

PROFITABILITY ANALYSIS OF LIMOUSIN CATTLE ORGANIC FARMING COMPARED TO THE CONVENTIONAL CATTLE MANAGEMENT SYSTEM

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ABSTRACT

The aim of the study was to analyze the profitability of organic farming of Limousin cattle and to compare selected production parameters with the conventional management system. The material involved 39 cows and their offspring from an organic farm and 81 cows with calves kept on a conventional farm, both located in West Pomerania, Poland; the data were retrieved from the "BOS" database system. Body weight of calves was established at birth and at weaning (converted to standardized body weight at 210 days of age), weight gains of calves from birth to 210 days and cow's milk yield. In the organic farm, basic analysis of the profitability of beef production was carried out when selling bulls around 250 kg in live weight. The average weight of Limousin calves at birth was significantly higher in the organic farm compared to those born in the traditional farming system, whereas at 210 days of age, the calves from the latter system were characterized by a higher body weight. They also attained greater body weight gains, and their mothers were characterized by better milk yields. It was also found that in the organic farm the parameters were more favorable in heifers compared to bull calves. The analysis of the economic effects of beef production on an organic farm showed that the total production costs including overhead summed up to PLN 2,581, and the production cost of 1 kg live weight was at the level of PLN 10.33. The profitability parameters, including direct payment and without it, were 122% and 106%, respectively.

Key words: Limousin cattle, rearing, organic production system, production costs, economic effect

INTRODUCTION

Ecological production methods address the best practices applied in agriculture and – according to the International Federation of Organic Agriculture Movements (IFOAM) – produce high quality food using natural production methods, without compromising the biological balance in the natural environment. The priorities in the organic farm management involve high standards of hygiene and animal welfare, intact biodiversity and protection natural resources, so as to sustain the advantageous interactions between the farm and the ecosystem [Grykień 1997].

According to Smoluk-Sikorska [2010], organic agriculture has been rapidly growing on most continents, involves 140 countries and amounts to a total of 32 million hectares of arable land, of which 25% is located in the European Union. A report by Poland's Inspection for Trade Quality of Agricultural and Food Products (IJHARS), the popularity of organic farm products in Poland is growing constantly from year to year. In 2016, the area of arable land cultivated used for organic farming reached nearly 540,000 ha, including over 100,000 ha in the West Pomeranian Voivodeship alone [IJHARS Report 2017].

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The expansion of organic farming has mainly be a result of subsidies to farmers granted by the state in order to support development and strengthening of organic agriculture in the degraded areas [Prokopowicz et al. 2007, Smoluk-Sikorska 2010]. The demand for organic products also increases as a result of unfavorable circumstances and consumer experience, such as BSE epidemics, escalating lifestyle diseases or allergies resulting from consumption of mass-production foods [Żelezik 2009, Kociszewski 2014]. Polish organic farms have a larger area of permanent grassland in relation to traditional farms.

This also pertains to animals production carried out on organic farms, such as organic cattle production, which does not require much labor. The population of organic beef cattle producers is increasing with the growing profitability of this farming method. Beef cattle production conditions are particularly advantageous in the north-eastern and western parts of Poland, due to large pasture areas, lands regained from former state-owned farms, and the access to numerous barns and sheds [Prokopowicz et al. 2007]. The most common beef breeds suitable for organic cattle farming in Poland include Charolais, Simmental, Blonde d'Aquitaine, Chianina, Limousin, Piedmontese, Aberdeen Angus, and Hereford. The decision of which breed should be chosen depends on many factors, including: climate, grazing conditions, available housing facilities or production purpose. Beef cattle production should be based on individuals which will have the desired traits of conformation suitable for low intensity of production. A long grazing period in the pasture also requires grazing cattle to quickly adapt to local conditions and climate. These factors affect the final effect of production and underlies its profitability [Strzetelski et al. 2004].

Organic cattle farming usually involves free-ranging management system with feeding heavily based on pasture forage. Also housing is extremely limited, with hardy breeds, well adapted to cold climate, often grazing around the year. Extensive rearing and finishing system means reduced production costs, also through feeding inexpensive roughage (hay, haylage, green forage). Extensive grazing positively affects reproduction and calf rearing, improves body weight gains, overall health status and body condition scores. Beef cattle reared in an organic farming system is a source of high-quality beef, valued for both taste and technological properties [Makulska and Węglarz 2001].

The aim of this paper was to analyse the profitability of Limousin cattle organic farming and a comparison of some performance parameters with a conventional beef cattle management system in the West Pomeranian Voivodeship, Poland.

MATERIAL AND METHODS

The study was carried out on two, Limousin rearing farms located in the West Pomeranian Voivodeship, near Drawsko Pomorskie, Poland. Both farms are similar in terms of the land area (more than 1000 ha each), however, differ in the structure of the used lands. The farm where ecological production is carried out, 70% of the area is arable land, 10% represent meadows and pastures, and as much as 20% are lakes, forests and barren lands. Organic plant production includes grasslands and mixed forages composed of grass and small-seed legumes. A part of meadows are incorporated into the protective zone of the Drawski Landscape Park. The other farm is in 80% on arable land, 13% are meadows and permanent grassland, the remaining 7% are forests and barren. Both farms are primarily focused on crop production, including rapeseed, barley, wheat and triticale; however, the decision to start Limousin cattle production on both farms resulted from the need to utilize a fairly large area of otherwise useless meadows and pastures. The farms differ as to location of the meadows and the management of the grassland. One of the farms possesses meadows located within the ecologically vulnerable area surrounding the Landscape Park, hence the decision to undertake ecological, extensive management system, which conforms to the current regulations on the maximum grazing herd sizes and seasons of forage harvest and grazing; also, no fertilizers are applied in this area. The other farm utilizes its grasslands intensively (maximized herd size, 2-3 grass harvests, fertilizing, remedial crop cultivation).

In the organic farming system, a herd of about 70-80 cows with their calves remains on pasture from May through November, maximally utilizing the permanent grassland. During the bad weather season, the herd is driven to an enclosure with sheds bedded with fresh, regularly replenished straw. The pasture ration is supplemented with green forage harvested from the meadows. During the winter management (housed), the cattle is fed basically on haylage and hay. In order to improve body condition, concentrates are occasionally supplied to the herd. Calves are under maternal nursing until 7-9 months. Besides the mother's milk, calves have access to green forage while on pastures. Bull-calves weighing about 250 kg are intended for sale or further rearing; heifers, on the other hand, are left as herd replacement.

On the other farm, a herd of about 100 cows are managed in a similar way, with the difference that intensive finishing is applied on pasture using a constant addition of concentrates. Also, bull-calves are reared up to a higher body weight (about 400 kg).

The studies on the organic farm directly involved 39 cows with their calves, whereas 81 cows with calves were observed on the conventional farm. The data on the herds were collected from the "Bos" database system. Analysis

included body weight of calves at birth and at weaning, weight gains of calves from birth to 210 days of age, and milk yields of the cows. The body weight of the calves on weaning was adjusted to 210 days. On the organic farm, a basic analysis of the profitability of beef production was carried out using sale data of bulls of around 250 kg.

The 210-d adjusted body weight of calves and milk yields of cows was estimated using the following formulas [Journal of Laws No. 47, pos. 470, 1999]:

$$MCS = \frac{MCB - MCU}{WW} \times (WS - WW) + MCB$$

where:

- MCS – adjusted body weight, kg
- MCU – actual body weight measured between the day of birth and 5 days after birth, kg
- MCB – actual body weight measured on the day of weighing, kg
- WW – age of the animal, days
- WS – adjusted age of the animals, days

$$M = \frac{C \times 1700}{W}$$

where:

- M – estimated milk yield, kg
- C – calf body weight at weaning, kg
- W – calf age at weaning, days

The data were analyzed statistically, Student's *t*-test was applied in order to test the significance of differences. We used Statistica 7.1. PL data analysis package for the purpose.

RESULTS AND DISCUSSION

Table 1 presents the results of raising bull calves and heifers from birth to seven months of age in the organic farm. During that time, young animals had unlimited access to mother's milk, and from May to November, together with their mothers, they also benefited from access to pasture forage. In the discussed farm, heifers had significantly ($P \leq 0.01$) higher body weights at birth (35.6 kg). At the age of 210 days (weaning), the mean body weight ranged from 227 kg, in bulls, to 266 kg, in heifers. The difference of almost 40 kg in body weight at this age in favor of heifers proved to be statistically significant ($P \leq 0.01$). The higher body weight of heifers at 210 days translated into significantly higher ($P \leq 0.05$) body weight gains (nearly 1100 g) in this period compared to bulls (over 900 g). To a large extent, this could be related to better milkiness of heifers (over 2100 kg of estimated milkiness) than mothers feeding bull calves [over 1800 kg of milk]. Differences in the estimated milk yield

of both groups of cows were found to be statistically significant ($P \leq 0.05$).

On the conventional farm, no such clear differences were found between heifers and bull calves (Table 2). Bull calves (33.9 kg) and heifers (33.5 kg) had comparable body weights at birth, though over 1 kg lower than calves born on an organic farm. The body weight of bulls at 210 days on this farm was slightly higher (over 8 kg) compared to the body weight of heifers of the same age. Therefore, in both groups of animals, weight gains up to 210 days of age were at a similar level of 1060 g. The milk yield of mother cows was slightly different in the group of bulls (2150 kg) and heifers (2095 kg). When comparing the results of breeding Limousin bulls on the conventional farm at 210 days of age, it should be stated that they had much higher body weights and greater gains compared to bulls raised on the organic farm, and mothers were characterized by better milkiness.

Table 1. The results of maternal nursing of bull calves and heifers on the organic farm

Tabela 1. Wyniki odchowu buhajków i jałówek przy matkach w gospodarstwie ekologicznym

Sex – Płeć	Masa ciała Body weight		Body weight gains, g Przyrosty masy ciała, g	Mothers' milk yield, kg Mleczność krów matek, kg	
	at birth urodzeniowa	at 210 days 210 dzień			
Bull calves	\bar{x}	35.0**	227.7**	917*	1843.3*
Buhajki	S	1.47	10.0	46.8	81.3
n = 13	V%	4.20	4.41	5.10	4.41
Heifers	\bar{x}	35.6**	266.1**	1097*	2154.2*
Jałówki	S	1.16	20.5	98.2	165.9
n = 26	V%	3.30	7.70	8.96	7.70

** Differences in columns significant at $P \leq 0.01$; * differences in columns significant at $P \leq 0.05$.

** Istotne różnice w kolumnach $P \leq 0,01$; * istotne różnice w kolumnach $P \leq 0,05$.

Table 2. The results of maternal nursing of bull calves and heifers on the conventional farm

Tabela 2. Wyniki odchowu buhajków i jałówek przy matkach w gospodarstwie konwencjonalnym

Sex Płeć	Masa ciała Body weight		Body weight gains, g Przyrosty masy ciała, g	Mothers' milk yield, kg Mleczność krów matek, kg	
	at birth urodzeniowa	at 210 days 210 dzień			
Bull calves	\bar{x}	33.9	265.3	1064	2150
Buhajki	S	2.76	24.76	195.4	233.4
n = 37	V%	8.14	9.33	18.3	10.4
Heifers	\bar{x}	33.5	257.0	1060	2095
Jałówki	S	2.95	21.97	104.9	200.8
n = 44	V%	8.81	8.81	9.9	9.58

Table 3 compares the results of calf rearing on the organic farm and the conventional farm. On the former, significantly ($P \leq 0.01$) heavier limousine calves were born compared to the conventional farm; it is difficult to guess what had caused this, though. Calf body weight analysis at 210 days of age in both farms showed that the value of this trait was significantly ($P \leq 0.05$) higher in the conventional system. Body weight gains of the calves from birth to 210 days was high and exceeded 1000 g (slightly higher were in the conventional system), which was probably related to the fact that calves had access to cow's milk throughout this period. Higher weight and body growth on a conventional farm than organic farms should be explained by the intensive use of pastures and feeding the animals with concentrate feeds.

Choroszy et al. [2011], in their studies on a larger population of Limousin cattle, obtained similar to ours re-

sults of body weights at birth, both for bull calves (within 34.5–36.3 kg) and heifers (33.1–34.7 kg).

Also in the studies of Wróblewska et al. [2007], body weight at birth in both bulls and heifers was at a level similar to that obtained in the presented study. Trela et al. [2000], on the other hand, showed that Limousin calves born in herds of cows imported from France had a higher body weight, averaging 39 kg. Other authors [Czerniawska-Piątkowska et al. 2011] on an organic farm also observed higher weight at birth of bulls, 38 kg, and heifers, 37.3 kg.

In the present study, both body weight and gains of Limousin calves of either sex at 210 days of age in the organic and conventional farm were significantly higher than those obtained by Choroszy et al. [2011], which in bulls were respectively 215–248 kg and 850–1000 g, and for heifers 207–234 kg and 810–960 g. Only bulls in the

Table 3. Comparison of calf rearing in the organic and conventional rearing systems

Tabela 3. Porównanie wyników odchowu cieląt w systemach ekologicznym i konwencjonalnym

Management system System utrzymania	Masa ciała – Body weight		Body weight gains, g Przyrosty masy ciała, g	Mothers' milk yield, kg Mleczność krów matek, kg	
	at birth – urodzeniowa	at 210 days – 210 dzień			
Organic Ekologiczny, n = 39	\bar{x}	35.41**	253.3*	1037.6	2050.5
	S	1.29	25.4	120.4	205.5
	V%	3.64	10.0	11.6	10.0
Conventional Konwencjonalny, n = 81	\bar{x}	33.72**	261.1*	1061.9	2019.7
	S	2.81	23.4	151.9	216.0
	V%	8.34	8.96	14.3	10.1

For explanations see Table 1.
Objaśnienia w tabeli 1.

Table 4. Economic result of up to 250-kg unit beef cattle production on an organic farm

Tabela 4. Wynik ekonomiczny produkcji żywca wołowego do masy 250 kg w gospodarstwie ekologicznym

Specification Wyszczególnienie	Quantity Ilość	Unit price, PLN Cena jednostkowa, PLN	Value, PLN Wartość, PLN
Sales – Wartość produkcji			
Live cattle – Żywiec wołowy	250 kg	11.00	2750
Direct payment to forage land area per head	–	–	421.60
Dopłata do powierzchni paszowej w przeliczeniu na jednego osobnika	–	–	421.60
I. Sales, total – Wartość produkcji razem	–	–	3171.60
Costs – Koszty produkcji			
Direct costs – Koszty bezpośrednie			
maternal feeding – wyкарmienie cielęcia przez mamkę	2000 kg	0.75	1500.0
Feeds – Pasze			
pasture forage – zielonka z pastwiska	45 dt	9.772	439.74
straw – słoma	4.5 dt	10.17	45.81
meadow hay – siano łąkowe	5 dt	30.51	152.55
II. Direct costs, total – Koszty bezpośrednie razem	–	–	2138.10
III. Overhead (labor, power, fuel, veterinary care, AI, taxes) – Koszty pośrednie (praca, energia, paliwo, obsługa weterynaryjna, inseminacja, podatek rolny)	–	–	443.44
IV. Total costs (II + III) – Koszty ogółem (II + III)	–	–	2581.54
V. Production cost of 1 kg of live weight (2581.54/250) – Koszt produkcji 1 kg żywca (2581.54/250)	–	–	10.33
Income – Dochód			
VI. Agricultural income (I – IV) – Dochód rolniczy (I – IV)	–	–	590.06
VII. Direct payment reduced income – Dochód bez dopłaty	–	–	168.46
Profitability rate (I/IV x 100) – Wskaźnik opłacalności (I/IV x 100)	–	–	122.87%
Direct payment reduced profitability rate – Wskaźnik opłacalności bez dopłaty	–	–	106.52%

organic farm at 210 days had body weight and weight gains at a level comparable with the results of the cited authors. In contrast, Przysucha and Grodzki [2007], who also studied in Limousin cattle, obtained comparable results of 210-d calf weight gains and body weight.

The economic effect of beef production was calculated only for the organic farm (Table 4), since only in this farm the full data on the value of production were available. The bulls are reared up to about 250 kg and then sold for export, so the cost calculations were made for this production system. The breeder gets a fairly high price per kilogram of live weight, on average PLN 11. The sales value of the production also includes the direct payment to the forage area calculated per finished bull. The total value of production from one bull was on average PLN 3171. The direct costs of production include the value of milk used by the calf and the value of feeds that bulls consume during the grazing period. The total production costs together with indirect costs amounted to PLN 2581, and the production cost of 1 kg of livestock was at the level of PLN 10.33. With such a system of maintenance, production value and its costs, the farmer obtained a positive agricultural income of PLN 590, and excluding the direct payment of PLN 168. Profitability rates in both analyzed cases (i.e. with and without direct payment) were at a level of 122% and 106%, respectively.

Skarżyńska [2011] claims that beef production is unprofitable, as the average profitability rate depending on the size of the farm ranged from 72% to 92%. In her research, the author did not, however, delimit the types of beef production, indicating at the same time that over 30% of large farms had a profitability index above 100%. Malaga-Toboła and Kuboń [2010] report the profitability rate of beef production at the level of 118.5%, which is similar to that obtained in our study. Prokopowicz and Jankowska-Huflejt [2007] indicate that the main income of an organic farm comes from animal production (from 60 to 90%) and the profit is linked with direct payments obtained for permanent grassland.

CONCLUSION

It has been demonstrated that Limousin cattle can be successfully managed in extensive farming conditions on permanent pastures in an organic farm. Calves at 210 days of age have body weights and gains in these conditions comparable to calves kept under intensive production on a conventional farm. Also milk yield of calf-feeding cows were on a similar level in both farms. The production of live Limousin cattle for a weight of 250 kg on an organic farm has brought a positive economic result, which indicates that this system of beef cattle rearing can be successfully used to properly maintain per-

manent grassland in areas covered by environmental programs and nature protection.

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ANALIZA OPŁACALNOŚCI CHOWU BYDŁA RASY LIMOUSINE W WARUNKACH EKOLOGICZNYCH W PORÓWNIANIU Z TRADYCYJNYM SYSTEMEM UTRZYMANIA

STRESZCZENIE

Celem pracy była analiza opłacalności ekologicznego chowu bydła rasy limousine oraz porównanie wybranych wskaźników odchowu tej rasy z systemem konwencjonalnym. Materiały do badań dotyczyły 39 krów wraz z ich potomstwem z gospodarstwa ekologicznego i 81 krów z cielętami utrzymywanych w gospodarstwie konwencjonalnym położonych w województwie zachodniopomorskim, a zebrano je w oparciu o dane stad z systemu komputerowego „BOS”. Określono masę cieląt przy urodzeniu i w dniu ich odsadzenia (przeliczono ją na standaryzowaną masę ciała w 210 dniu), przyrost masy ciała cieląt od urodzenia do 210 dnia oraz mleczność krów. W gospodarstwie ekologicznym przeprowadzono ponadto podstawową analizę opłacalności produkcji żywca wołowego przy sprzedaży buhajków w masie około 250 kg. Wykazano, że średnia masa cieląt rasy limousine przy urodzeniu była istotnie wyższa w gospodarstwie ekologicznym w porównaniu do urodzonych w tradycyjnym, natomiast w 210 dniu życia większą masą charakteryzowały się cielęta z systemu konwencjonalnego. Uzyskiwały one także większe przyrosty, a ich matki charakteryzowały się lepszą mlecznością. Stwierdzono ponadto, że w gospodarstwie ekologicznym wartości wymienionych wskaźników były korzystniejsze w przypadku jałówek w porównaniu do buhajków. Analiza efektów ekonomicznych produkcji żywca wołowego w gospodarstwie ekologicznym wykazała, że łączne koszty produkcji wraz kosztami pośrednimi wyniosły 2581 PLN, a koszt produkcji 1 kg żywca był na poziomie 10,33 PLN. Wskaźniki opłacalności przy uwzględnieniu dopłaty i bez niej kształtowały się na poziomie odpowiednio 122% i 106%.

Słowa kluczowe: rasa limousine, odchów, ekologiczny system gospodarowania, koszty produkcji, efekt ekonomiczny