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## **THE IMPACT OF DAIRY CATTLE WELFARE ON FARMS INCOME**

### *WPLYW DOBROSTANU BYDŁA MLECZNEGO NA WYNIKI EKONOMICZNE GOSPODARSTW*

**Key words: animal welfare, dairy cattle, net farm income, milk production**

*Słowa kluczowe: dobrostan zwierząt, bydło mleczne, dochód rolniczy netto, produkcja mleka*

**Abstract.** The paper presents estimation of selected factors impact on dairy farms income. Data used in the study were collected under the EDF program in 22 European countries. It was analyzed using the linear regression method. Factors related to animal welfare, farms' resources and milk production were taken into account. It was found, that net farm income is significantly affected by access to pasture and culling rate. There is no statistically significant impact on net farm income in the case of milk yield, period between calvings and milking frequency. Analysis model shows, that farms using pasture obtain higher net farm income than if they had not benefited from the pasture. On the other hand, increasing culling rate caused decrease in the net farm income. Mentioned factors are related to animal welfare. It confirms its influence on farms income.

### **Introduction**

Animal welfare problems are very topical. It has been widely discussed at the forum of European Commission. The general conclusion was that there is a need to clarify and upgrade existing animal welfare standards. The first animal welfare requirements in European Union were implemented within the legal directive in nineties. Later, the Luxembourg Common Agricultural Policy reform in 2003, included the animal welfare requirements in cross-compliance standards. The Community Action Plan on Animal Welfare is another manifestation of the ongoing discussion [Malak-Rawlikowska et al. 2010].

The concept of animal welfare has been defined in many different ways [Herbut, Walczak 2004, Kołacz, Bodak 1999, Malak-Rawlikowska et al. 2010]. Welfare is sometimes defined in relation to animals' ability to control their environment [Broom 1986] or in relation to their ability to adapt to environmental conditions [Broom 1996]. It is also defined as animals' feelings [Duncan 1996] or a state in which animals can live in harmony with their environment [Hurnik 1995 after Pisula 1999]. The animals' rights to be treated humanely in accordance with their nature and natural environment are very important here [Benson, Rollin 2004].

Animal welfare requirements raise important implications for the economics of farms [Lewandowski 2008b]. Production index, such as milk yield, is a very sensitive marker of animals health, and therefore the level of their welfare. Healthy animals reach better production results [Kołacz 2006]. It was found, that approximately 30% of differences in milk yield between two observed herds was linked to the level of fear, which was felt by dairy cows in relation to people [Walczak 2005]. According to other research, fear factor was responsible for 19% of the differences in milk yields [Breuer et al. 2000]. It was found, that cows treated gently produced 600 kg milk/year (13%) more than animals treated brutally [Walczak 2005].

That issue of animal welfare, is however, not sufficiently explored in the available literature. There are many articles describing the impact of selected welfare parameters on the health and productivity of animals, but only a few publications refer to the economic performance and farms' income. For this reason, it is reasonable to undertake the research in this field.

The paper aims to examine the dependence between selected characteristics and parameters of dairy farms and achieved income. Particular attention was paid into factors related to the farm animal welfare.

### **Materials and methods**

Data used in the study were collected under the EDF (European Dairy Farmers<sup>1</sup>) program in 256 farms representing 22 European countries. Linear regression model based on this data was constructed. That method allows for adequate analysis of data and ensure reaching the objective of the study.

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<sup>1</sup> Data from international research programme

**Table 1. Independent variables and its selected characteristics**  
*Tabela 1. Zmienne objaśniające i ich wybrane charakterystyki*

Variable/ Zmienna	Description/Opis zmiennej	Parameter estimate/ Parametr	p-value
Intercept/ Wyraz wolny	intercept/wyraz wolny	-27.49934	<.0001
$x_1$	culling rate/współczynnik brakowania krów	-0.11986	0.0029
$x_2$	family labour resources/zasoby pracy rodzinnej	2.61883	<.0001
$x_3$	hired labour resources/zasoby pracy najemnej	0.02984	0.0337
$x_4$	access to pasture/dostęp do pastwiska	1.86811	0.0217
$x_5$	share of forage area leased/udział dzierżawy w powierzchni paszowej	-0.03172	0.0058
$x_6$	calves (bulls) price/cena byczków	0.01667	0.0020
$x_7$	share of milk quota leased/udział dzierżawy w kwocie mlecznej	-0.15233	<.0001
$x_8$	milk price/cena mleka	69.91073	<.0001
$x_9$	milk produced from roughage/ mleko wyprodukowane z pasz objętościowych	0.00114	<.0001
$x_{10}$	the participation of milk revenues in total revenues/ udział przychodów z mleka w przychodach ogółem	0.09592	0.0001

Source: own study

*Źródło: opracowanie własne*

The Net farm income [PLN/100 kg ECM<sup>2</sup>] was taken as dependent variable. The starting set of independent variables included 40 variables. Factors related to animal welfare, farms' resources and milk production were taken into account.

In order to select the best set of independent variables the backward regression method was used. Previously, variables uncorrelated with dependent variable and outliers had been eliminated. Table 1 contains independent variables which finally entered into the model. All variables are statistically significant at the 5% significance level. The resulting model is as follows:

$$y = -0,12x_1 + 2,62x_2 + 0,03x_3 + 1,87x_4 - 0,03x_5 + 0,02x_6 - 0,15x_7 + 69,91x_8 + 0,001x_9 + 0,1x_{10} - 27,5$$

Constructing the linear regression model the Law of Great Numbers was used – all distributions tend to normal distribution with sufficiently large samples.

**Table 2. The results of selected tests for linear regression model**  
*Tabela 2. Wyniki wybranych testów dla modelu regresji liniowej*

Test/Test	Test statistic/ Statystyka testowa	p-value
Cramer von Mises/Cramer 'a von Mises 'a	0.02812767	>0.250
Anderson-Darling/Anderson 'a-Darling 'a	0.18988280	>0.250
White's	65.69	0.4182
Ramsey's Reset test – power/poziom:		
2	1.9645	0.1624
3	1.0062	0.3672
4	0.9336	0.4252

Source: own study

*Źródło: opracowanie własne*

The model explains the variability of net farm income in 55.8% (R-Square = 0.558) and is statistically significant. The rests of the model are normally distributed (results of test for normality are presented in table 2), there is no problem of heteroscedasticity (White's test results are presented in table 2), and collinearity (variance inflation under 2.0 for all variables). The correctness of functional form has been confirmed with Ramsey's reset test (the test results are presented in table 2).

## Results and discussion

Many various farms characteristics and parameters were used for the model in order to obtain the best explanation of net farm income variability, including parameters related to the welfare of dairy cattle (access to pasture, culling rate, period between calvings, milk yield and milking frequency). Those parameters will be described in details due to the objective of the study.

Access to pasture is one of the significant variables explaining the variability of net farm income. Farms using pasture obtained higher net farm income (by 1.87 euro/100 kg ECM) than if they had not

<sup>2</sup> Energy-Corrected Milk

benefited from the pasture (assuming *ceteris paribus*). It is a significant positive impact. Providing animals with access to pasture is resulting in an additional NFI of 3740 euro per year for a medium size farm maintaining 25 dairy cows and producing 200 000 kg ECM. It might be supposed, that this result is related both, to improved health status of animals, and lower costs of feeding. Keeping dairy cows year-round inside the building raises many implications for animal welfare, including: predisposition to various diseases and behavioral changes, limitation of movement, increased stress levels [Sossidou et al. 2004]. Lack of pasture and limitation of movement affects the incidence of lameness [Lewandowski 2008a] and reproduction [Grzegorzak et al. 1983]. On the other hand, regular access to pasture or outdoor run increase health of animals [Keil et al. 2006, Loberg et al. 2004]. Providing animals with regular access to pasture, possibility to physical exercises and ability to express their natural behaviour reduce veterinary costs. There is a need to ensure high-milk-yield cows an appropriate share of concentrates, however, it is also necessary to provide them with roughage. Roughage in the form of forage is undoubtedly cheaper than in the form of silage and hay. Therefore, feeding costs are reduced. Costs of feeding and veterinary treatment are one of the most significant direct costs in milk production. Significant savings in that costs translate into increased profitability of milk production.

Another important factor influencing the net farm income is culling rate. The research shows, that culling rate increased by 1% would cause a decrease in net farm income of 0.12 euro/100 kg ECM (assuming *ceteris paribus*). In the case of farm mentioned above, it would result in a decrease of net farm income by 240 euro per year. This result has also substantive explanation. Increased culling rate causes higher costs of herd replacing. There is a need to have more heifers in order to replace cows, which have to be sold because of healthy problems. Growing up heifers hold places in cowshed, which could be dedicated to cows. In the case of buying heifers instead of breeding them, costs are even higher. Culling rate could be decreased by providing animals with better conditions, e.g. access to pasture, ability to regular movement, high quality of feed, friendly staff. Cows living in better conditions produce more milk and are less lucky to get sick or injury. That extends their life. In addition, veterinary costs are also reduced.

Other factors associated with animal welfare were not statistically significant at the 5% significance level. Most of studies farms milked cows twice a day. Higher frequency of milking increases animal welfare, but at the same time increases its costs. That is why, from a practical point of view, only 2-3 times per day milking is taken into account instead of more often practices. [Barej 1991]. The studied farms were also characterized by relatively low volatility of period between calvings. This may cause irrelevance of this variable. However, the practice of extending the between calvings period, used in herds with high yields (over 8000 kg milk per cow per year) promotes animal welfare improvement [Walczak 2005].

It should be noted that a positive and statistically significant impact on farm income was found also in case of the following factors: family labour resources, hired labour resources, calves and milk price, milk produced from roughage and participation of milk revenues in total revenues. The positive impact of these factors emphasizes their importance to the farm income. If family labour resources increase by one unit the net farm income increases by 2.62 euro/100kg ECM (assuming *ceteris paribus*). All those factors make farm production more profitable and enhance its competitiveness relative to other activities. On the contrary, the negative and statistically significant impact on farm income was determined for share of forage area leased and share of milk quota leased.

## Conclusions

Presented research confirmed the impact of animal welfare increase on dairy farms income. Two of five variables related to animal welfare influenced dairy farms income with statically significance. The linear regression model shows, that farms using pasture obtain higher net farm income by 1.87 euro/100 kg ECM than if they had not benefited from the pasture. On the other hand, increasing culling rate caused decrease in the net farm income by 0.12 euro/100 kg ECM. In the case of medium size farm maintaining 25 dairy cows and producing 200 000 kg ECM that means changes in NFI respectively by 3750 euro and 240 euro per year.

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### **Streszczenie**

*W artykule przedstawiono oszacowanie wpływu wybranych czynników na dochód rolniczy netto gospodarstw mlecznych. W badaniu wykorzystano dane zebrane w ramach EDF w 22 krajach europejskich i metodę analizy regresji liniowej. Uwzględniono czynniki związane z dobrostanem bydła, zasobami gospodarstwa oraz produkcją mleka. Stwierdzono, że na dochód rolniczy netto istotny statystycznie wpływ ma m.in. dostęp do pastwiska oraz współczynnik brakowania krów. Statystycznie istotnego wpływu nie stwierdzono natomiast w przypadku wydajności mlecznej krów, okresu międzywycieleniowego i częstości doju. Stwierdzono, że gospodarstwo zapewniające zwierzętom dostęp do pastwiska uzyskuje wyższy dochód rolniczy netto niż gdyby z pastwiska nie korzystało. Natomiast wzrost współczynnika brakowania krów o 1% powoduje spadek dochodu rolniczego netto. Wymienione cechy i parametry gospodarstw związane są z dobrostanem bydła mlecznego. Potwierdza to jego wpływ na efekty ekonomiczne gospodarstw.*

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