THE ECONOMIC IMPORTANCE OF PRODUCTIVE LIFETIME IN DAIRY CATTLE BREEDING

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Abstract: *Breeding dairy cows are profitable if milk and beef income exceed the total costs including materials, labour, housing, maintenance and other expenses over the cow's lifetime. Profitability of dairy herd is determined mainly by milk yield per lactation and the length of cow productive life which in intensive production system often does not exceed three lactations. Data were collected for 17 years from 2000 to 2016 from a dairy cattle farm in South-Hungary. Results from farm data as well as model calculations are reviewed to indicate some crucial features concerning longevity in dairy cattle breeding. From the farm data gathered the level of production is measured in separate phases of the lactation. The strongest correlation between the total milk yield and the productive lifetime was observed in the first phase (0-100 days) of the lactation. One day increase in productive lifetime resulted from 19.32 to 29.34 kg increasing of milk yield. From economic viewpoint it is an interesting question when is the point in the lactation the cows fall out of production.*

Keywords*: dairy cow economy, culling rate, productive lifetime, break-even point*

INTRODUCTION

Cow longevity and reasons for culling are one of the most important research problems in the dairy cattle breeding. Profitability of dairy herd is determined mainly by milk yield per lactation and the length of cow productive life which in intensive production system often does not exceed three lactations [1]. The length of productive life of dairy cow, defined as the number of days from first calving to culling, is an essential impact on the net returns in dairy production. The average Holstein cow would have about 27 months in milk in her lifetime.

According to Kern at al (2016) two definitions are used for longevity. True longevity defined as ability to avoid culling for any reason, which mainly depends on productivity, and functional longevity defined as the ability to delay involuntary culling. Functional longevity is an important component of profits from milk production because high longevity reduces rearing costs and purchasing replacement females, enables the animals to reach their age dependent maximum of milk production, and increases the proportion of higher yielding cows in the herd [7].

Culling of dairy cows is a serious economic decision. The frequently reasons for culling include low milk yield, lack of conception, availability of replacements, high parity and various health disorders [13]. They analysed 7067 cows data in Iranian dairy herds. 3904 (56.4%) were in the first and 3163 (43.6%) were in the second lactation of these cows. In total, 22.1% cows were culled; these were 18.4 and 26.6% of the first and second parity cows. On other study (Brian at al, 2000) of the tested animals, 9.0% were culled prior to first lactation and 15.4% were culled during first lactation for a total culling risk prior to second lactation of 24.4%.

Researchers are trying to improve profitability through selection solutions. Selection for more profitable cows in the United States began with selection improvements in milk protein percentage in dairy cows. Later, traits were combined to form selection indices

including yield traits, service sire calving ease, daughter calving ease, daughter pregnancy rate, and body conformation traits. Lifetime profit index includes most of the traits that affect the profitability of a dairy cow [8].

During the past 10 years, researchers have become increasingly interested in measuring the genetic ability of a dairy cow to resist culling. This research has focused on direct analysis of culling information, and indirect analysis using traits correlated with the cow's ability to resist culling [5].

MATERIALS AND METHODS

The correlation between the productive lifetime and the milk yield of dairy cows are examined in present paper. The level of production is measured in separate phases of the lactation. Data were collected for 17 years from 2000 to 2016 from a dairy cattle farm in South-Hungary. Beyond the calculations, a break-even analysis is also made. Information on the 1508 culling of the cows was used first parity in the of cumulative estimation lifetime milk production. Culling rate was analysed in five different period of the lactation. The first period was the first 100 days after calving, the next were between 100 and 200 days, 201-400, 401-600, and more them 600 days. A general linear regression model was used to evaluate correlation between the milk yield and productive lifetime. The statistical analyses were performed with SPSS22.0 and Excel 2016 softwares.

RESEARCH RESULTS

Cow longevity and lifetime performance traits are good indicators of breeding effectiveness and animal welfare. They are also interrelated with the profitability of milk production. Unfortunately, a high milk yield is often associated with worsened cow health and fertility and, consequently, with an increased culling rate. This situation, observed in some Hungarian farms, inspired us to undertake a study on the associations between some factors and lifetime performance characteristics. According to our experiences infertility and reproduction problems as well as udder diseases (especially mastitis) and lameness constitute the most frequent reasons for cow culling.

Functional longevity can be defined as the number of days from first calving to culling, death, or censoring; adjusted for the effect of milk yield (Sewalem et al, 2008). According to the results of Beaudeau et al (1995) the probability of a cow being culled increased in early and late stages of lactation in older cows, in low producing cows, and in cows with poor reproductive performance. Gröhn et al (1998) did not find any effect of calving season on culling. At the same time, Schneider et al (2007) found that open cows had a pronounced effect on culling: they had a very high risk of being culled in all lactations, and it was even higher if they were treated for mastitis in early lactation. According to the data of Neerhof et al (2000) cow with mastitis had 1.69 times greater risk of being culled than did a healthy herd-mate with all other effects being the same.

When a dairy farm can generate only a moderate profit as well as the economic circumstances do not change so reliably the farmer usually tries to find the break-even point. This point shows the production level at which the revenue exactly covers the production costs. Thus, the production can be considered as profitable exclusively above the break-even point. Regarding the analysed farm the break-even point of milk production was determined by the use of model calculation. However, these calculations in their form are not necessarily useful for farmers in making economically optimal decisions depending on individual cow characteristics. At the same time this model would serve a more informed decision-making process in dairy management to avoid serious economic losses. Thus, this model can provide farmers economically optimal guidelines specific to their individual cows suffering from different health and fertility disorders.

Table 1

Model calculation of break-even point of milk production

Denomination	Values
Fixed cost/cow (EUR)	460
Value of by-product/cow (EUR)	39
Variable cost/kg milk (EUR)	0,25
Milk producer price/kg (EUR)	0,3
Break-even point (kg)	8667

According to the calculation shown in Table 1 the break-even point in the case of milk production in general circumstances is 8667 kilograms. It means that this minimum yield should be reached to production costs be exactly covered. The examined farm, except the first and second years, produce more milk in average than the critical level.

It is also important to know how the productive lifetime and the overall milk yield correlate. On the basis of our data analysis it can be stated that all additional day in production result 24 kilograms more milk yield.

Table 2

Statistical model of regression analysis during the examined period

Productive lifetime in the first lactatrion (days)	Regression function	R^2
0-100	Y= 27.264x - 21.71	0.8836
101-200	Y= 29.34x + 125.29	0.4687
201-400	Y= 21.632x + 1860.9	0.3906
401-600	Y= 19.322x + 2748.3	0.271
601-	Y= 23.135x + 951.14	0.5383
Total lactation time	Y= 24.258+ 388.17	0.9559

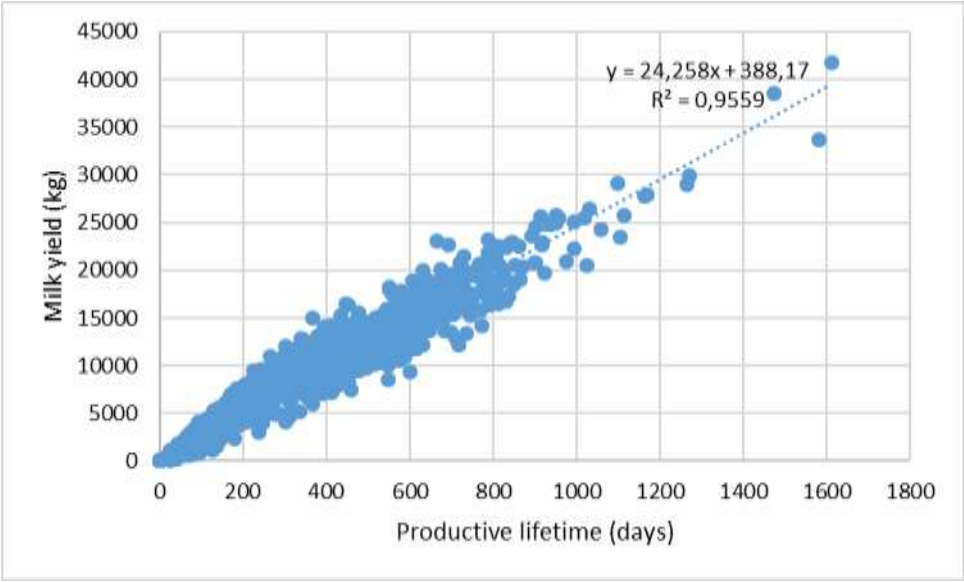

Figure 1. Correlation between the productive lifetime and the total milk yield in the first lactation

Regression analysis (Fig 1.) was applied to discover how many milk yield difference in kilograms is associated with the differences in productive lifetime. The results of the

linear regression showed a strong correlation between the productive lifetime and the milk production (R^2 =0.95).

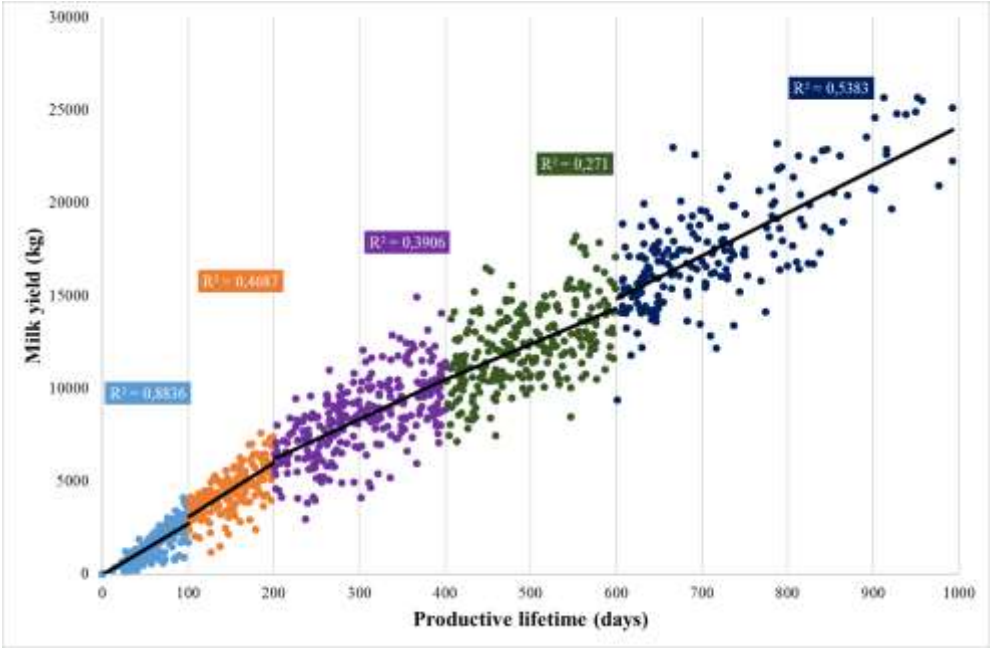

Figure 2 Correlation between the productive lifetime (in different phases of lactation) and the total milk yield

When the lactation phases were examined there were different relationships between the lifetime and the milk production (Fig 2.). The strongest correlation was observed in the first phase (0-100 days). Over the lactation the productive lifestyle impact on milk yield less strong. One day increase in productive lifetime resulted from 19.32 to 29.34 kg increasing of milk yield (Table 2). The largest increase, 29.34 kg, was observed in the second phase (lactation days 101-200).

From economic viewpoint it is an interesting question when is the point in the lactation the cows fall out of production. We analysed the percent of the culling in different lactation stage. The extreme values of this parameter were 11.8% and 37.47%. We found that the 37.47% of the culled cows did not spend more time with production as 100 days (Table 3). According to Andony (2015) early lactation cows are at a threefold greater risk to develop clinical ketosis, increased risk of metritis, cystic ovarian disease and reproductive problems.

Table 3

Ratio of culling time during the lactation

Productive lifetime in the first lactatrion (days)	Number of cows	Ratio from the total number of cow
0-100	565	37.47%
101-200	178	11.80%
201-400	288	19.10%
401-600	265	17.57%
601-	212	14.06%

CONCLUSIONS

Results from farm data as well as model calculations are reviewed to indicate some crucial features concerning longevity in dairy cattle breeding. It can be natural that overall milk yield and the productive lifetime are in strong positive correlation. However, when the different lactation phases are examined, distinguished results can be found. More than one-third of the cows are culled earlier than 100 lactation days. Then the culling rate is decreasing during the lactation. Though, the number of culled cows increases in the third phase but it is not significant. There is an intense need to minimize the involuntary culling of cows by providing appropriate feeding and management so that more of cows can be saved in herd, which will in turn facilitate in increasing milk production. Farmers at first have to cover fixed costs while variable costs also occur. When the producer price of milk is moderate the critical yield appointing the break-even point is relatively high. The farm-level milk yield can principally maximise by keeping the cows in production for a long time.

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