

ANALYSIS OF DIFFERENT FORMS OF ADVANCE IN DAIRY PRODUCTION

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Summary. Dynamic transformation of dairy production in regional and global scale emphasizes many problems and raise many questions. When we assess results of dairy cows improvement expressed by increase with milking capacity per cow, there can be raised research problem: is this improvement associated with development of other factors deciding about effectiveness of dairy production? What are the possible consequences coming from difference in rate of introduced biological, technological and technical advance in dairy farm? To answer for such formulated questions constituting objective of the analysis, the index for assessment of simultaneous development within agri-systems was elaborated. Such approach to analysed development on the base of some characteristic data for Polish and European conditions indicated possible consequences resulting from differences in introduced technical and biological advance expressed by milking capacity and dynamics of improved quality systems in dairy production. The proposed index to analyse and assess some aspects of simultaneous development of mutually connected elements of considered activity in dairy production constitutes one of the examples, how to consider and interpret results of the investigated dairy topics on the background of dairy agri-system.

Key words: automatic milking system, dairy, quality, milking capacity.

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Santrauka. Dinamiškas pieno produkcijos gerinimas regioniniu ir globaliu mastu atskleidžia daugybę problemų ir kelia daug klausimų. Analizuojant rezultatus, gautus melžiamų karvių tyrimų, kurie padidina gyvulio pieno produkciją, metu, kyla mokslinių tyrimų problema: ar šis padidėjimas susijęs su veiksniais, lemiančiais pieno produkcijos efektyvumą? kokios galimos pasekmės kyla dėl biologinės, technologinės ir techninės pažangos lygio pieno pramonės srityje? Norint atsakyti į kylančius klausimus, buvo sukurtas žemės ūkio sistemų sinchroninio vystymosi tyrimų indeksas. Toks požiūris į tiriamą vystymąsi, remiantis kai kuriais tipiškais duomenimis, gautais Lenkijoje ir Europoje, atskleidžia galimas pasekmes, susijusias su techninio ir biologinio vystymosi skirtumais ir pasireiškiančias didesnėmis pieno produkcijos galimybėmis bei dinamika ir pagerėjusia pieno gamybos kokybe. Siūlomas indeksas yra pavyzdys, kaip analizuoti ir tirti kai kuriuos abipusiai susijusius pieno produkcijos sinchroninio vystymosi aspektus, kaip nagrinėti ir interpretuoti pieno pramonės problemas, remiantis žemės ūkio sistema.

Raktažodžiai: AMS, pieno produktai, kokybė, pieno gamyba.

Introduction. Dynamic changes observed in the Polish dairy sector during the last fifteen years constitute one of the most important examples of transformation processes taking place in considered globally food economy. It is characteristic, that the initiated transitional processes, as a result of introduced market economy rules cover whole complex chain of Polish dairy system from the level of dairy farm through milk processing one to level of dairy products consumption related to consumers' preferences on the market.

Every transformation process in the field of dairy production is characterised by many specific features and determined by initial conditions, assumed aims of changes and other factors. Including importance of these aspects from view-point of dairy production future the main purpose of the paper was to indicate and compare some selected tendencies in development of different elements of dairy production, which decide about its potential and effectiveness.

Materials and methods. In order to realise the

purpose of the study some data edited by Polish Central Statistical Office (CSO), Eurostat, FAO and another sources of information have been used for the analysis.

To compare some emphasized type of advance in agriculture, i.e. biological and technical advance related to dairy production, an index of utilization of milking robot potential capacity was proposed and considered for selected countries.

Research results. At the first stage of the analysis the data concerning milking capacity of dairy cows in Poland were collected and compared for the period 1989-2005 (Table 1).

When we compare the data given in Table 1, there is possible to indicate considerable increase in amount of milk produced by cow per year in country (Polish) scale (increase by about 27 %) as well as scale covering private farms (increase by about 28 %) and public sector (increase by about 57 %).

Table 1 Selected data on milk production in Poland, 1989-2005

Year	Total milk production [10 ⁶ litres]	Average milking capacity		
		total litres/year	in private farms litres/year	in public sector litres/year
	1989	15926	3260	3156
1990	15371	3151	3042	4035
1991	14022	3082	2988	3906
1992	12770	3015	2942	3704
1993	12271	3075	3024	3600
1994	11866	3121	3072	3822
1995	11303	3136	3087	3840
1996	11355	3249	3210	4227
1997	11770	3370	3313	4880
1998	12229	3491	3443	5000
1999	11915	3510	3450	4952
2000	11878	3668	3605	5175
2001	11873	3828	3758	5742
2002	11861	3902	3812	5826
2003	11881	3969	3876	5842
2004	11810	4082	3984	5942
2005	11905	4147	4027	6324

Source: Data of the SCO, 1990...2006

Such results indicate favourable trends in the analysed changes as the effect of many activities (including introduction of research recommendations) undertaken in the field of zootechnics and other ones, important for development of dairy production on the farm level.

Conclusions resulting from the given above comparative data can be optimistic. It is possible to indicate on systematic biological advance concerning dairy cows herd in Poland. But it seems to be well-founded to consider two significant aspects: compare the analysed data in more extended – European scale and second one: ask about relationships between biological advance and another type of advances in dairy

production, which decide about effectiveness of dairy transformation. Such problem can be explained with use of two selected and considered type of advance: technological and technical. The technological advance in dairy production have been expressed in the analysis by quality of milk, while technical advance have been considered by possible equipping European dairy farms with milking robots.

Biological and technological advance

Detailed changes covering quality of purchased milk in Poland in the period 1998-2004 were showed in Table 2.

Table 2. Structure of purchased milk according to quality [in %]

Year	Extra class	Class I	Class II	Class III	Out of class
1998	27.0	23.9	20.8	28.3	-
1999	37.9	23.5	19.4	19.2	-
2000	56.8	25.9	14.3	-	3.0
2001	64.8	22.5	10.7	-	2.0
2002	69.8	19.9	8.6	-	1.7
2003	82.7	13.7	-	-	3.6
2004	90.3	8.1	-	-	1.6

Source: Data of GIW, 2005

The data given in Table 2 emphasize two characteristic trends. First of all there is possible to observe fast increase in percentage of purchased Extra class milk. During 7-years period it is possible to indicate more than 3-times increase in percentage of the highest quality raw milk delivered to Polish dairy plants.

However, the second trend concerns systematic decrease in number of milk quality classes and as a result more and more restricted quality needs for milk producers. Currently we have two raw milk classes in Poland, i.e. extra class and I class. But from January 2007 only one class (extra class) will be respected by Polish quality

standards and dairy plants.

Comparison of data given in Tables 1 and 2 indicate on considerable higher increase in milk quality than cows' milking capacity. Such results emphasize two aspects.

When some administrative activities are undertaken, there is possible to receive higher dynamic of changes, i.e. quality changes. Moreover, amount of purchased raw milk in Poland is higher and higher, so there are favourable perspectives for milk processing and quality of dairy products.

In contrast with quality changes there is possible to observe considerable slower increase in annual milking capacity. Such results confirm, that in national scale some changes (increase) concerning effects of some activities in the field of cows and their development are slower and more extended during the considered time. It means, that improvement of some indices characterising animals and level of milk production needs more time and research engagement.

Biological and technical advance

The biological advance expressed by increase in cows' milking capacity can be put together with some examples of technical advance in dairy production. The robotic milking system (RMS), named also by the acronyms VMS (voluntary milking system) and AMS (automatic milking system) belongs to the most important solutions expressing advance in modern dairy farm production and its technical infrastructure.

To develop relationships between biological and technical advance some data covering milking capacity for selected European countries and selected period (average value for 2000-2004 period) were used. Moreover, for detailed analysis some assumptions were included. Effective utilization of one-box milking robot, according to data given in some reports (Meskens *et al.*, 2001) and own survey carried out in Danish dairy farms (Gaworski, 2003), is achieved at the level of 500,000 litres of milk per year. When we take into account, that one-stall milking robot is adapted for herd sized 60 dairy cows, it means, that milking capacity of each cow should be on average 8,300 litres of milk per year. This data can be compared with current milking capacity in particular European countries. As a result there is possible to calculate index of utilization of milking robot potential capacity (η_{pc}). This index is calculated as the following relation:

$$\eta_{pc} = \frac{q_c}{q_p} \times 100\%$$

where:

η_{pc} – index of utilization of milking robot potential capacity, [%]

q_c – current milking capacity in the considered country (region, farm, etc.), [kg/year]

q_p – minimum milking capacity necessary for full utilization of milking robot, [kg/year]

The detailed indices ($x \pm S.D.$) calculated for selected countries and considered period (2000-2004) were

graphically showed in the Figure 1.

Analysis of data given in Figure 1 show considerable polarisation in some regional conditions connected with possible introduction of technical advance in dairy farms. The highest values of the index can be found for north-west European countries. It means that in the mentioned countries the highest level of biological advance was achieved, as one of the circumstances to introduce effectively the technical advance in dairy farms.

Discussion. Transformation of Polish dairy sector is characterised by many changes covering processes of dairy herds concentration, increase in milk quality, changes in milking capacity and other ones.

It is characteristic, especially in the first period of transformation, that reduction of the cow herds was noticed mainly in the public sector - on former state and co-operative farms, where the highest values of milking capacity per cow and highest concentration of cow herds were monitored. Including privately owned commercial farms total number of cows kept on big dairy farms amounted to 160,000 heads, i.e. 4,7% of cows' population in Poland. However, the biggest part of dairy cows stock (about 95%) was kept on small family farms. Reduction of the biggest cow herds characterised by high effectiveness of milk production and well established breeding programmes constitute one of the unfavourable aspects of the transformation process in Poland.

In the transformation period the milk production in Poland is based on small-scale dairy farms with low technical and technological level of production. Widely dispersed structure of raw milk production decides about low technical and technological level of the considered agricultural activity.

The market competition in the dairy sector considered in national and international scale put a lot different and at this same important requirements, especially in relation to quality of dairy products. This one is determined first of all by raw milk quality created directly on the dairy farms and all stages of milk production and procurement. Therefore permanent improvement of national standards concerning quality of raw milk was ranked among the most important activity in the period of dairy sector transformation in Poland.

It can be mentioned that at the beginning of the transformation period, the Total Bacterial Count (TBC) for milk produced on Polish farms amounted in general to 1-3 million per 1 ml. At this same time in the West European countries adequate values amounted to 30-50 thousand per 1 ml of raw milk. In order to adjust quality of milk to European standards the new Polish Standards referring to raw collected milk are introduced and from January 2007 only one class (extra) will be obliged in Poland.

Polish standard for collected raw milk include also, as obligatory condition - very important factor deciding among other things about quality of delivered milk from farm, i.e. temperature of raw milk. This one is determined as lower than 8 °C at the time of milk delivering.

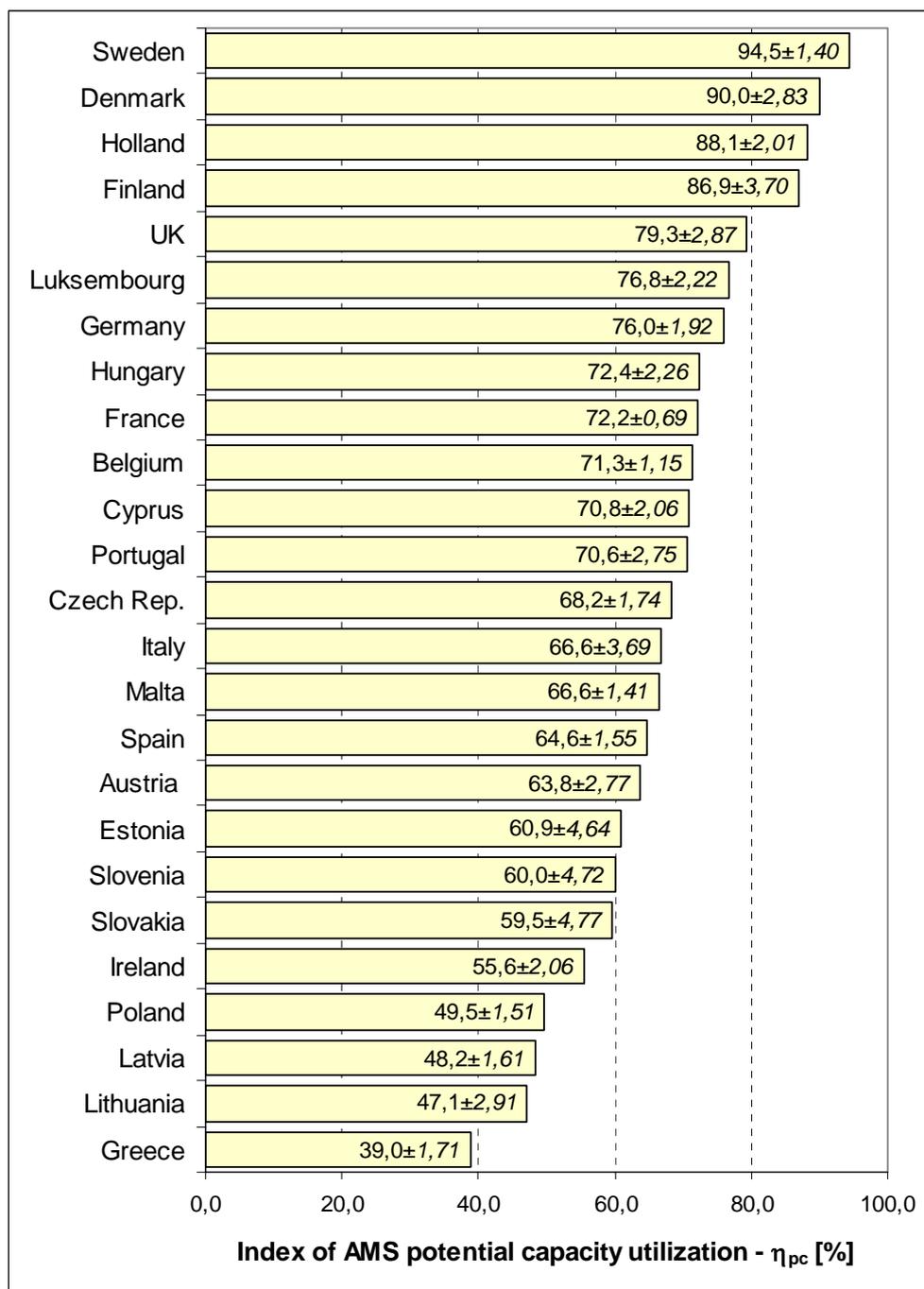


Figure 1. Comparison of index of utilization of milking robot potential capacity (η_{pc}) in selected European countries within the period 2000-2004 (source of data: www.fao.org)

The modernised standard for raw milk has found its expression in payment systems for ex-farm milk used by particular Polish dairy plants. Before the transformation period the payment systems were based mainly on evaluation of milkfat content and result of reductase test. At the present time the price paid farmers for delivered raw milk, besides milkfat includes additionally protein content and factors deciding about microbiological quality, i.e. level of total bacteria count and somatic cell count. Moreover, some dairy plants include also premiums for the following elements: amount of

delivered milk per month, cooling of milk to temperature below 6 °C, collection of milk every second day, collection of milk directly from dairy farm and others. It means that in the period of dairy sector transformation the suitably constructed payment system for ex-farm milk can constitute one of the most important factors stimulating process of milk quality improvement (Gaworski *et. al*, 1998).

It is also interesting to indicate on total number and especially structure of used milking machines and milk coolers on dairy farms. In 2002 the Polish dairy farms

were equipped with 262,000 bucket milking machines and only 10,600 pipe-line milking machines or milking parlours. Unfavourable structure was also noticed in the field of used milk coolers. In 2002 the modern tank milk coolers constituted only 32%, however 68% there were less effective in-churn milk coolers where using of small capacity cans for milk is necessary (CSO, 2002).

Conclusions. Comparison of the selected examples showing transformation processes in Polish dairy sector indicates on wide scale of the observed changes and their significant differentiation.

Moreover, the undertaken analysis indicate on importance of equilibrated development of particular elements creating complex dairy system for its globally considered effectiveness. Unfortunately, the dynamic changes in the field of quality standards for raw milk, resulting from current market economy requirements and consumers' needs, are not accompanied by proper rate of changes concerning structure of milk production on dairy farms. Concentration of milk production constitutes whereas, one of the basic conditions for effective equipment of dairy farms with milking machines and milk coolers, which are counted among the main factors deciding about quality of produced milk.

Therefore the further effective transformation of the Polish dairy sector depends on overcome some barriers of the sector development connected first of all with high dispersion in raw milk production and its low technology level, high dispersion of dairy processing and other ones.

As a result of the studies, there are scientific premises for identifying technical and biological solutions for optimising farm dairy production system, including sustainable improvement.

Implementation of dairy farms with modern technical equipment for milking needs simultaneous improvement of dairy cow herds and other factors, e.g. economic profitability.

The case study covering automatic milking systems confirmed, that modernisation of technical equipment in dairy farms should be coordinated with possible introduction of advance in areas connected with farm dairy production in order to use effectively and rationally the potentials contributed by technical advance.

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