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# Comparison of dairy potential in Europe and its effect on assessment of milking systems

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**Abstract.** The development of milking systems is one of the most important examples proving the dynamic improvement of dairy production on the basis of a technical infrastructure. Farm milking systems incorporate many technical solutions—this provides a basis for analysing and assessing different milking systems in use today. Milking systems can be evaluated on the basis of a set of data and indices directly connected with the work of milking installations. The purpose of the analysis is to show how different kind of milking systems can be assessed in view of milk and its selected features, especially the value of the milk.

**Key words:** assessment, milking system, dairy production, technical equipment.

## INTRODUCTION

It is possible to list many research problems concerning the assessment of dairy production systems as a set of elements, and the relationship between the elements.

The assessment involves most of the activities undertaken in a dairy system to identify advancement in the technical, technological, biological, economic and social aspects of dairy production.

Technical equipment, one of the most important elements in assessing the efficiency of a farm's dairy production, has provided the basis for many research analyses. A broad range of research projects indicate to the significance of technical facilities in barns and their substantial effect on the assessment of aspects like the level of comfort of dairy cows in the lying (Drissler et al., 2005), feeding (Fregonesi et al., 2004), milking (Wendl et al., 2000), and walking area (Haley et al., 2001) as well as the level of comfort resulting from microclimatic conditions created for animals in the buildings (Reppo & Pals, 2002).

Moreover, the technical equipment in a barn is investigated to find the most effective conditions for developing a farm's dairy production. The importance of equipment is highly evident in the area of milking. The analysis involves different kinds of milking systems. For example, milking parlour performance has been evaluated using primarily time and motion studies (Armstrong & Quick, 1986). Some procedures have also been used to evaluate the effect of different factors on milking parlour performance,

i.e., pre-milking hygiene, level of milk production, type of parlour, level of mechanization as well as construction (Armstrong et al., 1992).

The abovementioned examples of aspects to be considered emphasize that the individual assessment of technical potential in dairy production includes two categories, i.e., direct or non-direct contact with milk. The first category involves milking systems where the milk stream flows directly through the technical installation.

The milking systems can be evaluated with a set of data and indices directly connected with the work of a milking installation, while the purpose of this paper is to show how different kind of milking systems can be assessed in view of milk and its selected features.

## MATERIALS AND METHODS

A detailed analysis on milk may include qualitative and quantitative aspects. In this paper, only quantitative aspects are taken into account to explore some trends and their relations to milking systems.

Based on quantitative and economic data, some indices have been proposed in specialist literature for a comparative analysis of dairy production and its efficiency; for example, the index of dairy production development delay (Fernandes et al., 2014). The general formula for calculating the index of dairy production development delay ($i_{dpd}$) is as follows:

$$i_{dpd} = \frac{v_{\max} - v_c}{v_{\max}} \tag{1}$$

where: $v_{max}$ is the maximum value of the parameter in the set of countries and $v_c$ is the value of the parameter for the considered country.

The index can be used to compare differences between the biological and economic potential of dairy production in a selected country with the data of a set of other milk-producing countries. The index expressing dairy production value is based on data like annual milk yield per cow and price paid for the unit mass of purchased milk.

By extending some analyses concerning the developments in dairy production on the international scale, it was proposed to juxtapose the value of produced milk per cow in particular countries with the potential dairy production of these countries. Potential dairy production can be expressed with the index of dairy production share ($i_{ps}$), i.e., a quantitative share of the produced milk in a particular country in relation to the total amount of milk produced in the set of considered countries. Based on the milk value (produced by cow per year) and the index of dairy production share ($i_{ps}$), it is possible to calculate the value of dairy production significance ($v_{dps}$) according to the following formula:

$$v_{dps} = v_{dp} \cdot i_{ps} \tag{2}$$

where: $v_{dps}$ is the value of dairy production significance (in monetary units) per cow and per year; $v_{dp}$ is the value (in monetary units) of milk produced by cow per year, while $i_{ps}$ is the index of dairy production share (-).

In order to compare countries and their dairy production the next proposed step is to calculate the index of dairy potential diversification ($i_{dpd}$) according to the formula:

$$i_{dpd} = 1 - \left( \frac{v_{dps\max} - v_{dps}}{v_{dps\max}} \right) \tag{3}$$

where: $v_{dpsmax}$ is the maximum value of dairy production significance in the set of countries and $v_{dps}$ is the value of dairy production significance for the considered country.

The set of 28 EU countries was taken into account for this analysis. The FAO database (www.faostat.fao.org) was used to collect the following information about each country: total dairy production, annual milk yield per cow and price paid for one tonne of purchased milk. The data about the year 2012 were considered.

## RESULTS AND DISCUSSION

The set of data concerning dairy production in 28 EU countries is available in Table 1. Croatia is a member of the EU since 01 July 2013 but it was included in Table 1 and all the calculations.

The index of dairy production development delay was calculated on the basis of milk value data (Table 1) according to the general formula (1). The results of the calculated delay for the set of 28 EU countries are presented in Fig. 1.

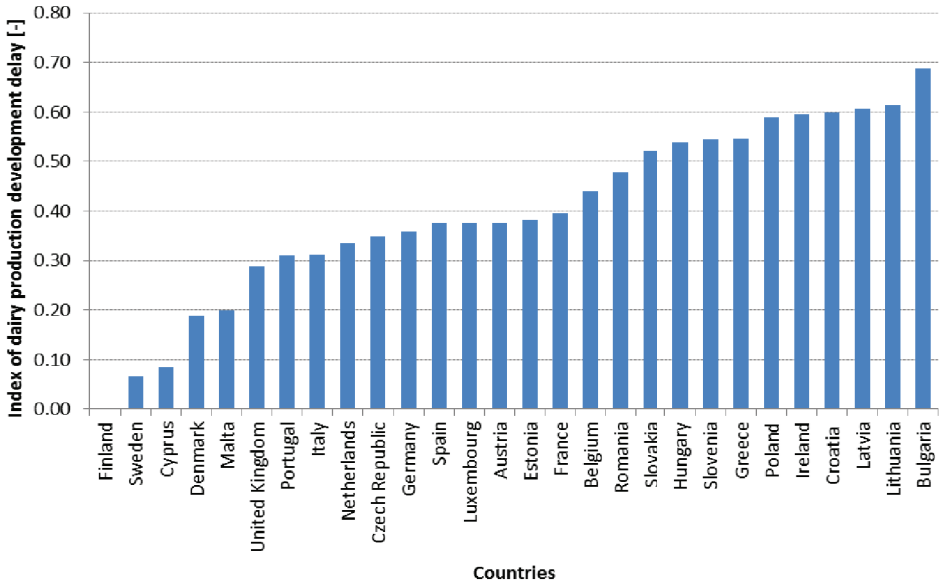


**Figure 1.** Index of dairy production development delay (Source: author).

**Table 1.** Dairy production data for 28 EU countries in 2012

| Country | Total amount of produced milk | Milk yield | Milk price | Value of milk |
|---|---|---|---|---|
| | tonne year$^{-1}$ | kg cow$^{-1}$ (year)$^{-1}$ | USD tonne$^{-1}$ | USD cow$^{-1}$ (year)$^{-1}$ |
| Austria | 3,382,076 | 6,418 | 452.6 | 2,904.6 |
| Belgium | 3,432,000 | 7,075 | 369.0 | 2,610.5 |
| Bulgaria | 1,093,034 | 3,562 | 409.1 | 1,457.3 |
| Croatia | 786,000 | 4,421 | 423.9 | 1,873.9 |
| Cyprus | 153,000 | 6,323 | 674.4 | 4,263.9 |
| Czech Republic | 2,814,680 | 7,633 | 398.2 | 3,039.6 |
| Denmark | 5,008,300 | 8,529 | 443.9 | 3,786.1 |
| Estonia | 720,718 | 7,492 | 384.5 | 2,880.6 |
| Finland | 2,296,676 | 8,098 | 575.6 | 4,661.1 |
| France | 23,983,197 | 6,583 | 428.0 | 2,817.3 |
| Germany | 30,506,929 | 7,280 | 410.3 | 2,987.0 |
| Greece | 800,000 | 3,738 | 566.7 | 2,118.5 |
| Hungary | 1,798,174 | 5,499 | 391.3 | 2,151.8 |
| Ireland | 5,379,700 | 4,716 | 401.0 | 1,891.0 |
| Italy | 10,579,572 | 5,921 | 541.8 | 3,208.0 |
| Latvia | 870,633 | 5,291 | 347.3 | 1,837.4 |
| Lithuania | 1,774,529 | 5,361 | 334.8 | 1,794.7 |
| Luxembourg | 289,395 | 7,266 | 399.9 | 2,905.5 |
| Malta | 43,360 | 5,940 | 628.2 | 3,731.3 |
| Netherlands | 11,675,448 | 7,577 | 409.2 | 3,100.3 |
| Poland | 12,667,773 | 5,189 | 368.6 | 1,912.7 |
| Portugal | 1,938,000 | 7,846 | 410.3 | 3,219.3 |
| Romania | 4,329,713 | 3,701 | 656.1 | 2,428.0 |
| Slovakia | 973,000 | 6,232 | 357.4 | 2,227.4 |
| Slovenia | 601,591 | 5,516 | 385.0 | 2,123.5 |
| Spain | 6,313,014 | 7,471 | 389.7 | 2,911.5 |
| Sweden | 2,901,000 | 8,717 | 499.3 | 4,352.4 |
| United Kingdom | 13,884,000 | 7,683 | 431.7 | 3,316.9 |

Source: faostat.fao.org

The general principle of the index was also used to calculate the index of annual milk yield per cow delay and index of milk price delay based on the data in Table 1. The two mentioned indices are displayed in Figs 2 and 3, respectively.

It is characteristic of the calculation method concerning different kinds of delays as well as for the results presented in the graphs (Figs 1–3) that the index amounts to 0.00 for the first country in the classification. Calculated values of delay show differences between a particular country and the best country in the set of data collected from 28 EU countries. This way it was possible to show the 'distance' (development gap) between regions of dairy production in Europe, including in view of important factors like annual milk yield per cow and price paid for raw milk, which have a decisive influence on a farm's dairy production efficiency.

On the basis of the analysis of some results gained through the calculations expressed with the three indices of delay discussed in this paper it can be claimed that Scandinavian countries have the lowest value of delay in view of the index of annual milk yield per cow, while the Balkan countries have the highest index values. The results

indicate to a clear regional diversification of certain dairy production conditions in Europe.

The group of countries with the lowest index of milk price delay includes countries with the smallest potential dairy production, i.e., Cyprus and Malta. The results suggest that small scale dairy production can inspire to implement more attractive economic tools, like the price paid for raw milk.

The comparison of dairy production development delay index values reveals considerable differences between the countries in view of existing premises for effective dairy production.

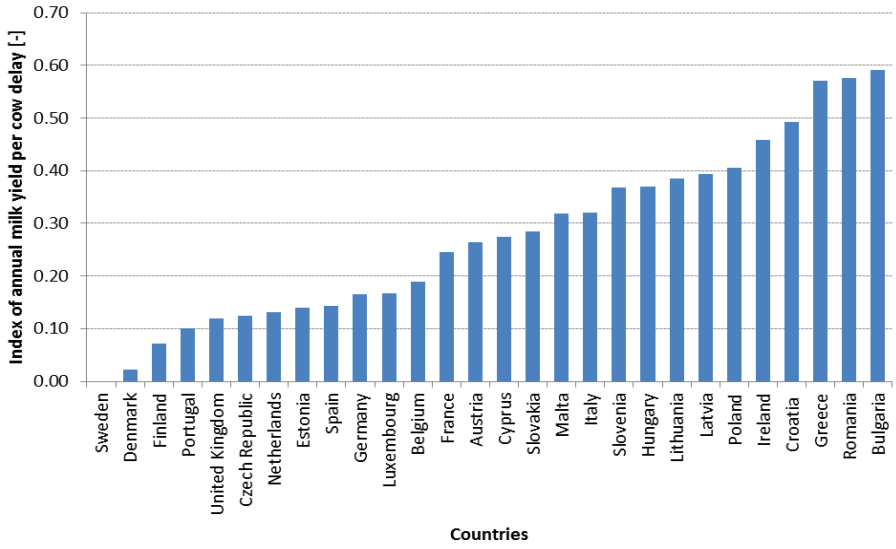


**Figure 2.** Index of annual milk yield per cow delay (Source: own elaboration).

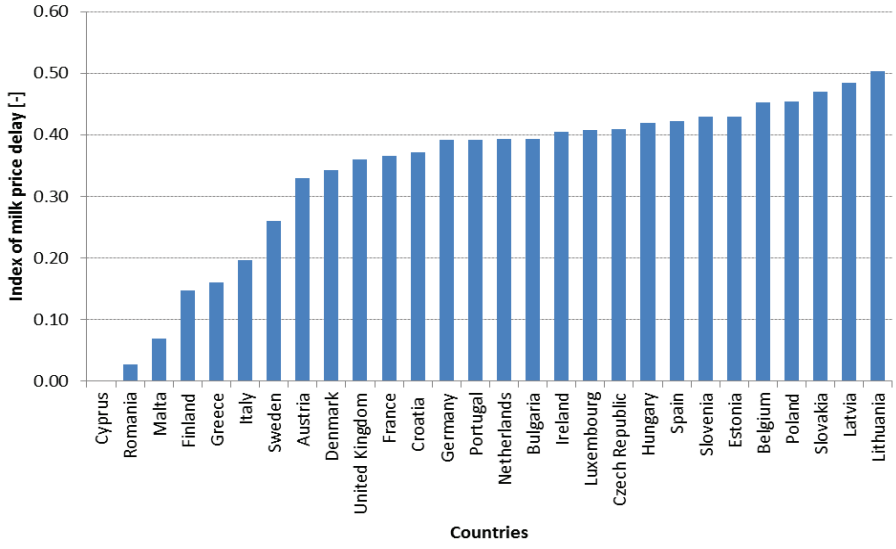


**Figure 3.** Index of milk price delay (Source: own elaboration).

The index of dairy potential diversification for 28 EU countries in Fig. 4

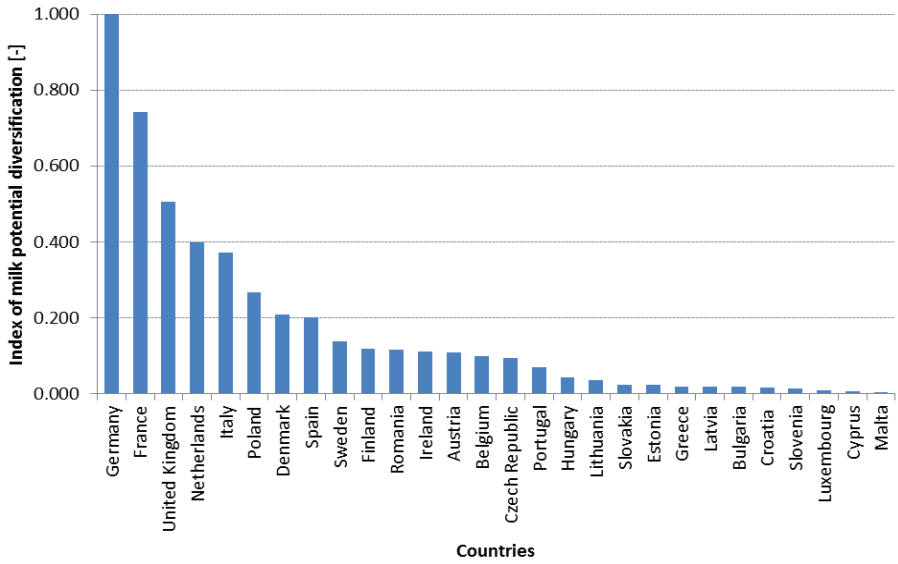


**Figure 4.** Index of dairy potential diversification (Source: author).

The index of dairy potential diversification concentrates on the most important features of dairy production on the national scale, including the value of produced milk by cow and amount of produced milk in comparison to the set of countries. Results of the index comparison (Fig. 4) indicate to considerable differences in potential dairy production in the 28 EU countries. Although the smallest countries are characterized by an attractive price for raw milk (Fig. 3), they have the lowest index values for dairy potential diversification. The differences between the countries primarily result from production potential expressed in the amount of produced milk.

The presented results confirm the differences between regions that produce dairy in Europe, including in view of some criteria of evaluation. The differences concern dairy production potential as well as the effects of using technical equipment like AMS (Gaworski et al., 2013) and other types of milking systems (Gaworski & Priekulis, 2014) in particular countries. In view of the efficiency of using milking systems, there are also other important factors that are manifested in the difference in dairy production. Dairy production can be stabile (month by month) in terms of the amount and value of milk collected from the farms. This is one of the most important factors confirming the effective use of technical potential in dairy production (Gaworski & Leola, 2014). Moreover, milk production regionalization (Parzonko, 2013) is a significant factor in dairy production assessment also within a specific country.

In order to underline the importance of some relationships between dairy production potential and different types of milking systems, the author presents the results of their calculations about Polish dairy farms equipped with the following milking systems: bucket, pipeline, milking parlour and AMS. The following data were collected from each of the investigated dairy farms: cow herd size, annual milk yield per cow, number of milking devices (or milking stalls for milking parlour and AMS), price paid for raw milk,

current value of milking installation, etc. Some results concerning the aforementioned relationship, i.e., the value (in PLN) of produced milk (per year) in proportion to the current value of the milking installation (in PLN) in the investigated Polish dairy farms have been presented in Fig. 5.

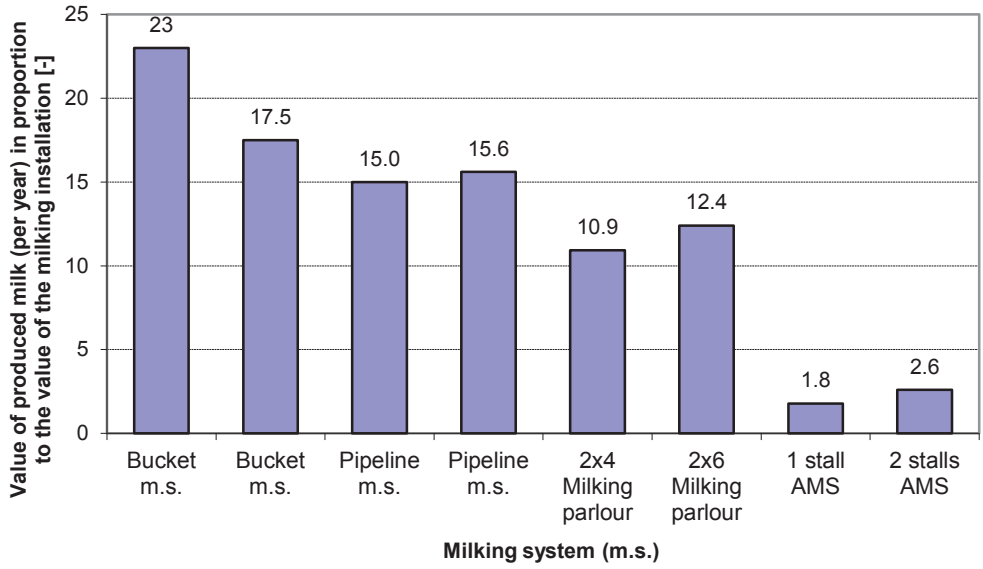


**Figure 5.** Value of produced milk (per year) in proportion to the value of the milking installation for Polish dairy farms (Source: author).

Analysis results (Fig. 5) contribute to the discussion on the significance of the value of produced milk in dairy farms in relation to such aspects as milking installations and data characterizing the technical equipment in dairy farms. It can be claimed that when milking equipment is modernized, the two types of values, i.e., that of produced milk and milking installations, become less closely connected.

## CONCLUSIONS

Results of the performed analyses show many possible comparisons of dairy potential can be made in the European dairy production sector to outline differences between countries and their dairy production. The proposed index of delay shows that some elements of the dairy production systems in the set of 28 EU countries are on completely different developmental levels.

The indices of delay as well index of dairy potential diversification are a possible approach for the assessment of dairy production systems on the international scale. Comparisons can also be made on a national or regional scale to find out ways how to increase potential dairy production as a result of using milking systems more efficiently.

Analysing milking systems in view of the value of milk in milking installations can be considered a necessary additional element of assessment to guarantee more precise results for comprehensive milking system assessments.

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