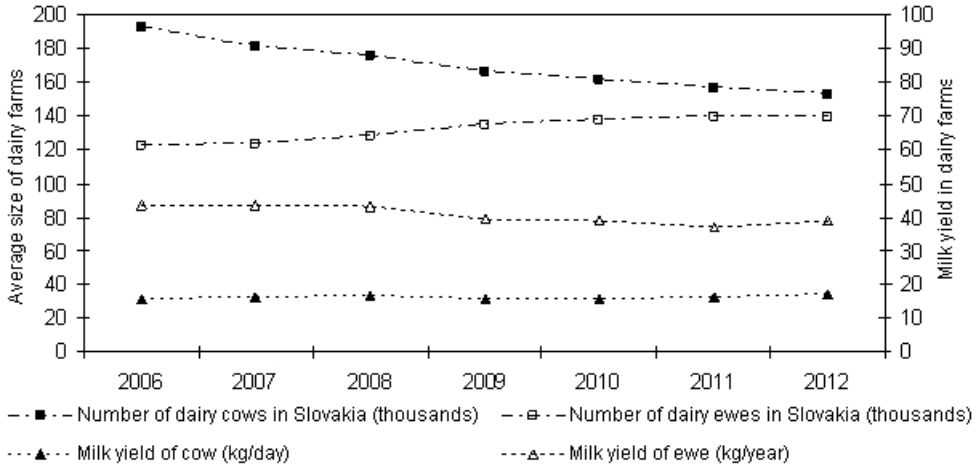
Individual items of cost's formula	2006	2007	2008	2009	2010	2011	2012	Mean value	*v* (%)[a]
Labour costs without subsidies	2.65	3.29	2.59	2.94	2.22	2.03	2.56	2.61	15
with subsidies	-	2.31	1.92	2.28	1.69	1.60	2.41	2.12	17
Own feed costs without subsidies	1.20	1.57	1.77	2.06	2.03	2.20	2.70	1.93	23
with subsidies	-	1.10	1.31	1.59	1.55	1.73	2.53	1.58	28
Purchased feed costs without subsidies	10.21	4.96	8.94	27.42	43.78	12.42	8.17	16.56	78
with subsidies	-	3.48	6.64	21.27	33.31	9.77	7.67	13.19	74
Other direct material costs without subsidies	7.84	37.72	11.56	48.25	19.24	13.56	14.10	21.75	65
with subsidies	-	26.50	8.59	37.42	14.64	10.66	13.24	16.99	60
Repair and services costs without subsidies	22.41	27.49	20.73	71.14	29.87	19.00	59.60	35.75	54
with subsidies	-	19.31	15.40	55.18	22.73	14.94	55.98	29.42	57
Depreciation of long-term tangible property without subsidies	2.55	4.03	5.47	6.07	9.53	6.33	5.74	5.67	35
with subsidies	-	2.83	4.06	4.71	7.25	4.98	5.39	4.54	33
Depreciation of basic stock without subsidies	3.67	5.17	4.33	6.45	5.99	7.22	7.22	5.72	22
with subsidies	-	3.63	3.22	5.00	4.56	5.68	6.78	4.65	25
Other direct primary costs without subsidies	3.18	4.53	4.20	3.59	3.25	2.74	3.41	3.56	16
with subsidies	-	3.18	3.12	2.78	2.47	2.15	3.21	2.87	13
Other direct secondary costs without subsidies	2.51	2.79	7.42	7.99	6.18	4.04	4.19	5.02	40
with subsidies	-	1.96	5.51	6.19	4.71	3.18	3.93	4.00	36
Production overhead costs without subsidies	6.46	24.10	13.76	11.42	9.22	7.31	6.98	11.32	51
with subsidies	-	16.93	10.22	8.86	7.02	5.75	6.56	8.83	41
Management overhead costs without subsidies	25.74	188.22	32.63	12.57	13.19	8.55	13.71	42.09	143
with subsidies	-	132.24	24.23	9.75	10.04	6.73	12.87	31.66	131

Source: own calculations
[a]Coefficient of variation

sheep farms (Table 1) along with stabilisation in these parameters (- 1 % in milk and + 5 % in number of ewes in farm) in Slovakia was found in this period (Figure 2). According to these trends, higher stability in the agricultural sector can be indicated for the sheep farms together with cattle farms analyzed in our study.

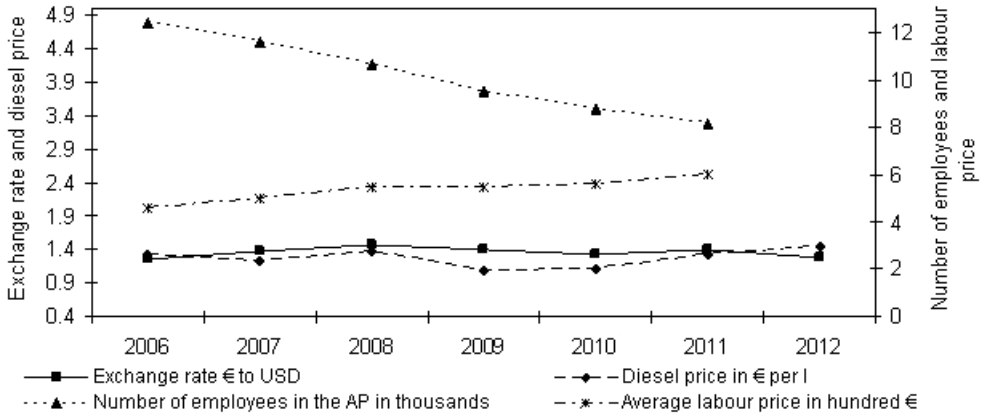
When analyzing the determinants of economic efficiency in cattle and sheep it is also necessary to take into consideration the price of diesel, which creates predominant part of costs for roughage and concentrates (Gunlu *et al.*, 2003; Blaskó *et al*., 2012). Costs for grain and forage feeds represent from 30 to 35 % of total costs in dairy cattle and sheep farms (Krupová *et al.*, 2012). In Slovakia, price of diesel slightly increased (from 1.320 to 1.380 € per litre) during the period 2006 - 2008 mainly due to the reduction of its supply at world market. At the same time, increase in diesel price was slightly taken care of by strengthening of USD exchange rate against the EUR (Figure 3). Increase in the level of diesel price influenced the costs for feed production (Figure 4 and 5) and also the level of costs for own (mostly forage) and purchased feeds used in analyzed dairy cattle and sheep farms (Table 1). For comparison, decrease in production costs for forage feeds was officially published in Slovakia for this period (Figure 5). The costs of grain feeds at first jumped to 176 € and then decreased to 162 € per tonne (Figure 4). It was not possible to quantify the real costs for feed production in database of evaluated farmers. Nevertheless, it is supposed that the mentioned disproportion could be caused by the difference between the real costs for feeds production and the value (price of intermediate goods) they were accounted in cattle and sheep economic evidence. This assumption is partly confirmed by the fact that average price of grain feeds

on the market slightly raised over the whole time period (Figure 4). This trend could presumably result in rise of intradepartmental price of all plant commodities, inclusive of forage feeds. Additionally, increase of milk yield in dairy cattle and sheep connected with rise of nutrients requirements was another factor that influenced the increase of feed costs in analyzed farms (Table 2 and 3) which was also confirmed in paper Kuipers *et al*. (1999). In analysed farms, the unit costs per kg of milk finally raised by 12 % in cattle (Table 2) and costs per ewe and year by 31 % during the years 2006-2008 (Table 3). Regarding the value of own feed costs, they should be calculated only in the own cost value for given plant commodities. Finally, it seems to be a very useful solution to optimize the value of own feed costs in animal production.



Source: RIAFE (2013); economic database of APRC Nitra, own calculations

Fig. 2: Milk yield and average number of dairy cattle and sheep in Slovakia in 2006 to 2012



Source: EUROSTAT (2013); SO SR (2013)
[a]Number of employees in the AP and the average labour price have not been available for 2012 until now

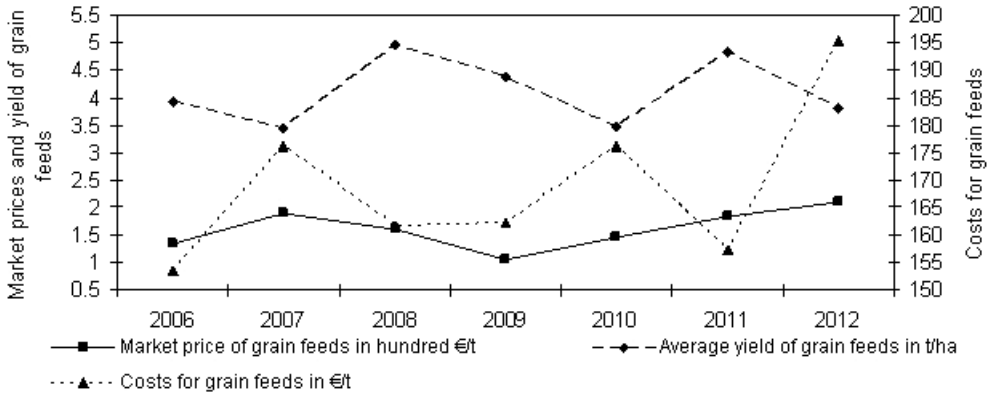
Fig. 3: Development of the exchange rate of € to USD, diesel price, number of employeesa and average labour price[a] in animal production (AP) in Slovakia from 2006 to 2012

Labour costs, similarly to feed costs, are an important item in calculation formula of dairy cattle and sheep farms (Table 2 and 3). Average monthly wages in the branch of animal production slightly rose (nearly by 90 €) during the period 2006 to 2008 in Slovakia. On the other hand, a number of employees in animal production during this period decreased (Figure 3). This disproportion could cause the irregular development of labour costs (increase in 2006-2007 and decrease in 2007-2008) in dairy cattle herds (Table 1). Contrary, value of labour costs in sheep was exempted from this disproportion probably due to existence of seasonal employees and external personnel typical for this production system.

Market supply (production) of milk increased until 2008 (Table 1) with simultaneous increase of market price of milk (Table 2) in cattle producers. This situation resulted in surplus commodity on the market in 2009 and 2010 and in decrease of demand for milk (Table 2) which was also confirmed in paper Blaskó (2012).The consequence of these events caused to a drop in milk price in 2009 and 2010 (Table 2). This negative situation was partly compensated by the addition of national direct payment per dairy cow and support per dairy cow - help in milk crisis - paid in dairy sector in 2010 (Table 2). In dairy sheep, raised demand for dairy sheep products over the whole time period positive expressed in the milk price. These economic conditions focused farmers more on milk production compared to producing lambs especially if the price of lambs was close to its minimum. Number of ewes in the flock and milk yield per ewe slightly increased in the consequence (Table 1).

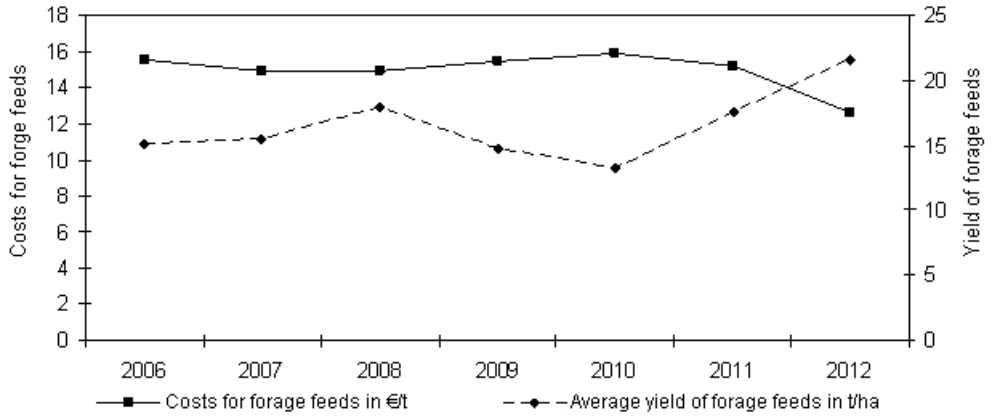
However, uncertainty in overall economic situation in 2009 lead to reduction in inputs mainly these for feeds. Yield of forage and grain feeds per hectare slightly decreased in 2009 - 2012 and unit costs for feed production increased by 5 % (Figure 4 and 5). This situation was related with the higher feed prices (+ 34 %) in 2010 and 2011 compared to the rest of the mentioned years and with the cancellation of tax benefits for fuel in 2011 which were implicated in the agriculture sector in previous period. At first, dairy cattle farmers tried to solve this unfavourable situation mainly by reduced amount of purchased feeds and their substitution by own feeds. In addition, the producers who supply the most of the required amount of purchase the own feeds, probably have an important advantage in decreasing the production costs comparing the ones who buy from outside (Gunlu *et al.*, 2003). At the end of evaluated period, the situation in cattle nutrition, especially in purchased feeds, returned to the state before 2009. Total increase of feeding costs in cattle (+ 55 %) was based on change in cost for own (44 %) and for purchased feeds (89 %) over the whole period (Table 2). Regard to the situation in 2009, further reaction of dairy cattle farmers was a short-term decreasing of the size in the analyzed dairy cattle herds by 5 % in 2009 (Table 1). However, according to average Slovakian data reduction in numbers of dairy cows took place almost over the whole period (Figure 2). However, these changes were not effective from the complex point of view mainly due to the milk yield per cow slowly decreased (Table 1, Figure 2).

Similarly in sheep farms, value of costs for purchased feeds was strongly influenced by overall economic conditions, mainly by market prices of grain feeds after 2009 (Figure 4). Reduction was observed even in costs for own feeds (Table 3). In the context of these facts, average milk yield per ewe and year in



Source: RIAFE (2013)
[a]Average values for wheat, rye, barley, grain maize and oats

Fig. 4: Base production and economic parameters of grain feeds[a] from 2006 to 2012



Source: RIAFE (2013)

[a]Average values for green maize, multiannual forage crops, meadows and pasture

Fig. 5: Base production and economic parameters of forage feeds[a] from 2006 to 2012

Slovakia reached only the 64 % of the yield in analysed sheep farms and its value slightly declined over the time (Figure 2). This situation was not compensated even by the fact that increase in size of flock was found in dairy sheep farms analysed in our study as well according to average Slovakian data (+ 10 %, Table 1 and Figure 2) in the last four years compared to pervious period. In addition of reduced value of subsidies, farm profitability remained in red numbers (Table 3, Figure 1).

Value of labour costs changed by + 23 % and + 57 % in last four years compared to the previous period and by + 49 % and + 108 % over the analyzed period in cattle and sheep farms, respectively. In comparison, number of employees decreased by 24 % and the average value of monthly wages increased by 14 % in Slovakia (Figure 3). Existence of over-employment along with alternatively less effective utilization of labour power in the production process in analyzed farms can be indicated.

Concerning the value of revenues in 2009 and 2012, the unit milk price changed + 22 % and + 15 % (with and without subsidies, respectively) in dairy cattle (Table 2). Total revenues increased by 27 % in sheep farms in this period. However, total incomes remained almost the same (77 € in 2012 vs. 79 € in 2009) when considering of subsidies (Table 3). Finally, combination of the above mentioned micro and macro economic factors and animal performance resulted in the increase of loss by more then two times (to 0.10 € per each kg of milk or to 1.62 € per FD of cow on average, Table 2) in analysed cattle farms and loss in sheep remained almost at the same negative level (85 € per ewe and year on average, Table 3).

CONCLUSION

Dairy cattle and sheep farmers should concentrate on accounting the costs only for categories to which they belong (especially overhead costs) to define objective value of cost for given value of production. Moreover, dairy farmers should connect to marketing associations to promote higher market prices of milk commodities. Experience suggests that milk price is higher by 20 % on average for farmers cooperating in marketing associations compared to the individual sellers. Nevertheless, possibilities to increase milk price individually per additional milk fats and proteins paid to farmers by dairies are small. Regarding the revenues, it seems to be useful to focus on diversifying their structure by farmers. Diversification (on cow-calves/meat sheep, plant, biogas production and services) can spread business risk to the widest base of outputs. Moreover, universal orientation of production can reduce the response time to market changes and lead to higher flexibility of organizational and cost systems.

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